

RELATIONSHIP BETWEEN SELF-ESTEEM AND DEPRESSION AMONG ELDERLY**J.Selva Mary Devakani^{1*}, A.Akila Devi², R.Vijayalakshmi³**^{1,2,3} Department of nursing, SRM Institute of Science and Technology, Kattankulathur, TamilNadu, India**ABSTRACT**

AIMS: The goal of this research is to see if there is a link between self-esteem and depression among the elderly.

STUDY DESIGN: Descriptive design is used for this study.

PLACE AND DURATION OF STUDY: The study was conducted at selected old age homes, Kancheepuram District, between August 2014 and September 2014.

METHODOLOGY: Sample included 62 elderly (22 men, 40 women; age range 60-75 years).

RESULTS: The results show a strong in the elderly, there is a negative association between self-esteem and depression, which is highly significant at the P 0.01 level.

CONCLUSION: As one's self-esteem grows, so does depression. As a result, to avoid depression, older people should have higher self-esteem.

Keywords: self-esteem, depression, elderly

Introduction

India is slowly but steadily becoming a greying nation. With a rise in the number of persons in their 60s and 65s, life expectancy has grown..(1)

Self-esteem is defined as "how we value ourselves," and it has an impact on our religion and relationships in many aspects of life. Low self-esteem may make a person feel weak and insecure about themselves. Furthermore, poor self-esteem increases the likelihood of depression, the most frequent illness among the elderly, which leads to a variety of behavioral changes as well as suicide.(2)

Fukkawa Y(2000) says that , The connection In middle-aged and older people, there is a significant relationship between social assistance, personality, and melancholy persons was studied throughout time. Samples were 1,116 subjects of aged between 40-79 years. Rosenberg's self-esteem scale was used. Results reveals that social support reduces depression and increase in self-confidence .The findings concludes that improving self-esteem and social support will decrease depressive symptoms.(3)

Self-esteem, as a regulation of self-value, is important at all stages of life, especially in older people. (4)

Self-esteem is important of mental health, mature personality, and a person's adaptability.

Hence low self-esteem is related to low self-worth, low life satisfaction, loneliness, depression, and anxiety.(5)

Ankur Barua (2011) In India, a study on the incidence of depressive illnesses in the older adults was carried out. The prevalence of depressive illnesses in the cultural context ranges from 10% to 20%. (6)

Depression is the most prevalent problem among the elderly, and it is caused by a lack of self-esteem.

Material and Methods

The research was carried out at Sivananda Saraswathi Sevashram in Kattankulthur as well as the Tiny Fall Ageing Residence in Kattankulthur. Purposive sampling was used to choose 62 elderly people. The objective of the study is explained and their agreement is obtained. The structured questionnaire is used to examine demographic data and depression in the elderly. The Geriatric Depression Scale [GDS] by J.A. Yesavage was used to measure depression, while Rosenberg's Self-esteem Scale (Rosenberg, 1965) was utilised to assess self-esteem.

Results and Discussion

Table 1: Frequency and percentage distribution of demographic variables among elderly

N=62

S.NO	VARIABLES	CLASS	NO OF RESPONDENTS	PERCENTAGE
1.	AGE	60-65 YEARS	14	22.5
		66-70 YEARS	29	46.8
		71-75 YEARS	19	30.7
2.	SEX	MALE	22	35.4
		FEMALE	40	64.6
3.	EDUCATION	NO FORMAL EDUCATION	3	4.8
		PRIMARY SCHOOL	7	11.2
		MIDDLE SCHOOL	30	48.3
		HIGH SCHOOL	19	30.6
		GRADUATE AND ABOVE	3	4.8
4.	MARITAL STATUS	MARRIED	22	35.4
		SINGLE	7	11.2
		SEPERATED	8	12.9
		DIVORCED	2	3.2
		WIDOW	11	17.7
		WIDOWER	12	19.3
5.	SOURCE OF INCOME	PENSION	9	14.5
		CURRENT INCENTIVES	10	16.5
		GRANTS AND AIDS FROM DAUGHTERS AND SONS	43	69
6.	INCOME	LESS THAN 1520	3	4.8
		1521-4555 INR	38	61.2
		4556-7593	20	32.2
		7594-11361	1	1.6
7.	PREVIOUS EMPLOYMENT	UNEMPLOYED	5	8
		COOLLY	47	75.6
		GOVERNMENT EMPLOYEE	1	1.6
		SELF EMPLOYEE	3	4.8
8.	NUMBER OF CHILDREN	NO CHILDREN	7	11.2
		1	10	16
		2	43	69.3
		3	2	3.2
9.	DURATION OF THE STAY AT OLD AGE HOME	BELOW ONE YEAR	26	42
		1-3 YEARS	30	48.3
		4-5 YEARS	6	9.7
10.	REASON FOR JOINING	NO ONE TO LOOK AFTER	11	17.7
		FORCED FOR JOINING	9	14.5

		NEGLECTED AT HOME	41	66.1
		VOLUNTARY	1	1.6
11	PRESENCE OF MEDICAL CONDITION	YES	62	100
		NO	0	0
12.	SPECIFY THE ILLNESS	NO ILLNESS	0	0
		ARTHRITIS	10	16.1
		HYPERTENSION	32	51.6
		DIABETES MELLITUS	19	30.6

Table 2: Correlation between self esteem and depression among elderly

N=62

VARIABLES	KARL PEARSON CORRELATION CO-EFFICIENT	SELF - ESTEEM	DEPRESSION
SELF ESTEEM	PEARSON CORRELATION	1	0.7799**
	SIG.(2-TAILED)	0	0
	N	62	62
DEPRESSION	PEARSON CORRELATION	0.779**	1
	SIG.(2-TAILED)	0.00	0
	N	62	62

****.** Correlation is highly significant at the $P \leq 0.01$ level (2-tailed).

According to the Pearson Association coefficient analysis, there is a strong negative correlation between elderly self-esteem and depression, which is highly significant at the P 0.01 level.

Conclusion

Depression is the most frequent issue among the elderly, leading to poor self-esteem. Improving their in their elderly, subconscious may reduce the risk of melancholy.

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Competing Interests

There are no conflicting interests disclosed by the authors.

Authors' Contributions

“Author 1' conceived the study, did the statistical analysis, prepared the protocol, and produced the initial draught of the manuscript,”

the authors may write in this area. The study's analyses were overseen by 'Author 2' and 'Author 2'. The final text was reviewed and approved by all authors.”

Consent

All authors declare that ‘written informed consent was obtained from the Elderly.’”

Ethical approval

SRM University, Kattankulathur, Chennai, Tamilnadu, has established an IRB and an IEC .India, gave their formal permission. The researcher received formal written permission to conduct the study from the Director of Sivananda Saraswathi Sevashram, Kattankulathur, and the Co-ordinator of Little Drop Old Age Home, Somangalam

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DATA ANALYSIS INTEGRATION COMPUTER IMPORTED LEARNING: A MICROSOFT EXCEL CASE WITH STATISTICS

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ABSTRACT

The use of ICT in teaching and studying mathematics helps students to develop mathematics. The practice's application, therefore, depends on different considerations, amongst which: teachers' expectations of their ICT teaching skills, instructor attitudes towards teachers in mathematics, teacher attitudes towards ICT contributions to student mathematics awareness. The research was undertaken to assess ICT integration readiness in the classroom in the Paracelis district, Paracelis Mountain Province, Philippines for mathematics teachers at secondary schools. The thesis used a questionnaire with comments on any of the above variables. This questionnaire was forwarded to 15 mathematics teachers at public secondary schools. It shows that ICT teachers' intervention in mathematics has an average limit of 4.06. It also ensures that mathematics teachers are confident and willing to use ICT in mathematics and mathematics instruction. The research results indicated that the controls and the sample groups were substantially different and verified. It shows that the research group was higher than the test group. The use of Microsoft Excel in integrating machine data in the resolution of statistics positively affects the student's performance. The integration of ICT into teaching, therefore, has an advantageous effect on the progress of students.

Keywords: Computer Integration, Microsoft Excel, Statistics

Introduction

Today, the 21st century relies on machines and robotics to carry out statistical analyses. The decision-making processes are vital for the machine when reviewing mathematical records utilizing software packages. No uncertainties exist with software packages concerning programming obligations, and managers today depend on which mathematical approach is acceptable and how outcomes should be interpreted.

Computers are doing a better job of creating graphs, maps, and execute computational calculations regardless of data precision. We ought to think about two things while we use machines in statistics. It obeys the guidelines as to if the operation is valid and suits the data design. The machine cannot invoice the nature of the data with an unsuitable exam. The customer is liable for asking for the correct mathematical procedure, not the machine Gibson, et al (2014).

Technology may improve the effectiveness of teaching. They enhance quality teaching, promote the learning process, encourage constructive learning by students in terms of involvement and input at their own speed and

provide students the psychological rewards they need to work hard Ciampa, (2014).

Statistics is one of the subjects in Senior High School that learners need to master. It involves collecting, presenting, and implementing data gathered through a direct or indirect method to solve a problem Hashem, et al. (2015). These skills are essential for learners to manifest because they are prerequisites in undergoing a higher form of inquiry as they go on with their study. Likewise, the Grade 11 students of Butigue National High School had difficulty solving problems involving statistics.

The proponent wants to integrate computers through Microsoft Excel to encourage learners that solving Statistics offers a broad understanding of the lesson. The CIDA is a Computer Integration of Data Analysis (CIDA) in using Microsoft Excel. For example, the following are the spelling scores of 10 male and 10 female students. Test the null hypothesis that there is no significant difference between males' and females' performance in HUMSS students in spelling. Use the t-test at a 0.05 level of significance. The student will enter the data in Microsoft Excel.

The CIDA is Computer Integration of Data Analysis using Microsoft Excel to aid the

students in their solving ability. After the lecture and discussion on the subject matter, the students will apply the data analysis by opening their Microsoft Excel.

The purpose of the CIDA technique's exposure is to enhance students' enthusiasm to love numbers and enjoy solving. It also allowed students to function alone or as a community to seek solutions to their concerns. As a consequence of data processing, higher-order abilities are developed, and students can only make decisions. It also provides the students with opportunities to apply what they have learned to other subjects and other learning areas.

As experienced and observed at Butigue National High School, solving skills is difficult for students when done manually. Students refuse to finish their tasks due to their inability to solve problems involved in their studies. But with the use of technology, problem-solving would be easier. Thinking critically and successfully solving mathematical problems are skills that evolve in the course of learning mathematics in a school context and everyday life. Using spreadsheet software to demonstrate and practice mathematical skills is likely to help teachers and students develop them.

The following researchers support this. In the research of Lesnussa, Melsasail, and Leleury (2016) mentioned, students gain a sense of pride when they complete authentic work that shows their perceptions and newly found knowledge. Students are more likely to take ownership of their learning and create a portfolio of their learning experiences when given the freedom to use various technologies. According to Ozofor (2015), however, the results' review did not show any substantial difference between the two modes of guidance in the dissertation entitled "The Impact of a machine aided instruction on the student achievement." The students' awareness surveys showed that the feelings towards computer assistance did not change significantly (CAI).

The study of Fairlie and Kalil (2016) also accepted that enhanced commitment to students as technology is used. Yet they find that children who receive machines are more likely to have a social network account, but they often spend more time communicating with peers themselves. There are no casual

impacts on school results and only minor beneficial benefits to children's social welfare.

Similarly, Nizarudin, Muhtarom, and Sugiyanti. (2017) has shown that students are increasingly able to solve problems—the possibility of solving problems from 68% to 96% by video games. However, the One Laptop per Child Program conducted in Peru is examined according to Critina, et al (2017). The initiative contributed to a significant rise in the use of computers both at home and at college. In conclusion, neither mathematics nor language courses has a substantial impact on testing. However, there is no effect on the academic abilities of pupils.

Likewise, Faber, Sanchis-Guarner, and Weinhardt, (2015) concluded that the one-to-one laptop program for 4th and 5th grades in California school district. After two years, the students who received laptops perform better than the non-laptop students in English language arts and tests measuring writing strategies and literacy response and analysis. Yet, the study revealed that the effects of government upgrades in ICT, by increasing the connection speeds, on children's performance in England. They found out that it has a zero impact on students' educational attainment or learning productivity.

Similarly, Scherer, Siddiq, and Tondeur, (2019) has reported that often shy or more uninhibited students sometimes use technology to become more active since they see it as more non-threatening. Nevertheless, research has shown that the usage of individual laptops in high schools has little impact on academic achievement.

Technology will enhance student participation and thereby influence intellectual comprehension and academic performance overall Bal-Tastan, et al (2018). However, in Molly Knack's study on computer-based education and its impact on learners in the 21st century, there was no substantial change in statistics in algebra students who use the Orchard app. According to Tanveer (2011), both teachers and learners realized that e-learning enables students to become acquainted with their own learning, provides diversification activities, stimulates intrinsic impetus for learning, and allows introverted students to engage.

Some studies have established a positive relationship between educational technology and student mathematics Guzeller and Akin (2014). Their results indicate that students who have computers in their homes and schools appear to do well and have a significant beneficial association with students using computers at home and their mathematics performance. In contrast, several researchers find negative links between these variables Eickelmann, Gerick, and Koop (2017) TMSS 2011 data examined to examine the association between machine usage and student scores in Taiwan, Singapore, and Finland. The authors observed that students in Taiwan continued to have lower mathematical ratios if they used computers at home and school.

Previous research is viewed as new determinants of academic performance since they affect student work at different levels and in different ways. Several authors have examined young people's use of technologies and the impact of some of these tools on their academic performance. Likewise, that both computers use and the type of activity engaged in contribute significantly to explain not only the academic performance in young people Torres-Diaz, et al (2016).

In contrast, other studies have found no relationship between academic performance and technology usage, and access to education, reporting no significant correlation between marks and the time students spend using technologies. It has also been reported that the use of technologies can affect student performance in one particular area but not in others. For example, it has been found that computer use in education does not significantly improve students' performance in mathematics but does so in science Noshahr, Talebi, and Mojallal (2014).

Similarly, Rohaeti, Bernard, and Primandhika (2019), with greater thought and machine literacy abilities being more relevant, teaching students in conventional approaches do not fulfill learning requirements. Likewise, in their research on developing the interactive learning media for school level mathematics through an open-ended approach supported by an Excel visual application. Research shows that students' creativity in interactive learning media is better than that of students with an

expository method of Visual Basic Application for Excel and the creativity of students in interactive learning media is the combination of their knowledge of mathematics and the ability to learn.

Experimental research from various levels has shown that teaching mathematics with GeoGebra positively impacts student accomplishments on various mathematical topics compared with those received conventional guidance or treatments focused on the textbook. Similarly, the effect of teaching mathematics with GeoGebra on the intellectual perception of limit and consistency of talented high school students was studied. It was discovered that experimental community students receiving GeoGebra interventions had more significant results in the evaluation than those receiving conventional instructions in their mathematical skills Aydos, (2015).

Similar studies were done for pre-service mathematics teachers for the same subjects Ocal (2017). Concerning students' logical comprehension, experimental students who obtained GeoGebra training were superior to students receiving conventional instruction. Further, showed that the intellectual comprehension of first-degree students on the definitive integral was higher in the experimental community, which was primarily achieved with GeoGebra. Subsequently, GeoGebra examined the impact on students' roles in terms of logical and procedural information. When the experimental students consider their logical and procedural skills, there are slightly better results than those in the control sample Lueckmann, et al (2017). In their research, he agreed on GeoGebra's impact on students' logical and procedural skills: the case of the implementation of derivatives. These results showed that the use of derivation instruction of GeoGebra has a substantial effect on students' achievement regarding their logical skills.

In the study Valencia (2016), all positive results from the use of statistical software were published. Similarly, the main facets of writing had promising results for fundamental ways of mathematical simulation of technology, both in terms of improving student levels and student satisfaction with the curriculum. Results indicate that the use of MobyMax increased

student success in contrast to Direct's traditional guidance in computer-assisted mathematics. The results showed that this enhanced student performance. Similarly, teachers using CAI had to find adequate ways of incorporating technology into a school to profit from the advantages. Computer helped learning could also be more effective than traditional teaching.

Conferring basic education and traditional teaching methods in the research of Erdem, and Gürbüz (2015). Computer-supported simulation and data analysis show that the students know all about the likelihood, sample size, and sample size implications via the intervention using simulations. With these related bases, the proponent wants to find the effect of CIDA in solving Statistics. The participants considered for this study are the 61 Grade 11 HUMSS students of Senior High School of Butigue National High School. They are composed of 30 males and 31 females enrolled in the school for S.Y. 2019-2020. The participants of the study are chosen will be using the CIDA technique. The students will be exposed to the CIDA technique to improve the solving ability of the students. The study, when completed, would be beneficial for the following: students, teachers, parents, Department of Education, and the community.

Conceptual Framework

In his thesis, Ocal, (2017) agreed on Geogebra's effect on student conceptual and procedural knowledge: the implementation of derivatives. From these results, it was apparent that teaching the Geogebra derivation application substantially impacted students' performance in conceptual understanding.

The findings show the usage of MobyMax in comparison to those who got standard Direct instruction in the seven-degree Mathematical Impact of Computer Assisted Instruction on Achievement. Like that, teachers using CAI had to find effective methods of integrating technologies into the classroom to get the advantage, and CAI could be more effective than conventional teaching.

Similarly, in Mulenga, and Prieto (2018), the survey's finding showed that the teachers' attitudes towards computers were all positive statements about computer attitudes, with most

of the teachers considering ICT as a valuable tool for teaching and learning. The survey shows that most mathematics teachers have the confidence to integrate several ICT software in their education and learning, with most of the respondents being very confident in using PowerPoint. This is because attitudes play a fundamental role in integrating ICTs in the teachers' teaching practices.

According to Das (2019), pupils are encouraged to benefit from ICT-based task automation and immediate reviews, using theoretical approaches and implementing mistake and trial methods. Students utilize computers to explore and grasp mathematical theories. The five most popular application packages used by mathematics teachers were word processing packages (71.1%), spreadsheets (51.2%), search engines (44.1%), presentation software (36.9%), and drill and practice software (24.3%). The five most popular application packages used by mathematics teachers were word processing packages (71.1%), spreadsheets (51.2%), search engines (44.1%), presentation software (36.9%), and drill and practice software (24.3%). The five most popular application packages used by mathematics teachers were word processing packages (71.1%), spreadsheets (51.2%), search engines (44.1%), presentation software (36.9%), and drill and practice software (24.3%). The Use of ICT in Mathematics Teaching found out that the five most popular application packages used by mathematics teachers were word processing packages, spreadsheets, search engines, presentation software, and drill and practice software.

Similarly, highly motivating mathematics teachers mostly seemed enthusiastic and optimistic in using ICT in high school mathematics. The results show, however, that supportive behaviors alone are not enough. This was seen in the analysis of Bozkurt (2016). Most teachers believed that technology would make students more inspired, love mathematics, gain more insight, and deal with challenges in the real world. The pupils are advised to use ICT's automation of assignments and immediate input, using conjecture and trial and error approaches. Students utilize

computers to explore and grasp mathematical theories.

Paradigm of the Study

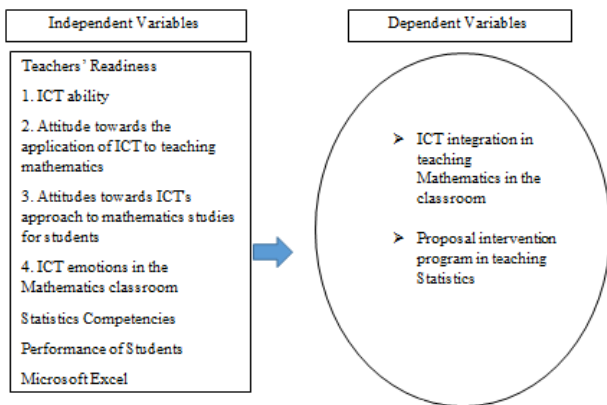


Figure 1. A diagrammatic representation of the Paradigm of the study

The body's paradigm indicates that ICT incorporation in teaching Mathematics in the classroom is the dependent variable to assess the teachers' aim to integrate ICT in the classroom. These factors include expectations of ICT skills, ICT commitment to teaching mathematics, ICT contribution attitudes to Mathematics learning and feelings for ICT usage in the Mathematics Classroom, statistical expertise, student success, and Microsoft Excel, which are the independent variables.

Statement of the Problem

This research is mainly designed to analyze Microsoft Excel as a teaching and learning medium for 11-grade students at the Butigue National High School. This study also explored the different facets of Paracelis Mountain Province, Philippines teachers' willingness to incorporate information and communication technology in mathematics teaching. Specifically, it answers the following questions:

1. What is the level of perceptions of Mathematics teachers as to:
 - 1.1. ICT ability;
 - 1.2. attitudes to ICT in the teaching of mathematics;
 - 1.3. attitudes to the application of ICT to the learning of mathematics students;
 - 1.4. ICT feelings in the classroom in mathematics;
 - 1.5. Self-Esteem and Control in the Presence of ICT in the Mathematics Classroom; and;

- 1.6. intention to use ICT in the Mathematics Classroom?
2. What is the pretest performance of the control and experimental group of respondents?
3. What is the significant difference between the pretest performance of the control and experimental group of respondents?
4. What is the posttest performance of the control and experimental group respondents?
5. What is the significant difference in the posttest performance of the control and experimental group respondents?
6. What is the significant difference in the pre and posttest of the control and experimental groups of respondents?

Methodology

This chapter presents the research methodology of the study. It includes research method, research environment, respondents, data gathering tools, data gathering procedures, and statistical treatment of data. An experimental method was used in the study because it will be used two groups of respondents. The experimental method is used to establish a cause-effect relationship among various variables in a research study. The researcher made an effort to control for all variables except the one being manipulated.

Chakravarty, Liu, and Mazumdar, (2010) suggest that an experimental method is used when one condition is manipulated while the other conditions are not manipulated, and then differential effects of this condition variable are measured. Specifically, the researcher employed the one-group pretest-posttest design. Below is the representation of the design:

Pretest	Intervention	Posttest
O	X	O

As shown in the above design, a single and structured group of learners were under observation (O). Before applying the treatment or intervention (Microsoft Excel), careful measurement (pretest) was done. This was also done in the measurement after (posttest).

Test questions that cover the fourth quarter were used as the primary gathering tool of the data needed. The level of performance of

students using and not using Computer Integration of Data Analysis was determined through posttest. The result will be analyzed using a t-test.

The study was conducted at Butigue National High School (BNHS). It is situated at Paracelis District, Mountain Province, Philippines. The study's respondents were the grade 11 learners with 61 and the 15 Secondary Mathematics teachers.

The researcher utilized the questionnaire as the main instrument for the data gathering for the teacher respondents. This was to survey if the teacher-respondents are ready to integrate ICT in teaching mathematics. The questionnaire was adapted from Fernandez Batanero, and Colmenero Ruiz,(2016). The researcher modified the questionnaire that applies to the teacher-respondents.

A 25-item teacher-made questionnaire, which covered all the fourth quarter competencies, was used for the student-respondents. These competencies were the basics of hypothesis testing, testing hypotheses about population mean, and testing hypotheses about proportion. The test questions were used to measure if there is a significant difference in Computer Integration of Data Analysis in teaching mathematics.

The researcher sought the approval of the Schools Division Superintendent to carry out the research. Consequently, permission was sought from the schools in each school before administering the questionnaires to the concerned teachers. Further, informed consent was sought from the teacher-respondents before administering the questionnaires.

For the student-respondents, the proponent conducted the test and retrieved the answered test papers from the respondents. A teacher-made test was used to assess the students' mastery level on the lesson selected by the researcher. Participants are subject to the use of CIDA technology. A pretest was also offered before the lesson was introduced and a posttest after the course was completed. Both pretest and posttest before and after therapy are the same. And in each treatment, the researchers calculated and analyzed the results to evaluate if their mean variations in pretest and post-testing were meaningful.

A weighted mean was used to assess the teachers' readiness to incorporate ICT into mathematics teaching. A weighted mean is a procedure for combining the means of two or more groups of different sizes; it takes the groups' sizes into account when computing the overall mean or grand mean.

The research results and the control and test population were evaluated using a t-test. The t-test will help to determine if the variation between situations was true or was simply due to chance variations between tests.

Results and Discussion

The research findings will give the output needed by the researcher to answer the research questions. The results of this study may be specific to the Secondary Mathematics teachers in Paracelis, Mountain Province. The findings focus on the level of the secondary mathematics teachers' perception in using ICT in teaching Mathematics and the significant difference between integrating ICT and non-integration of ICT teaching Mathematics.

Level of Perceptions of Mathematics Teachers

The degree of understanding of technology teachers in mathematics is positive. The mathematics instructors want to use ICT in daily activities. But teachers have ample time to learn and to provide ICT instruction and seminars. Via this preparation and workshop, teachers feel more secure and controlled with the classroom's computers. It also means that the addition of ICT to the lesson enables students to learn the task more quickly. This enthusiastic outlook shows that mathematics teachers know the beneficial effect ICT may have on student learning. Teachers in mathematics are prepared to incorporate ICT into a classroom in mathematics.

Perception of teachers of mathematics with ICT ability

The extent of expectations of mathematics teachers about their ability to use ICT in their lessons is positive. This is shown in Table 1. It illustrates how teachers distribute their ICT skills. Most of the mathematics instructors believe that they are skilled in using ICT to teach mathematics, with an average ranking of 3.60. Most mathematics teachers think that

they have the necessary productivity in teaching Mathematics to cope with ICT, with a median score of 3.53. Most mathematics teachers agree that the average score of 3.53 is not so challenging with ICT. It means that teachers of mathematics have the opportunity to integrate ICT in mathematics.

This conclusion is the same in the findings of the mathematics review Kasmin, Othman, and Syed Ahmad, (2019). The teacher's readiness to incorporate ICT into the classroom suggests that teachers can integrate ICT into the educational framework. Their desire to include ICT into their mathematics lessons is expressed not just in their awareness and attitudes towards technology integration in teaching and learning. The total mean is 3,38, and their ICT capabilities are neutral. This implies that the mathematics teachers have the intention to use ICT in everyday classroom practices but must be given teachers enough time to prepare their ICT-integrated lessons.

A large amount of ICT preparation courses is scheduled for teachers. Much of them were conducted in schools and aimed primarily at applying ICT instruments in education. There

was a large amount of ICT preparation programs for teachers. Most of them were conducted at schools and focused mainly on using ICT tools in educational practice.

The findings are similar in Sanger and Osguthorpe, (2011) that teachers may not have time to successfully use CT in teaching and learning in several areas of their practice. This is the same with this study result since it provides teachers with adequate time to schedule their ICT integration lessons. This requires time to learn, exploration and pedagogy, insufficient time to cope with technological issues. Voogt, (2010) argued that the lack of time needed to achieve the pedagogical strategy is one of the principal cause's teachers don't use ICT in the classroom pedagogically. This is analogous to the results that mathematics teachers effectively interact with ICT at all stages, which gives them ample time to plan their teaching.

Table 1. Teachers' Perception of their ICT ability

Indicators	Mean	Qualitative Description
1. I have the productivity required in mathematics instruction to deal with ICT.	3.53	Agree
2. I have the know-how to use ICT in training in mathematics.	3.60	Agree
3. It is not that difficult to engage with ICT	3.53	Agree
4. It is convenient to engage with ICT in mathematics instruction	3.47	Agree
5. I can effectively communicate with ICT at all stages if I like.	3.33	Neutral
6. I have the potential to use ICT methods in different mathematical subjects.	2.87	Neutral
Overall Mean	3.38	Neutral

Level of Perceptions of Teachers Attitudes towards ICT contribution to Mathematics Teaching

The level of perceptions of teachers' attitudes towards ICT contribution to Mathematics teaching is a positive attitude in using ICT in education. They are aware of the importance of integrating ICT in the lesson.

Table 2 showed the behaviors of the teachers in mathematics towards ICT in mathematics. It reveals that most teachers of mathematics consent to use ICT as a constructive approach

in mathematics instruction. The use of mathematics in teaching would not prevent the completion of the instructional content with a mean score of 3.67. Likewise, the high standard of ICT skills facilitates teaching mathematics by an average of 3.67. The use of ICT is critical for good mathematical teaching with a mean score of 3.47.

The finding is in line with previous Mulenga, María, and Prieto, (2018) research since the results revealed that most mathematics teachers agree that they have a positive attitude in using

ICT. It was revealed that the computer-based attitudes of teachers have been positive in most ICT professors.

The overall mean of 3.45 means agreeing with the positive attitudes Mathematics teacher-respondents have towards ICT contribution to Mathematics teaching.

It implies that integrating ICT in the lesson makes the students understand the lesson more and speeds up teaching simultaneously. This agrees with the research of Kamodi, and

Garegae, (2016) because the research findings revealed that integrating ICT in the lesson makes the students understand more the lesson at the same time it speeds up the process of teaching, and with the use of Excel might have positive effects on the affective domain of the students learning mathematics and the use of Excel might help the students enjoy the study of mathematics hence improve their ability to solve some practical questions.

Table 2. Teachers' attitudes towards the application of ICT to teaching mathematics

Indicators	Mean	Qualitative Description
1. I can get more math knowledge than books from the internet.	3.13	Neutral
2. The use of ICT is critical for effective mathematics instruction.	3.47	Agree
3. Using ICT in mathematics instruction speeds up the teaching method.	3.33	Neutral
4. The high standard of ICT expertise facilitates teaching mathematics.	3.67	Agree
5. The use of ICT in mathematics education should not prevent the completion of the instructional materials.	3.67	Agree
Overall mean	3.45	Agree

Level of Perceptions of Teachers' Attitude towards ICT contribution to Students' Mathematics Learning

The degree to which teachers recognize the importance of ICT to student mathematical learning is positive. Teachers demonstrate mathematical concepts for students in ICT application. Table 3 shows this.

Table 3 showed that teacher-respondent mathematics attitudes towards ICT contributions to student learning. It showed that most mathematics teachers believe that using ICT offers the students a good result. Using ICT in mathematics teaching improves understanding with an average score of 3.87. More ICT integration in mathematics teaching helps students with a median score of 3.80. Also, ICTs in mathematics show students with an average score of 3.60 mathematical principles.

The analysis demonstrates that most Mathematics Professors who use ICT in teaching mathematics demonstrate to researchers' mathematical principles that students use technology to identify mathematical ideas and grasp them in closer collaboration with research findings using ICT

shows a strong result Kasmin, Othman, and Syed Ahmad, (2019).

The cumulative mean is 3.61, which is optimistic in terms of the commitment of ICT to students' mathematical inclusion. This optimistic attitude indicates that mathematics teachers are conscious of the positive impact ICT may have on students' learning. Integration of ICT in mathematics instruction adds enthusiasm to the problem solving of the students. This result is parallel to the literature on the improvement in learning statistics called The function of technology. Following the results, mathematics instructors are numerous for the beneficial impact ICT may have on student learning Avalos, (2016). Similarly, the results of the study showed that these optimistic behaviors reveal the positive impact ICT may have on student learning. Integration of ICT in mathematics instruction gives students enthusiasm for solving questions.

Table 3. ICT commitment attitude of teachers towards student mathematics learning

Indicators	Mean	Qualitative Description
1. ICT allows it easier for students to learn.	3.33	Neutral
2. The use of ICT in mathematics instruction improves comprehension.	3.87	Agree
3. Students profit from the usage of ICT in mathematical education.	3.80	Agree
4. The use of ICT in mathematics facilitates student self-learning.	3.47	Agree
5. The usage of ICT in mathematical education teaches pupils the values of mathematics.	3.60	Agree
Overall Mean	3.61	Agree

Level of Perceptions of Teachers' Emotion towards ICT in the Mathematics Classroom

The level of perceptions of teachers' emotion towards ICT in the Mathematics classroom is positive. Engaging in ICT does not scare them in presenting their lesson.

Table 4 explains the emotion of teachers in the Mathematics Classroom against ICT. As seen in the table above, most mathematics teachers have constructive feelings about using ICT in mathematics. Most respondents believe they felt good about the use of ICT in instruction. As if dealing with ICT, I don't fear the average score of 4.00, ICT also doesn't frustrate me with a medium score of 3.67, but ICT is also not upset with the average score of 3.60.

The research found that most of the respondents engaging with ICT were not scared of it, were not frustrated, and ICT does not make them feel angry. This is comparable in the study of Fernández Batanero, and Colmenero Ruíz, (2016) because the findings revealed that engaging in ICT does not scare, does not feel angry, and doesn't frustrate Mathematics teachers. Likewise, the analysis

showed that the faculty has somewhat favorable attitudes towards ICT and respect for diversity while sharing the positive interactions with colleagues through which ICT is used, examine and focus on the activities of classrooms to increase success with such technologies.

It shows that the overall mean of 3.61 means that mathematics teachers have favorable emotions towards mathematics classrooms. They will use ICT in teaching with the provision of ICT training and workshops. This finding is related to the results of Ghavifekr, and Rosdy, (2015) that ICT helps to improve classroom management as students are well-behaved and more focused; however, teachers have some knowledge about internet use in teaching and learning, teacher's knowledge about ICT is very limited, which was also revealed in the research that provision of training and workshops for teachers are necessary. This research suggests that mathematics teachers will use ICT to provide training and workshops for teachers.

Table 4. Teachers' Emotion towards ICT in the Mathematics Classroom

Indicators	Mean	Qualitative Description
1. It is fun to interact with ICT.	3.40	Agree
2. It is fun to use ICT to teach mathematics.	3.47	Agree
3. ICT engagement doesn't make me feel tired and exhausted.	3.53	Agree
4. ICT engagement doesn't frustrate me.	3.67	Agree
5. ICT engagement doesn't make me mad.	3.60	Agree
6. ICT engagement doesn't frighten me.	4.00	Agree
Overall Mean	3.61	Agree

The degree of self-perception of teachers in the presence of ICT in the classroom of mathematics

The degree of self-esteem and control of teachers in the presence of ICT in mathematics is positive. They feel confident and in charge of their classroom instruction. This can be found in Table 5. It explains the teacher-respondents' self-esteem and power in mathematics while ICT is present. It demonstrates that teachers in secondary mathematics are knowledgeable, monitor their instruction, experience a sense of accomplishment, and thriving in the teaching classroom. As seen in the table above, I will have a mean score of 3.53 in charge of my teachings. Moreover, I will have a feeling of integrity in the classroom, and if I communicate with ICT, I will feel a sense of skill in the classroom with a mean score of 3.47 if I communicate with ICT. Also, I can have a sense of satisfaction with a mean score of 3.40 if I deal with ICT.

This finding was comparable to the results Klusmann, Richter, and Lüdtke, (2016) since mathematics teachers are competent, have a

sense of control and achievement, and also have an effective teaching experience in the classroom, which showed that most teachers agree that the use of technology can motivate and make mathematics more enjoyable, help them gain a greater understanding.

The total average of 3.46 suggests that mathematics correspondents are willing and capable of integrating ICT into the lesson. The machine availability will also help the instructor feel more in charge of his/her teaching. This result was close to the study Tanveer, (2011) since the test results show that mathematics teachers felt supervised, knowledgeable, and performing. These results were comparable to the research. Both teachers and learners see how e-learning allows students to learn, has diversification activities, stimulates the inherent impetus of learning, and enables introverted students to engage in how the instructor feels their teaching.

Table 5. The self-esteem and control of teachers in the presence of ICT in classroom mathematics

Indicators	Mean	Qualitative Description
1. If I engage with ICT, I might have a feeling of competence in the classroom.	3.47	Agree
2. If I engage with ICT, I will be in control of my guidance.	3.53	Agree
3. I can feel satisfied when I work with ICT.	3.40	Agree
4. My job will be more successful if I engage with ICT.	3.47	Agree
Overall Mean	3.46	Agree

Degree of teacher perceptions of ICT use of mathematics

The extent of expectations of the purpose of teachers to use ICT in mathematics is nice. Teachers in mathematics intend to use ICT in mathematics instruction. They are well informed of the optimistic outcome of incorporating ICT into the lesson. This is seen in Table 6.

The purpose of teacher interlocutors to use ICT in mathematics is outlined. It revealed that mathematics teachers expect to use ICT in math. I intend to use ICT in mathematics, as seen by the average score at 4.13 in the graph.

Also, I am willing to use ICT in math with a mean score of 4.07. Besides the average score of 4.00, I want to use ICT in teaching mathematics.

This is linked to research [41], as the results suggest that most mathematics teachers are prepared to use ICT for teaching mathematics. The application of ICT in higher education and learning: Two findings from the study indicate some teachers who were able to utilize ICT and were consistently using the techniques and registered an essential difference in the manner in which they developed and taught. These teachers considered ICT usage to be vital in

teaching and studying and regularly using the in-service education coordinated by the school and the high school delegation.

The overall mean of 4.06 means that the teacher-respondents have a positive intention to use ICT in mathematics teaching. The finding is similar to the study of Velickovic, and Stosic, (2016) entitled Preparedness of Educators to Implement Modern Information

technologies in their Work with Preschool Children "the fact in our research is that educations are not passive when it comes to implementing computers in the process of realizing the contents of the Preparatory Pre-school program. As similar to the findings that the Mathematics teachers are willing to integrate ICT in their teaching.

Table 6. Intention of teachers to use ICT in mathematics

Indicators	Mean	Qualitative Description
1. I am eager to use ICT in mathematics instruction.	4.07	Agree
2. I want to use ICT in mathematics instruction.	4.00	Agree
3. I plan to use ICT in mathematics teaching.	4.13	Agree
Overall Mean	4.06	Agree

Summary of Level of Perception of the Mathematics Teachers

This illustrates the readiness of teachers to integrate ICT into teaching mathematics. It showed that the introduction of ICT into mathematics instruction was accepted favorably. It means that teachers of mathematics have the right mindset and can use ICT in teaching mathematics. Therefore, it helps learners understand and continue and love the learning experience at the same time.

It demonstrates the willingness of teachers to integrate ICT into teaching mathematics. It revealed that teachers' intervention to the ICT in mathematics has the highest mean of 4.06. It also showed an overall mean of 3.59, which means agreeing to integrate ICT in mathematics teaching. It means that mathematics teachers are confident and can use

ICT for mathematics and intervene in mathematics. Thus, it will help learners explore, appreciate, and learn more while enjoying the teaching-learning process. However, the lowest mean of 3.38 is teachers' perception of their ability. It means that teachers need proper training in using ICT in teaching mathematics to help boost their confidence in using ICT in teaching mathematics and other learning areas.

This was reaffirmed in the study [38] as most teachers in Mathematics show positive behavior and readiness to use ICT in their teaching, which is also demonstrated by the study Kasmin, Othman, and Syed Ahmad, (2019), which shows that teachers are ready to integrate technology into their instruction. It means that the incorporation of ICT into the lesson helps the students grasp the task better.

Table 7. Summary of Level of Perception of the Mathematics Teachers

Indicators	Mean	Qualitative Description
Perception of teachers' capacity	3.38	Neutral
Attitudes of teachers towards teaching in ICT	3.45	Agree
Teachers' attitude towards the application of ICT to student mathematics	3.61	Agree
ICT teacher passion in the algebra classroom	3.61	Agree
Self-esteem and instructor power in the case of ICT in the math	3.46	Agree
ICT interference by instructors in mathematics	4.06	Agree
Overall Mean	3.59	Agree

The Pretest Performance of the Control and Experimental Group

The control and experimental group's pretest performance shows significant differences between the two groups. It shows that the experimental group got high results in the pretest. It means that they perform better than the control group, as shown in table 8.

Since the mean score of the experimental group is 16.5882, a variance score of 3.4616 is greater than the mean score of the control group, 12.9629 with a variance score of 8.1908. The research hypothesis is confirmed, which means that there is a significant difference between the two groups. It implies that the experimental group performs better than the control group. The parents-teachers conferences revealed that most parents of the experimental group attended meetings. It also revealed that both parents were in the home guiding their children. Compared to the control group, where most of the students lived with their relatives, and others were underwent boarding, these students came from other barangays like Palitud and Poblacion. It was also revealed that most parents were working in the government, few were contractors, and the rest were farmers, as was seen in the School Form 1 of the experimental group.

This finding was related in the study of Taylor, et al., (2015) that parent involvement can increase academic performance, which is interrelated in the results of this study that both parents were in the home guiding their children. It denotes that parents have a vital role in guiding their children.

Table 8 Control and experimental group pretest output

	<i>Control Group</i>	<i>Experimental Group</i>
Mean	12.96296296	16.58823529
Variance	8.190883191	3.461675579
Observations	27	34

Significant Difference of the Pretest Performance of the Control and Experimental Group

The control and experimental group's pretest performance shows a significant difference in their performance between the two groups. It shows that the experimental group got high results in the pretest. It means that they perform better than the control group. This

implies that factors that cause the experimental group's high performance include socio-economic status, parental involvement, and both students' and parents' attitudes on mathematics education. These were seen in their School Form 1 filed by the adviser. In addition to most of the students, the experimental group was composed of more excelling students with modest family backgrounds. These factors are crucial for learners to be guided in the studies to succeed in their chosen endeavor.

Table 9 revealed that the t-computed value is -5.6953 is greater than the t-critical value of 2.0166 with a degree of freedom of 43 at a 0.05 level of significance. The research hypothesis is confirmed, which means that there is a significant difference between the two groups. It shows that the experimental group performs better than the control group.

These findings were associated with Genlott, and Gronlund, (2016) because socio-economic status, parental involvement, and both students' and parents' attitudes on mathematics education impact students' achievement, similar to this finding that financial-status and parents involvement affect the performance of their children in the classroom.

It is also connected to the study of Bellibas, (2016) states that their higher Socio-Economic Status students have the confidence to make sense of mathematics, similar to this finding that most parents worked in the government. It shows that parents can help their children academically and financially, like assisting their children in their assignments and projects compared to the lower economics-status.

Table 9 Significant Pretest Performance of the Control and Experimental Group

	<i>Control Group</i>	<i>Experimental Group</i>
Mean	12.96296296	16.58823529
Variance	8.190883191	3.461675579
Observations	27	34
Df	43	
t Stat	-5.695300182	
t Critical two-tail	2.016692199	

The Posttest Performance of the Control and Experimental Group

The posttest performance of the experimental group has a higher score than the control group. It means that the experimental group performs better than the control group. It shows that Computer Integration of Data Analysis (CIDA) using Microsoft Excel contributes to the experimental group's performance. It implies that using or integrating computers in the lesson will add to the lesson's understanding more.

Table 10 denotes that the experimental mean score of 20.91176 with a variance score of 7.0525 is greater than the control group mean score of 13.6666 with a variance score of 7.3846. The research hypothesis was confirmed, which means that there is a difference between the two groups. It implies that the experimental group performs better with the Computer Integration of Data Analysis using the Microsoft Excel in Solving Statistics than the control group, which did not use the CIDA.

The previous study Valencia, (2016), The impact of Computer Assisted Instruction on the achievement of 7th-grade mathematics shows the findings that MobyMax has improved student performance compared to those receiving the standard Direct Instruction. This is parallel to the research findings revealed that using the Computer Integration of Data Analysis using Microsoft Excel increased the students' performance in Statistics of the Grade 11 students. It indicates that using ICT has a significant effect on the performance of the learners.

Table 10 The Posttest Performance of the Control and Experimental Group.

	<i>Control Group</i>	<i>Experimental Group</i>
Mean	13.66666667	20.91176471
Variance	7.384615385	7.05258467
Observations	27	34

Significant Difference of the Posttest Performance of the Control and Experimental Group

The posttest performance of the experimental group was higher than the control. It means that the experimental group performs better than the control group. It shows that Computer Integration of Data Analysis (CIDA) using

Microsoft Excel contributes to the experimental group's performance. It implies that using or integrating computers in the lesson will add to understanding the task more.

Table 11 revealed that the t-computed value of -10.4472 is greater than the t-critical value of 2.0040 with a degree of freedom of 55 at a 0.05 level of confidence. The research hypothesis is confirmed, which means that there is a statistically significant difference between the two groups. It implies that the experimental group performs better with the Computer Integration of Data Analysis using the Microsoft Excel in Solving Statistics than the control group, which did not use the CIDA.

It confirms that the previous researches by Bai, Mo, Zhang, Boswell, and Rozelle, (2016) showed that teachers who used CAI required better ways to bring technology into the classroom to enjoy the benefits. Equally Wilson, et al., (2019) found reasons Computer-Aided Instruction could be more effective than traditional instruction. These findings were related to this study's results because it indicates that using Microsoft Excel marks students' better performance than those who did not use the software. It designates that ICT affects the performance of the students.

Table 11 Significant of the Posttest Performance of the Control and Experimental Group

	<i>Control Group</i>	<i>Experimental Group</i>
Mean	13.66666667	20.91176471
Variance	7.384615385	7.05258467
Observations	27	34
Df	55	
t Stat	-10.44724722	
t Critical two-tail	2.004044783	

Significance Difference in the Pre and Post Tests

The difference between the control and the experimental group before and after testing is essential. It means that the experimental group exposed to Computer Integration of Data Analysis (CIDA) using Microsoft Excel performs better than the control group who are not exposed. It implies that computer integration in the lesson offers dynamic

understanding in the lesson. It also implies that manipulating the technology in the learning process gives a broad and deep appreciation of the lesson while learning by doing.

Table 12 revealed that the t-computed value of -1218 is greater than the t-critical value of 2.0048 with a degree of freedom of 54 at a 0.05 level of confidence. The research hypothesis was confirmed, which means that there is a significant difference between the two groups. It shows that the experimental group improved performance than the control group. It implies that the use of Microsoft Excel in solving Statistics has a positive effect on the performance between the two groups.

This finding interrelated to the studies of Falck, Mang, and Woessmann, (2018) that their results showed that students who have a computer available at home and school tend to perform better and showed a significant positive relationship between students who used computers at home and their Mathematics achievement. Their findings were related to the result of this study, which revealed that using Microsoft Excel in solving Statistics has a positive effect on the students' performance. It suggests that the integration of ICT in teaching directly affects the performance of the students.

Table 12 The Significant Difference in the Pre and Post Test of the Control and Experimental Groups

	<i>Pretest of the Control Group</i>	<i>Posttest of the Experimental Group</i>
Mean		
Variance	12.96296296	20.91176471
Observations	8.190883191	7105258467
Df	27	34
t Stat	54	
t Critical	-11.12188357	
two-tail	2.004879288	

Conclusions

The following conclusions are taken based on the findings: The mathematics teachers were unwilling to use ICT, but they had constructive attitudes and had to incorporate ICT into mathematics teaching. The students' success improved with their parents' ongoing

participation. The students' success has been further developed with continuous parental involvement in student academic activities. After exposure, students gained fundamental knowledge such as ICT skills, skills in solving, and analytical thinking skills using Microsoft Excel to solve statistics problems. The students' efficiency is improved using the Microsoft Excel computer integration of data analysis. The incorporation of data analysis by Microsoft Excel has enhanced student success in solving statistical problems.

Recommendations

As a logical offshoot of the findings surfaced, the following are highly recommended: (1) Teachers should be ready to integrate ICT in their lessons in teaching Mathematics. (2) The school should encourage stakeholders, especially parents, to involve in their children learning routines. (3) Emphasize home-visitation and stress students' counseling should be done regularly. (4) The acquired basics skills should be applied in the learning classroom as well as real-life situations. (5) Sustain the Computer Integration of Data Analysis (CIDA) application using Microsoft Excel in solving problems in Statistics in the Mathematics Department. (6) Mathematics teachers should integrate ICT in teaching Mathematics. And (7) Potential future action research should investigate whether technology integration's gained in student engagement results in a corresponding increase in student achievement.

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Baker's Vendi

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ABSTRACT

Today in the world technology is given the utmost importance and is further revolutionizing with time. Thus, industries are also exploring around transforming or manufacturing new types of vending machines which are more efficient and time-saving. Therefore, the aim is to contribute towards the technology of vending machines in the automation world. The paper elaborates the designing and fabrication of a bakery item delivering vendig machine. This machine is designed by implementing mechatronic systems and designs, which includes mechanical structures, electronics and computer logics combined. The operation of this particular vending machine is distinguished from the pre-existing spring vending machines available in Pakistan currently. Due to the fact that it has been designed keeping in mind the handling of delicate bakery items. The aim is to deliver bakery items by maintaining their delicacy and freshness through faster and effective means of automated machines. It also shows the design methodology that has been adopted to create this machine that will be controlled via controller through programming logics and gives a description of how these efficient automated machines will replace our future bakeries.

Keywords: Vending Machine, Conveyors, Automation, Coin Acceptor, Temperature Controlling

1. Introduction

Technology is advancing day by day. Automation is the current hype around the world and the entire world is progressing at a great speed towards automation. The manual working phenomenon is gradually decreasing [1-3]. The machine revolution has empowered people to concentrate more towards automation of things from simple household chores to huge industrial based projects.

This vendi is about further revolutionizing the vending machine world. Up until this point, many different types of item and luxury holding vending machines have been fabricated for human use and those things could be purchased from a vending machine such as food, beverages, medicinal drugs, toys and even cars [4-10]. Therefore, in order to further revolutionize the vending world in Pakistan it was thought upon to design a vending machine that would serve the people with confectionary items and bakery eatables. The vending machines are a bigger step towards the automation field. Not only do they provide comfort and save time and money but also solve bigger problems of space occupancy and increased market competition. Bakeries are

well-known to occupy huge space and require huge capital investments on their establishment and later on their maintenance. Therefore, vending machines are a smart solution to end these problems. However, it wasn't as apparent as thought. Since it isn't easy to deliver a confectionary item without it getting the presentation look destroyed or reshaped into something unappealing. It is a known fact that dealing with confectionary items requires a lot of care since they are extremely delicate. This is one reason that no one so far has made a vending machine for bakery or confectionery items in Pakistan. Springs are the most well-known mechanism utilized in vending machines to drop packed food items such as chips, biscuits, beverages etc. but bakery items are such delicate eatables that they can get decimated with a fall. To counter such an issue a new transportation system had to be developed which would not annihilate the appearance of the confectionary item and will transport it easily without making it look like a massacre.

Therefore, the feature in this particular vending is that this project uses a combination of conveyors and lift mechanism. The technique needs to be subtle and not too time consuming

as vending machines have been designed for the sole purpose of faster service. In order to tackle the problem of efficient delivery and faster service also keeping in mind the delicacy of the items, the design had to be switched upon from conventional spring mechanism to conveyor and lift mechanism [11-12]. This transportation framework comprising belt conveyors and lift had to complete the entire extraction of the packed confectionery items from the placement counter to the positioned exit without any fail. Upon further thinking and assumptions there arose certain problems, one of which was the prime issue of maintaining the confectionery items at a certain temperature to keep them fresh. Therefore, the need of temperature-controlled compartments also had to be implemented inside the vending machines.

2. Literature Review

In 2017 a study by a bunch of students structured a smart newspaper vending machine. Machines are the most noteworthy advancement towards automation of industries since they not only reduce human efforts and risk but also are precise and effective in all sorts of conditions and situations. Their main objective was to decrease manual/human exertion of delivering or selling paper from door to door also, sparing time as opposed to remaining in long queues to purchase newspapers and to actualize a blunder free method for payment in order to stay away from all sources of cash error and miscalculations. They have structured a digitized payment strategy utilizing RFID as a client interfacing technique. They have used a combination of mechanical designs, electrical and electronic selection and computer interfacing so as to summarize it to a mechatronic framework plan. An RFID is utilized for client validation and membership purposes, a mechanical instrument of slider and rods being driven through DC motors are utilized to administer each newspaper in turn utilizing micro-controller (MS430G2553) as an embedded system with low power utilization interfaced with an ultrasonic sensor to abstain from dispensing more than a single paper at once making it a

successful attempt. Besides, the ultrasonic sensor is utilized to monitor the width of the paper utilizing its reverberation (echo) detecting technique. This concept is similar to our project i.e., the thought behind designing a vending machine for bakery items is to abstain from standing in long queues during rush hours and festivities when bakeries are flooding with people and to execute an accurate approach towards payment to dodge manual cash miscounting. In addition to this, a vending machine does not consume excess space in contrast to a bakery and has 24/7 accessibility to it. However, Bakers' Vendi differs from this one since it has not been proceeded towards a cashless and digitized payment strategy rather has utilized a coin acceptor as a payment technique. Also, the mechanical framework is a combination of conveyors and lift considering the delicacy of eatables. Furthermore, this project differs from Bakers' Vendi due to the simplicity of the newspaper vending machine of having a single column of dispensing whereas, we have multiple columns and rows to deal with making our vending a bit complex and diversified [13].

In the University of Science and Technology of Southern Philippines, a research/survey was carried by a student of that university regarding the selling of loose sheets at the printing shop to students for different purposes such as examination answer sheets were particularly of yellow color, A4 sheets, long sheets, short sheets, bond papers, etc. The survey conducted states that among all the tasks the counting and selling of loose sheets is the most painful task for retailers and so it is for the customers (students) to wait for their turn just to buy a few sheets of papers. Retailing papers is a very hectic and time-consuming job which also includes dishonesty of few retailers deliberately and at times it happens mistakenly under the pressure of multitasking since there are thousands of students in a university with few resource availabilities. Therefore, to make it efficient a 20" tall, 13" wide and 18" long paper vending machine was designed for students to purchase loose sheets whenever required without wasting time at the book shop crowded with students. This not only reduces manual efforts but is a step towards automation and saves plenty of time. This machine has

been designed keeping in mind the busy schedule of students and it consists of a printer dispensing section used for storing and dispensing of papers. Outdated printer parts driven by a servo motor have been used in designing this particular vending machine. A selector switch is used to select the type of paper you intend to buy, indication button indicates the ongoing status/task being performed by the machine, IR proximity sensors are used to check the availability of papers, PIC16F84A microcontroller device was interfaced with a motor driver to regulate the working of the dc motor. A coin acceptor machine is being used which can accept Php 1, 5 and 10 coins only. The machine will dispense the number of sheets equivalent to the amount inserted in the form of coin. However, there is no way for dispensing change out of this machine. After being assembled the machine was set up at the University for Evaluation Purposes. The performance of the machine was not up to the mark due to inaccuracy of the machine which was probably due to the old/outdated recycled parts that were put to use in the machine but the portability of the machine was highly appreciated and the retailers were willing to invest in such machines which would save their time and effort however in more accurate and precise version of such machines. To overcome this issue the machine needs to be designed with excellent quality printer parts, motors, and money operators for complete accuracy of service [14].

Programming Logic Controller operated vending machine was designed based on Mitsubishi PLC rather than Arduino or Raspberry Pi as micro-controllers. A vending machine is a money-driven machine therefore, a coin slot is compulsory in this particular kind of vending machine. It has a coin slot mechanism installed in it which will accept money in the form of coin. However, the disadvantage of this vending is that the machine can't identify forged coins and the purchaser can't discount the cashback if the product is unavailable in the slot of the machine which isn't the case in Bakers' Vandi [15].

The smart coffee vending machine is based on RFID rather than coin or currency system in

order to prevent machine misuse under any circumstances. RFID based cards are mainly used for security purposes or identification purposes. In this case, it is used as an employee ID in order to get coffee from the vending machine. However, the vending is programmed to evaluate per person requirement using Arduino as a microcontroller due to its cost-efficiency and ease to program in order to allow only the particular set number of coffee cups as assigned by the company for a single employee per day to avoid overconsumption. Exceeding the number of cups is allowed but at the cost of payment from the salary account. Coffee is only dispensed after the identification procedure is completed using the RFID card. The machine has a storage compartment for all the ingredients such as coffee powder, milk, and sugar. A hot water mechanism is controlled using a temperature controller interfaced with the microcontroller. The microcontroller used is ARDUINO UNO. The controller in this coffee machine is interfaced with RFID for identification of employees, IR sensor for detection of coffee cups, EPROM is an erasable memory chip to store data regarding the number of coffee cups consumed, motor to manage the consumption of coffee powder and LCD to display consumer details. Also, the quantity of each item is controlled using a microcontroller. The counter in the machine keeps a track of the number of coffee cups consumed per person [16].

The Chocolate vending machine is a very simple device that has been designed using RFID and Arduino UNO. The whole idea of this machine stands on the grounds of using RFID rather than using currency or coin acceptance-based system due to their lack or inability to dispense the remaining change out of the system. RFID is used to detect the user ID and the balance account which is also displayed on the LCD. Arduino is used to interface RFID with the LCD screen to display the price of the items. Microcontroller Arduino UNO is a user-friendly interfacing device and can be also used to interface display and keypad which is the point of concern for Bakers' Vendi [17].

The Cold drink vending machine with a reverse vending system for empty bottles has been basically designed keeping the idea of being

environment-friendly. The globe has been polluted due to plastic bottles which cannot be decomposed and remain on the planet for thousands of years, making it more polluted. Therefore, the basic concept is to recycle plastic bottles contributing to an eco-friendly environment. The working of this machine involves a coin acceptor module which will be working on the basis of the diameter and thickness of the coins. If the coin has been identified to be correct the machine will further proceed on otherwise it will reject the coin and initialize the machine. If the coin has been accepted then the customer can select the cold drink bottle using the keypad. Once selection has been made the servo which is working in accordance with the microcontroller will dispense the bottle out of the machine. Meanwhile, the LCD will be displaying the status of the vending machine operations. However, for the reverse vending procedure the barcode on each bottle is already saved. For reverse vending, the machine will scan the barcode on the bottle and compare with the saved barcode in the system. If it matches the microcontroller will allow the servo to open the shutter for the bottle recycling compartment. The monitoring system keeps a check on the number of bottles in the container. Once the container has crossed a certain level the monitor generates an alert beep. When it gets full the monitoring system stops the machine from further accepting any bottle. The reverse vending system will have a great impact on creating a cleaner and better environment [18].

Bakery Items Shelf Life

According to book, bread has a time span of usability of around a couple of days while cakes have a more prominent time span of usability particularly known as shelf life of around half a month since they are food sources with moisture substance in the range $18\pm 30\%$ of the mass of the item. Biscuits, cookies, and crackers comprise of moisture in them which is commonly below 5% of the item mass and the low moisture combined with the thinness of the items gives them their crispness. The low moisture and low water movement of items imply that they have a long mould-free shelf life of usability, normally many months. Pastries generally comprise of

higher moisture than that in cookies and biscuits however it is lower than that of cake. Thus, pastries lie in the range between biscuits and cakes. Freshly baked pastries have a long shelf life but due to the movement of moisture from the filling content towards the crust content decreases their shelf life to a few weeks [19].

The most fundamental method of increasing the shelf life of bakery items during distribution and storing time period is through temperature control. But this case is not suitable with bread since upon refrigeration, although it does increase its shelf life but also builds up its pace of hardening and becomes firm making it inedible. This has been a common problem with sandwiches because for storing purposes refrigeration is the best option. However, it turns the bread firm which eliminates the fresh appeal of the food item turning away the consumers. Therefore, bakers consider freshly made bread to be sold on a daily basis due to the fact that these products lose their appeal within a day or two at the most. However, the refrigeration phenomenon supports the cakes and pastries department. Therefore, we will be utilizing a cold compartment for cakes and pastries section in our vending machine. Moreover, packaging is another basic technique to increase the shelf life of food items which will be similar in our case since all the items will be packed for convenient transportation from the conveyor to the lift and to the exit and for hygienic purposes as well since packaging of bakery items is done to restrict moisture flow within the product i.e., moisture flow from the filling of the pastries to the crust part. In biscuits, packaging helps avoid moisture absorption from the atmosphere [20].

The ways to increase mould-free shelf life are by adding preservatives, using packaging techniques, MAP (Modified Atmosphere Packaging), ingredients selection, maintain hygienic measures, keeping returned mouldy products away from bakery and other bakery products, keeping the bakery environment clean, avoid build-up of detritus on shelves, trays conveyors or machines, keep utensils clean, clean all surfaces in contact with food and isolate flour-handling range from the packaging section and other sections[21-23].

3. Structure and designing

3.1. 3-D CAD Model

During this phase of the project the Literature review study became the source of guidance and help. Quite a number of procedures and approaches that have been implemented were derived from the help of those. After studying and analyzing a great deal of literature reviews of successful and unsuccessful attempts done previously in designing and implementing different kinds of vending machines helped to avoid repeating the errors that occurred previously. Furthermore, it helped to bridge the gap between the technologies lagging currently in Pakistan regarding the vending world. By pondering over all these errors and issues and making multiple design iterations and reviewing it for all errors, the design of Bakers' Vendi was finalized and concluded. Bakers' Vendi comprises three main mechanical mechanisms i.e., Conveyor Mechanism, Lift Mechanism and the Coin accepting criteria. The CH926 coin acceptor which has been interfaced with the Arduino MEGA (controller) is used for identification of any counterfeiting of coins and is used for payment methods. The conveyor mechanism functions as a transporting device in order to transport the confectionery item from the conveyor belt to the lift tray. The lift mechanism based on customized lead screws and pulleys that work in accordance to the requirements of the project are used for further transportation of items towards the exit pocket of the machine. Below is the CAD design model of Bakers' Vendi:

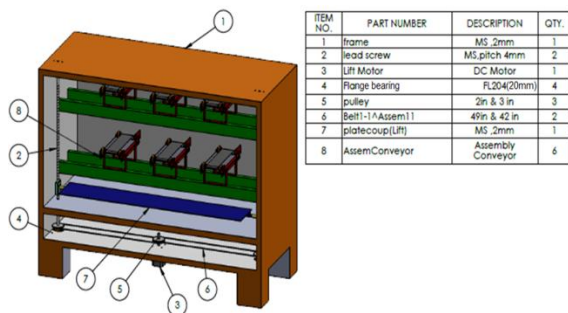


Figure 1. CAD Assembly of Bakers' Vendi

3.2. Design Analysis

The 3-D design of Baker's Vendi had to undergo simulation in order to determine the

stress analysis and factor of safety of the critical areas identified the outer structure. Simulations were carried out on the base of outer structure. The base of the outer structure will hold the weight of the entire structure itself and the components housed within. Therefore, the material and design need to be firm enough to support the machine. Stress analysis and Factor of Safety are extremely essential parameters and need to be calculated and checked against the load (force) applied. As these analyses helps in the prevention of structural damage of the material used. In the stress analysis, the maximum induced stress and actual stress are simulated, which helps to determine whether the material can bear the load or not. While the Factor of Safety indicates the reliability of the material's design. The entire analysis was done on Solid works and results are shown below:

3.2.1 Stress Analysis of the Base Outer Structure:

The simulation results of the stress analysis are shown in figure 11, when the force is applied onto the base of the outer structure in the downwards direction according to the load that will be applied on to it. Yield Strength is found to be around 220 MPa whereas the maximum stress of mild steel is 247Mpa therefor load applied is under the safety limits hence the structure will not get deformed upon application of load.

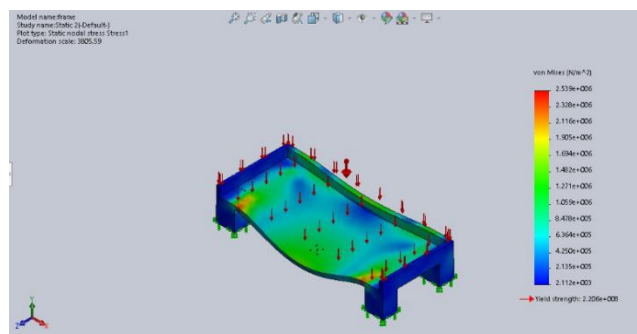


Figure 2. Stress Analysis of Base Structure

3.2.2 Stress Analysis of the Base Outer Structure:

The entire structure is under the range of FOS which is found to be 87, which indicates that the part is quite far away from fracture point and is reliable. Hence the design and material

of the structure are reliable and suitable for carrying the load.

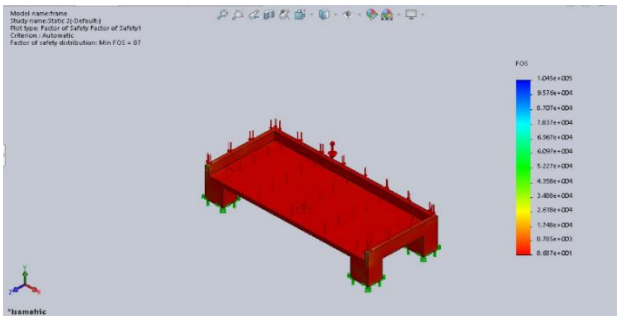


Figure 3. Factor of Safety Analysis of Base Structure

3.3. Block Diagram

Arduino MEGA is the controller, interfaced with sensors and actuators of the vending machine. It controls and monitors all the processes, starting from input to output. The Android application is connected via Bluetooth Module which transmits the data to Arduino. Moreover, the Coin Acceptor sends data to the Controller, regarding the coins being accepted or rejected. After the acceptance of coins, selection of items is done by the customer through an Android application. Then Arduino gives commands in sequence and monitors via sensors. Relays are activated accordingly, which controls the motors due to which conveyors and lift operate. It checks for the command and generates the suitable logic signal for the relay switching. Firstly, lift is moved up towards the respective floor, and the limit switch sends the signal to Arduino that lift has reached the floor in order to halt its movement. After which conveyors are moved until the Confectionary item is transported to the lift and monitored by the IR sensors. Finally, lift is moved down towards the exit. Moreover, the temperature is real-time monitored and controlled by Arduino. Thermocouple continuously sends signals to Arduino, which either turn on or off, Peltier Module or Heating Element, required to maintain the temperature. The following is a block diagram of the flow of information from the sensors, devices and actuators to the controllers:

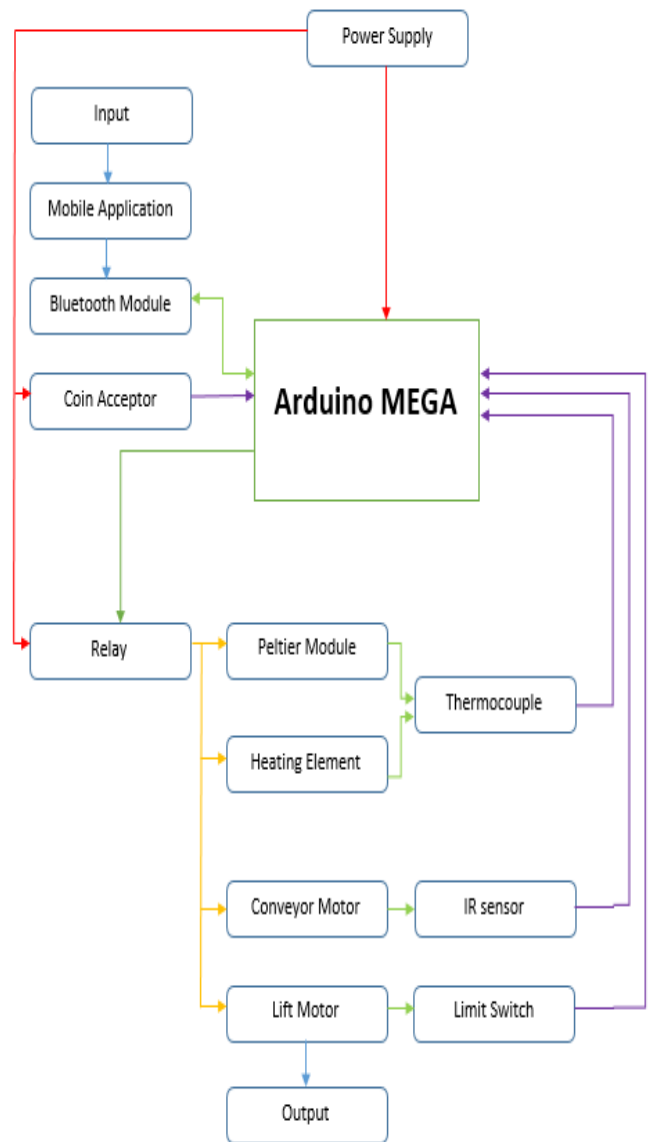


Figure 4. Vending Machine Block Diagram

3.4. Flow Diagram

The logical working of the project is demonstrated through the flow chart which explains in detail the working procedure of Bakers' Vendi. The flow diagram of the process explains the working principle of the vending machine i.e., the procedure to deliver bakery items from the vending to the exit as follows:

- *In order to select the desired eatable, the customer needs to select the item number using the mobile application that is interfaced to the vending machine.*

- Then the customer will insert the amount of the product that he/she intends to buy into the coin acceptor. After the cash is accepted, the machine disposes away the cash in the money box. If the machine recognizes any counterfeit it will discard the coins and will not further proceed with the instructions.
- When the machine acknowledges the sum of money deposited in it, the lift will move towards that designated floor of the selected conveyor item (there are two rows and each floor have three columns assigned to it in this vending machine).
- Once the lift has reached that floor, the conveyor will start moving and will consequently transport the item on to the lift.
- Then the lift will move towards the base pocket of the machine from where the customer can pick up the eatable and consequently the machine will halt.

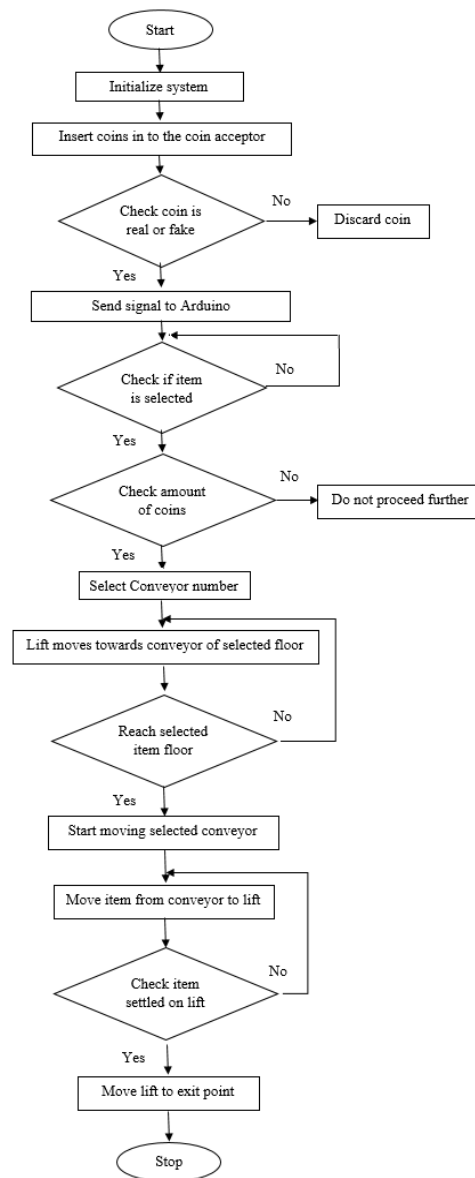


Figure 5. Process Flow Diagram

4. Working

4.1. Hardware Fabrication

With the success of an effectively designed CAD model and achieving relevant outcomes from the stress analysis and simulation model, the work proceeded on with the manufacturing and fabrication of the hardware. The hardware fabrication was executed with respect to the proposed CAD design and its dimensioning. First of all, the outer frame of the structure of the vending machine was fabricated using L-shaped Mild steel angle brackets of one-inch width as per the finalized dimensions i.e., 4 feet x 4 feet x 3.5 feet. The angle brackets were welded together to bond the structure together firmly. The dimensions were selected considering the overall architecture of the

machine such that it could accommodate and withstand the weight of the conveyors, lift and other parts to be installed within the structure. The structural dimensioning and material strength are sufficient to hold and accommodate the load of six conveyors all together. Then the conveyors and lift were fixed onto the structure respectively. The conveyors were distributed among two floors with three conveyors on each floor. The conveyor assembly consists of a frame of mild steel of 5.5 inches x 40 inches with a rubber conveyor belt of 42 inches x 5 inches wrapped around two rollers of 2 inches diameter each that are housed at each end of the conveyor frame. Next, the DC geared motors of the conveyor were mounted on the flange adjustment plate which holds the flange bearing (FL204) having 20 millimeters diameter which were coupled with the ends of conveyor roller in order to drive the conveyor belt conveniently. Each conveyor assembly has been constructed similarly. Just beyond the conveyors the lift mechanism had to be assembled with minimal gap between the two in order to safely transport the confectionery item from the conveyor on to the lift by maintaining its delicacy. This is the sole reason of designing a confectionary based vending machine.

The lift mechanism comprises of two customized square threaded lead screws made of Mild steel having length of 3 feet and a pitch of 4 millimeters. The ends of the lead screws are coupled with a flange bearing (FL204) to fix them to the structure and consequently allow them to freely rotate from within. The lift plate has been fabricated using Mild steel sheet of 35 inches length, 8 inches width and 2 mm thickness. The ends of the plate are coupled with the lead screws using threaded bearing so that the plate can freely move up and down. The bottom ends of the lead screws are coupled with one pulley on each lead screw and another in the center of the frame of the lead screws. Rubber V-belts are encircled around these pulleys. V-Belt are used to mechanically couple the three pulleys with the motor and lead screws. They are used to transmit the rotation of the motor from the pulleys to the lead screw. With completing this the final lift assembly was installed on the structure

completing the basic hardware structure of the vending machine.

After mounting conveyor assemblies and the lift mechanism, the electronics and electrical components were mounted on their desired position for efficient working of the machine. The FC-51 IR sensors were mounted on the front end of the conveyor frames in order to control the movement of the motor in accordance to the availability and transportation of the item on the conveyor belt so as to avoid multiple item transport in a single purchase. The FC-51 IR module has a detection range of 2 to 30 cm and a detection angle of 35 degree. The processing speed is faster, precise and can be altered with the help of a potentiometer placed on the module. An optical encoder is attached to the conveyor motor to manage the speed and position of the motors to ensure single displacement of the item for every purchase. The encoder works as a feedback control system and monitors parameters such as speed, position, direction etc. It converts mechanical movement to electrical pulses in order to control the desired parameters or make adjustments are per requirement. Limit switches were mounted at the bottom of the lead screws for guiding and controlling the lift to reach its desired floor. The switch is made of steel and PVC and has a voltage specification of 250 V and energizing current of 10 A.

Next the temperature controlling was carried out for both the hot and cold compartments. The cooling compartment was the center of focus since it required well maintained temperature using Peltier modules. Thermoelectric cooler TEC1-12706 works on the phenomena on creating a temperature difference between two semiconductor electrodes when voltage is applied. Due to which one junction cools while the other transfers heat towards it, making one side cold and the other hot. Moreover, this module works on 12V and 6A, compatible with the power supply installed. The temperature of the vending machine will be maintained at 15 degree Celsius for the cold compartment in order to keep the bakery items such as pastries, cakes and donuts fresh. A single Peltier module was not sufficient for the compartment. Therefore, in order to maintain the temperature

of the entire compartment three Peltier modules were used.

For the warm compartment halogen bulbs which are commonly known as incandescent bulbs have been utilized. They comprise of tungsten filament with a combination of an insignificant quantity of halogen gas, for example, iodine or bromine along with an inert gas. This mixture causes a chemical reaction of halogen cycle. The evaporated tungsten is redeposit back on to the filament which expands the life of the bulb. It also permits the tungsten filament to work at higher temperature as compared to standard bulbs of the same power. The color temperature also contributes to its higher temperature, they give off the most amount of heat as compared to other types of LED bulbs. For e.g., a 50 W halogen bulb will emit about 48 W of heat. Therefore three 50 W halogen bulb will be needed according to the heat analysis carried out.

Thermocol is used to provide insulation from inside as it has very low thermal conductivity. Moreover, it is light in weight, economical and easy to use. The entire vending machine is properly insulated using a 4-millimetre thermocol sheet on all the sides of the vending machine to prevent any loss of heat due to any means of conduction or convection. Vending machine accepts coin as payment and for this machine a CH926 coin acceptor was installed for consumers to purchase food items. The coin acceptor has the capacity to accept six different coins. It can work with all coins universally available as long as it is within its acceptable diameter and thickness range. It has a coin diameter acceptance range of 15 millimeters to 32 millimeters while thickness acceptance range of 1.2 millimeters to 3.8 millimeters. The identification of counterfeit coins in this machine basically works on weight, material and dimension identification and has an accuracy identification rate of 99.5%. Moreover, it can work in extreme temperature ranges with great stability which makes it more preferable over other coin acceptors. A HC-05 Bluetooth module is integrated with the Arduino ATMEGA 2560 (microcontroller) to receive signals from the mobile application and transfer the commands to the microcontroller.

A power supply of 12 volts and 25 amperes was installed and connected to the system. One must be certain that there is enough power for all the components to draw and work on their optimum levels to acquire the best and most efficient machine it can be. The human access with this machine comes to be virtual when selecting the choice of food, they want and would be physical when inserting coins and picking up the food item they selected from the desired exit.

4.2. Hardware Working Principle

The working of the hardware is described as initially when the power is supplied to the vending machine only the Peltier module and the bulb will be in working state 24/7 without fail. The conveyors and lift will remain stationary until they receive any input operating command from the application. The Peltier and bulb need to remain working continuously since they maintain the temperature of the cold and hot compartments of the vending machine to keep the confectionary items fresh and healthy all day long and to protect them from humidity and moisture that might occur due to temperature variation. The entire vending machine is completely insulated using thermocol to prevent any heat loss and to maintain the temperature of the vending machine.

The item to be purchased is selected using a mobile application by selecting the predefined item number. The mobile application is interfaced with the vending machine using a Bluetooth module which is interfaced through the Arduino. The moment the item is selected on the application the Bluetooth initializes the Arduino regarding the price of the item. The coin acceptor is also initialized. In order to purchase an item, the customer must insert the sufficient coins according to the price stated. As the customer inserts the amount to be paid, the coin acceptor runs scans for any counterfeit or fake coins and also scans whether the amount payable is equivalent to the cash inserted or not. Once the coin acceptor has completed this scanning and processing it signals the Arduino to carry on with the delivery of the item. If any of the following criteria has not been achieved the cash will be dispensed out and the Arduino will receive

signal to stop further processing. The Arduino signals the lift motor to operate resulting in rotation of the v-belts which are coupled with the pulleys that rotate the lead screw to move the lift up or down to the respective floor on which the item is placed. Here the limit switches play an important role in guiding and directing the lift to the respective floor and also to synchronize it in line with the conveyor bed. Once the lift has reached the desired floor the respective conveyor motor starts moving and the item is moved from the conveyor bed on to the lift. The IR sensors that are mounted on the sides of the conveyor bed monitor and detect the item movement from the conveyor bed on to the lift and stops the conveyor motor when the IR detects that item displacement has been carried out. Once the conveyor motor stops it consequently turns the lift motor on and delivers the food to the base pocket of the vending machine from where the customer can collect the item. This way the entire process of the vending machine can be carried out.

4.3 Software

The programming of any project is the main core and soul of the Vendi project. The software comprises of Arduino coding inclusive of an Android application to begin the process of buying an item from the vending machine.

The software used to design the application for the vending machine is android studio [21]. Design layout was finalized and planned on the main frame whereas the coding of the process was compiled on the back end. The application can be downloaded onto any android phone and can be connected to the vending machine through Bluetooth. Hence connecting the application with the main program which has been compiled and finalized on Arduino. Arduino is the microcontroller, in which the program has been installed and loaded on its software to instruct the working of the hardware.

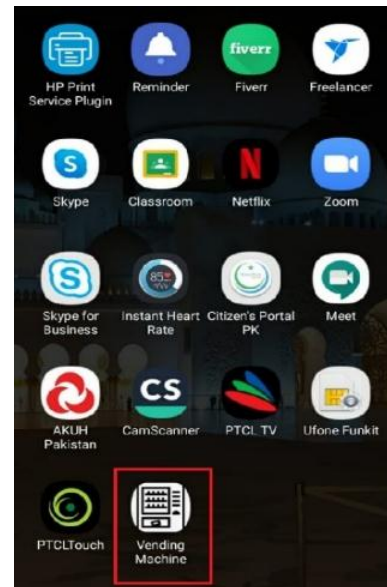


Figure 6. Bakers' Vendi Application Icon

Vendi's software comprises of two parts. First one being an application designed on android studio which will show the items and their respective prices to the customer in order for them to purchase an item from the vending machine. The application has been developed on Android Studio and can be connected within all android users. However, only one mobile can be connected with the vending machine at a time. The interfacing of the machine and mobile will occur through Bluetooth pairing. Bluetooth is interfaced with the Arduino microcontroller to instruct the working of the project in accordance with the android application selection to provide an efficient transport system for the confectionery items.

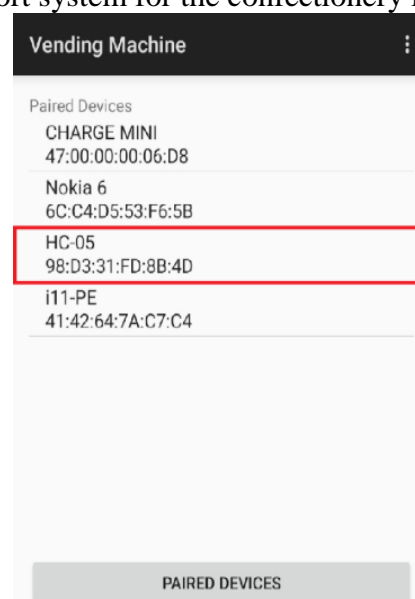


Figure 7. HC-05 Bluetooth Pairing with Vending Machine

When a user connects the application with the machine using Bluetooth, a page will open on the mobile screen showing the products and their respective price. Once user selects the desired food item, it is required to make the payment which will be made through the coin acceptor installed on the Vendi. For example, the user selects an item which costs Rs. 10 then the user will have to enter two Rs. 5 coins as those are the standard coins that have been chosen for the coin acceptor to accept. Any other coin that does not match with the properties of this coin such as a different shape and size will be rejected.

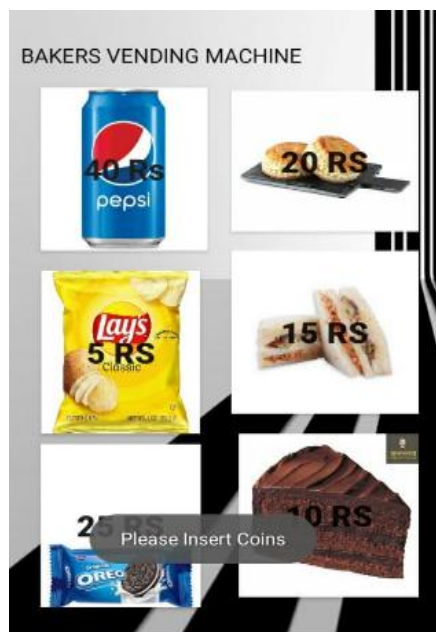


Figure 8. Bakers' Vendi Android Application

For every conveyor a unique string has been designed that is initialized by the Arduino upon the selection of that particular conveyor item and once the payment has been made. Once the Arduino is initialized, the further instructions that are to be carried out by the machine are activated. After the payment has been made, a string would be sent to the Arduino that will activate the lift motor first to move towards the respective floor of the selected conveyor and then initializes the conveyor motor to systematically operate as the lift reaches the floor. Consequently once the item has been transported from the conveyor on to the lift the IR sensor which has been installed at the front edge of the conveyor detects the item and instructs the Arduino to halt the conveyor

motor and to initialize the lift motor to deliver the item towards the base pocket to be retrieved by the customer.

5. Observation and Analysis

5.1. Material Selection Criteria

The selection of the material depends on the capability of load handling that can be managed by the material without any sort of deformation. The weight of the entire structure plays an essential role in the material selection criteria. In order to select an appropriate material considering the weight bearing capability and other factors such as resistance to corrosion, ease of machining, price, yield strength etc. To mathematically support the selection of mild steel as the structure material the stress equation has been used. The Yield strength will be compared to the calculated stress The Yield Strength of Mild Steel is 247 MPa. Therefore, any value that falls below the Yield Strength will be acceptable and will not cause the structure to deform.

The stress equation can be given as

$$\sigma = \frac{F}{A} \tag{1}$$

$$F = W = mg \tag{2}$$

$$\sigma = \frac{m * g}{A}$$

Substituting the estimated values of the parameters in to the above equation where the estimated weight of the structure is about 50 kg. Since the structure is hollow from within therefore the cross-sectional area can be calculated through the following method

$$\sigma = \frac{50 * 9.81}{(0.9144 * 1.12776) - (0.887 * 1.10036)}$$

$$\sigma = 502.533 \text{ Pa}$$

Therefore, the calculated stress supports the fact that Mild steel is a suitable choice. Moreover, it is also cost-efficient, easy to machine and corrosion resistant.

5.2. Lead Screw Calculation

Lead screws have been used in order to convert rotary movement to linear movement. For Bakers' Vendi two lead screws have been utilized. One at each end of the plate for the upward and downward movement of the lift plate. Square threaded lead screws have been used due to the fact that they offer least friction during movement and are highly efficient. However, the torque that is needed to raise or lower the load which includes both the weight of the lift itself as well the weight item on the lift can be determined using the lead screw torque raising and lowering formulae.

The lead screws are made of mild steel having a pitch of 4 mm and has a single thread throughout the length of the lead screw so 'n' is 1.

Therefore, the lead 'l' of the lead screw can be found using

$$l = n \times p \quad (3)$$

$$l = 1 \times 4$$

$$l = 4 \text{ mm}$$

The minor diameter 'd_r' of the lead screw is measured to be 14 mm and major diameter 'd' of 20 millimeters while the pitch is determined to be of 4 millimeters, The mean diameter 'd_m' of the lead screw can be determined using

$$d_m = d - p/2 \quad (4)$$

$$d_m = 20 - 4/2$$

$$d_m = 18 \text{ mm}$$

The estimated load that the lift will carry can be determined using the below stated formula where mass includes the mass of lift plate as well as the estimated mass of the confectionery item itself.

$$F = W = m \cdot g$$

$$F = 1.3 \cdot 9.8$$

$$F = 12.753 \text{ N}$$

The coefficient of friction of the collar and the coefficient of friction for the thread are both 0.64 since both have been fabricated using the same material i.e., mild steel while the mean diameter of the collar is 27 millimeters.

5.2.1 Torque Required to Raise Load: The torque required to raise the load using a lead screw can be determined using

$$Tr = \frac{F \cdot dm}{2} \left(\frac{l + \pi \mu dm}{\pi dm - \mu l} \right) + \left(\frac{F \mu c dc}{2} \right) \quad (5)$$

$$Tr = \frac{12.75 \cdot 18}{2} \left(\frac{4 + (\pi \cdot 0.64 \cdot 18)}{(\pi \cdot 18) - (0.64 \cdot 4)} \right) + \left(\frac{12.75 \cdot 0.64 \cdot 27}{2} \right)$$

$$Tr = 195.584 \text{ Nm}$$

5.2.2 Torque Required to Lower Load: The torque required to lower the load using a lead screw can be determined using

$$Tl = \frac{F \cdot dm}{2} \left(\frac{\pi \mu dm - l}{\pi dm + \mu l} \right) + \left(\frac{F \mu c dc}{2} \right) \quad (6)$$

$$Tl = \frac{12.75 \cdot 18}{2} \left(\frac{(\pi \cdot 0.64 \cdot 18) - 4}{(\pi \cdot 18) + (0.64 \cdot 4)} \right) + \left(\frac{12.75 \cdot 0.64 \cdot 27}{2} \right)$$

$$Tl = 172.65 \text{ Nm}$$

5.2.3 Lead Screw Critical Speed Analysis:

As the lead screw has been assembled using flange bearings on each side of the lead screw so 'C' will be 1 for both ends simply supported. The length between bearing supports 'L' is 36 inches while the smallest diameter of lead screw is 0.551181 inches.

The critical speed of the lead screw 'N' can be determined using

$$N = \frac{(4.67 \cdot 10^6) dr \cdot C}{L^2} \quad (7)$$

$$N = \frac{(4.67 \cdot 10^6) \cdot 0.551181 \cdot 1}{36 \cdot 36}$$

$$N = 1986.12 \text{ rpm}$$

5.3. Heat Analysis

Temperature controlling is another important factor that needs to be handled while fabrication of the vending machine since it contains confectionery items. The vending

machine has been distributed into two compartments i.e., a hot and a cold compartment.

The entire vending machine is properly insulated using thermocol on all the sides of the vending machine to reduce loss of heat due to any means of conduction or convection. Therefore, in order to determine the number of Peltier modules and heat bulbs that will be required to maintain the desired temperature, heat analysis has been carried out on both the compartments in the below sections.

5.3.1 Heat Analysis of Cold Compartment:

The cold compartment temperature will be maintained using Peltier modules. The temperature of the vending machine will be maintained at 15 °C for the cold compartment in order to keep the bakery items such as pastries, cakes and donuts fresh.

Inside Temperature = $T_i = 15\text{ }^\circ\text{C}$

Outside Temperature = $T_o = 40\text{ }^\circ\text{C}$

Area of Roof and Base surface = $A_r = 3\text{ ft} \times 3.7\text{ ft} = 0.9144\text{ m} \times 1.1278\text{ m} = 1.0313\text{ m}^2$

Area of Right and Left surface = $A_l = 3\text{ ft} \times 1.5\text{ ft} = 0.9144\text{ m} \times 0.4572\text{ m} = 0.4181\text{ m}^2$

Area of Front and Back surface = $A_f = 1.5\text{ ft} \times 3.7\text{ ft} = 0.4572\text{ m} \times 1.1278\text{ m} = 0.5156\text{ m}^2$

Mild Steel Structure thickness = $\Delta x_m = 2\text{ mm} = 0.002\text{ m}$

Acrylic Door thickness = $\Delta x_a = 4\text{ mm} = 0.004\text{ m}$

Thermocol insulation thickness = $\Delta x_t = 1\text{ in} = 0.0254\text{ m}$

Convection Heat Transfer Coefficient for inside air @ 15 °C = $h_i = 25.5\text{ W/m}^2\text{ }^\circ\text{C}$

Convection Heat Transfer Coefficient for outside air @ 40 °C = $h_o = 27.35\text{ W/m}^2\text{ }^\circ\text{C}$

Thermal conductivity of Mild Steel = $k_m = 44.97\text{ W/m }^\circ\text{C}$

Thermal conductivity of acrylic = $k_a = 0.2\text{ W/m }^\circ\text{C}$

Thermal conductivity of thermocol insulation = $k_t = 0.029\text{ W/m }^\circ\text{C}$

The equation for thermal resistance for conduction can be given as $\frac{\Delta x}{kA}$. Similarly, the equation for thermal resistance for convection can be given as $\frac{1}{hA}$.

- **Total thermal resistance through the roof:** The total thermal resistance through the roof is calculated as:

$R_{\text{roof}} = \text{Convection resistance on inside} + \text{Conduction resistance in MS plate} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{roof}} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_m}{k_m \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{\text{roof}} = \frac{1}{25.5 \cdot 1.0313} + \frac{0.002}{44.97 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{27.35 \cdot 1.0313}$$

$$R_{\text{roof}} = 0.9228\text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the base:** The total thermal resistance through the base is calculated as:

$R_{\text{base}} = \text{Convection resistance on inside} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{base}} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{\text{base}} = \frac{1}{25.5 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{26.24 \cdot 1.0313}$$

$$R_{\text{base}} = 0.9243\text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the left and right surfaces:** The total thermal resistance through the left and right is calculated as:

$R_{\text{left}} = R_{\text{right}} = \text{Convection resistance on inside} + \text{Conduction resistance in MS plate} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{left}} = R_{\text{right}} = \frac{1}{h_i \cdot A_l} + \frac{\Delta x_m}{k_m \cdot A_l} + \frac{\Delta x_t}{k_t \cdot A_l} + \frac{1}{h_o \cdot A_l}$$

$$R_{\text{left}} = R_{\text{right}} = \frac{1}{25.5 \cdot 0.4181} + \frac{0.002}{44.97 \cdot 0.4181} + \frac{0.0254}{0.029 \cdot 0.4181} + \frac{1}{27.35 \cdot 0.4181}$$

$$R_{\text{left}} = R_{\text{right}} = 2.2762\text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the front surface:** The total thermal resistance through the front surface is calculated as:

R_{front} = Convection resistance on inside +
Conduction resistance in acrylic plate +
Convection resistance on outside

$$R_{front} = \frac{1}{hi \cdot Af} + \frac{\Delta xa}{ka \cdot Af} + \frac{1}{ho \cdot Af}$$

$$R_{front} = \frac{1}{25.5 \cdot 0.5156} + \frac{0.004}{0.2 \cdot 0.5156} + \frac{1}{27.35 \cdot 0.5156}$$

$$R_{front} = 0.1858 \text{ } ^\circ\text{C/W}$$

- **Total thermal resistance through the back surface:** The total thermal resistance through the back surface is calculated as:

R_{back} = Convection resistance on inside +
Conduction resistance in MS plate +
Conduction resistance in thermocol insulation
+ Convection resistance on outside

$$R_{back} = \frac{1}{hi \cdot Af} + \frac{\Delta xm}{km \cdot Af} + \frac{\Delta xt}{kt \cdot Af} + \frac{1}{ho \cdot Af}$$

$$R_{back} = \frac{1}{25.5 \cdot 0.5156} + \frac{0.002}{0.2 \cdot 0.5156} + \frac{0.0254}{0.2 \cdot 0.5156} + \frac{1}{27.35 \cdot 0.5156}$$

$$R_{back} = 0.4127 \text{ } ^\circ\text{C/W}$$

- **Overall thermal resistance through all the surfaces:** Since all the surfaces are parallel to each other therefore, thermal resistance 'Rth' will be determined as:

$$\frac{1}{R_{th}} = \frac{1}{R_{roof}} + \frac{1}{R_{base}} + \frac{1}{R_{right}} + \frac{1}{R_{left}} + \frac{1}{R_{front}} + \frac{1}{R_{back}}$$

$$\frac{1}{R_{th}} = \frac{1}{0.9228} + \frac{1}{0.9243} + \frac{1}{2.2762} + \frac{1}{2.2762} + \frac{1}{0.1858} + \frac{1}{0.4127}$$

$$\frac{1}{R_{th}} = 10.8494 \text{ W/}^\circ\text{C}$$

The overall heat transfer coefficient 'U' can be related to thermal resistance 'Rth' through the following relationship

$$UA = \frac{1}{R_{th}}$$

$$UA = 10.8494$$

The relationship of overall heat-transfer due to a combination of conduction and convection with the overall heat transfer coefficient 'U' can be stated in terms of the given relation

$$q = UA \Delta T$$

$$q = UA (T_o - T_i)$$

$$q = (10.8494) (40-15)$$

$$q = 271.234 \text{ W}$$

The heat transfer in the cold compartment of the vending machine will be of 271.23 W.

5.3.2. Heat Analysis of Warm Compartment:

For warm compartment halogen bulbs will be used. The temperature of the vending machine will be maintained at 25 °C for the warm compartment in order to keep the bakery items such as patties, samosas and croissants fresh.

Inside Temperature = $T_i = 15 \text{ } ^\circ\text{C}$

Outside Temperature = $T_o = 40 \text{ } ^\circ\text{C}$

Area of Roof and Base surface = $A_r = 3 \text{ ft} \times 3.7 \text{ ft} = 0.9144 \text{ m} \times 1.1278 \text{ m} = 1.0313 \text{ m}^2$

Area of Right and Left surface = $A_l = 3 \text{ ft} \times 1.5 \text{ ft} = 0.9144 \text{ m} \times 0.4572 \text{ m} = 0.4181 \text{ m}^2$

Area of Front and Back surface = $A_f = 1.5 \text{ ft} \times 3.7 \text{ ft} = 0.4572 \text{ m} \times 1.1278 \text{ m} = 0.5156 \text{ m}^2$

Mild Steel Structure thickness = $\Delta x_m = 2 \text{ mm} = 0.002 \text{ m}$

Acrylic Door thickness = $\Delta x_a = 4 \text{ mm} = 0.004 \text{ m}$

Thermocol insulation thickness = $\Delta x_t = 1 \text{ in} = 0.0254 \text{ m}$

Convection Heat Transfer Coefficient for inside air @ 25 °C = $h_i = 26.24 \text{ W/m}^2 \text{ } ^\circ\text{C}$

Convection Heat Transfer Coefficient for outside air @ 40 °C = $h_o = 27.35 \text{ W/m}^2 \text{ } ^\circ\text{C}$

Thermal conductivity of Mild Steel = $k_m = 44.97 \text{ W/m } ^\circ\text{C}$

Thermal conductivity of acrylic = $k_a = 0.2 \text{ W/m } ^\circ\text{C}$

Thermal conductivity of thermocol insulation = $k_t = 0.029 \text{ W/m } ^\circ\text{C}$

The equation for thermal resistance for conduction can be given as $\frac{\Delta x}{kA}$. Similarly, the equation for thermal resistance for convection can be given as $\frac{1}{hA}$.

- **Total thermal resistance through the base:** The total thermal resistance through the base is calculated as:

R_{base} = Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{base} = \frac{1}{hi*Ar} + \frac{\Delta xm}{km*Ar} + \frac{\Delta xt}{kt*Ar} + \frac{1}{ho*Ar}$$

$$R_{base} = \frac{1}{26.24*1.0313} + \frac{0.002}{44.97*1.0313} + \frac{0.0254}{0.029*1.0313} + \frac{1}{27.35*1.0313}$$

$$R_{base} = 0.9217 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the roof:** The total thermal resistance through the roof is calculated as:

R_{roof} = Convection resistance on inside + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{roof} = \frac{1}{hi*Ar} + \frac{\Delta xt}{kt*Ar} + \frac{1}{ho*Ar}$$

$$R_{roof} = \frac{1}{26.24*1.0313} + \frac{0.0254}{0.029*1.0313} + \frac{1}{25.5*1.0313}$$

$$R_{roof} = 0.9243 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the left and right surfaces:** The total thermal resistance through the left and right is calculated as:

$R_{left} = R_{right}$ = Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{left} = R_{right} = \frac{1}{hi*Al} + \frac{\Delta xm}{km*Al} + \frac{\Delta xt}{kt*Al} + \frac{1}{ho*Al}$$

$$R_{left} = R_{right} = \frac{1}{26.24*0.4181} + \frac{0.002}{44.97*0.4181} + \frac{0.0254}{0.029*0.4181} + \frac{1}{27.35*0.4181}$$

$$R_{left} = R_{right} = 2.2736 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the front surface:** The total thermal

resistance through the front surface is calculated as:

R_{front} = Convection resistance on inside + Conduction resistance in acrylic plate + Convection resistance on outside

$$R_{front} = \frac{1}{hi*Af} + \frac{\Delta xa}{ka*Af} + \frac{1}{ho*Af}$$

$$R_{front} = \frac{1}{26.24*0.5156} + \frac{0.004}{0.2*0.5156} + \frac{1}{27.35*0.5156}$$

$$R_{front} = 0.1836 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the back surface:** The total thermal resistance through the back surface is calculated as:

R_{back} = Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{back} = \frac{1}{hi*Af} + \frac{\Delta xm}{km*Af} + \frac{\Delta xt}{kt*Af} + \frac{1}{ho*Af}$$

$$R_{back} = \frac{1}{26.24*0.5156} + \frac{0.002}{0.2*0.5156} + \frac{0.0254}{0.2*0.5156} + \frac{1}{27.35*0.5156}$$

$$R_{back} = 0.4105 \text{ }^\circ\text{C/W}$$

- **Overall thermal resistance through all the surfaces:** Since all the surfaces are parallel to each other therefore, thermal resistance 'Rth' will be determined as

$$\frac{1}{R_{th}} = \frac{1}{R_{base}} + \frac{1}{R_{roof}} + \frac{1}{R_{right}} + \frac{1}{R_{left}} + \frac{1}{R_{front}} + \frac{1}{R_{back}}$$

$$\frac{1}{R_{th}} = \frac{1}{0.9217} + \frac{1}{0.9243} + \frac{1}{2.2736} + \frac{1}{2.2736} + \frac{1}{0.1836} + \frac{1}{0.4105}$$

$$\frac{1}{R_{th}} = 10.9292 \text{ W/}^\circ\text{C}$$

The overall heat transfer coefficient 'U' can be related to thermal resistance 'Rth' through the following relationship

$$UA = \frac{1}{R_{th}}$$

$$UA = 10.9292$$

The relationship of overall heat-transfer due to a combination of conduction and convection with the overall heat transfer coefficient 'U' can be stated in terms of the given relation

$$q=UA\Delta T$$

$$q=UA (T_o - T_i)$$

$$q= (10.9292) (40-25)$$

$$q= 163.937 \text{ W}$$

Therefore, it can be concluded that three halogen bulbs of 50 Watt each will be sufficient for the warm compartment.

6. Result and Conclusion

Bakers' Vendi after being assembled looked similar to the anticipated design which had been drafted on the CAD modeling software. The entire structure was fabricated from scratch, even the conveyors and lift mechanism. During the testing phase of the vending machine it has been noticed that acquiring input from the Android Application via Bluetooth was quite efficient and no glitches in the working of the software has been noticed so far. Furthermore, the payment method via coin acceptor has demonstrated working up to the mark with great counterfeit recognition. Moreover, calculations that have been done were quite useful and beneficial for creating the machine with great precision. The temperature controlling of the cold

compartment is a bit flexible and can be changed as per requirement of the items placed in it. The placement and working of the IR sensor for item detection is also up to the mark and has shown a great working response and accuracy. Adjustments have been made accordingly, in order to achieve the best results and to minimize the time delays.

The working of the bakers' Vendi demonstrates proper real-time response which is quite similar to the designed prototype. There is minimal possible time delay in the working structure of the machine. However, some externally forced vibrations have been noticed due to the oscillations occurring in the lift motor. The lift motor is quite powerful and the base structure of the vending machine is also not fixed to the ground instead it is slightly above ground level and is based on structural framework. Therefore, due to the absence of solid base foundation, the ground cannot provide the damping effect in this case. Therefore, two options have been considered in order to solve this issue. The first is to provide damping to the machine in order to reduce the vibration. It has been thought upon to utilize a rubber foundation block at the empty base space in the later stages. While the second option is that lift motor speed will have to be slowed in order to avoid unnecessary vibration however this option might cause compromising a bit on the timing phenomenon of the vending machine.

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EVALUATION OF THE EFFICACY OF GRIEVANCE REDRESSAL MECHANISM IN BANKING SYSTEM

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ABSTRACT

In today's competitive banking environment, customer service excellence is the most critical instrument for sustaining corporate development. Customer complaints are an inevitable aspect of every business's operations. The challenge becomes much more difficult in the banking industry, where it is necessary to improve and streamline customer service while growing penetration and providing access to unbanked people. Customer protection requires effective resolution of consumer grievances. Regrettably, redress in the Indian banking industry is a complicated and time-consuming process that makes meaningful restitution difficult to obtain. While authorities have made a number of initiatives to make redress more open and consumer-friendly, there is always space for improvement. If banks can use cost-effective technology with an acceptable delivery model, banking services will improve in terms of speed, efficiency, and quality. Through this paper the researcher aims to bring to light the numerous lacunas in the current grievance redressal mechanism. Further an aim has also been made to understand the applicability of the online dispute resolution system and how it can help in improving the current grievance redressal system.

Keywords: Banks, Grievances, ODR, Redressal, Ombudsman

I. Introduction

A bank's customer is regarded essential. The Bank acts as a service provider for the client. According to the 1986 Consumer Protection Act, a service provider is liable to the consumer if it fails to provide appropriate service. As a result, the Consumer Protection Act has been expanded to include banks. While India's government has passed several regulations to protect consumers' interests when it comes to banks, the final answer for total contentment is reserved for consumer forums. Because several bank officials' blunders jeopardise customers' rights in today's technological age, the role of consumer forums is important. Every Indian person has a bank account, which increases the possibility of fraud. Consumer forums only express alarm about the banking authorities' flagrant incompetence. Additionally, the Banking Ombudsman Scheme, 2006, as amended in 2017, gives little comfort to consumers, undermining their belief in this route of redress and precipitating a accumulation of consumer cases alleging 'deficiency in service' and 'unfair trade practises' under Sections 2(1)(g) and 2(1)(r) of the Consumer Protection Act.

The capacity of a customer to express concerns and have them successfully resolved is critical to consumer protection¹. Along with protecting consumer interests, efficient grievance resolution may contribute to the development of trust between customers and suppliers². In this sense, grievance resolution has the potential to create or destroy consumer-provider relationships.

It is critical that consumer redressal is effective, i.e. accessible, inexpensive, just, and timely³. Regrettably, consumer redress in the

¹Chapman, M., & Mazer, R. (2013, December). *Making Recourse Work for Base-of-the-Pyramid Financial Consumers*. Retrieved from Consultative Group to Assist the

Poor: https://www.cgap.org/sites/default/files/researches/documents/Focus-Note-Making-Recourse-Work-for-Base-of-the-Pyramid-Financial-Consumer-Dec-2013_1.pdf

²Sahoo, M., & Sane, R. (2011, December). *A regulatory approach to financial product advice and distribution*. Retrieved from Indira Gandhi Institute of Development

Research: <http://www.igidr.ac.in/pdf/publication/WP-2011-029.pdf>

³Organisation for Economic Co-operation and Development. (2011, October). *G20 High-Level Principles on Financial Consumer Protection*. Retrieved from Organisation for Economic Co-operation and

Indian banking industry is now complex, inaccessible, and onerous. While ineffective grievance redress harms all customers, it disproportionately harms low-income consumers⁴. The researcher through this article aims to understand the current grievance redressal system of the country and also present the idea of how ODR can be used in order to improve the consumer grievance redress.

II. Research Questions

1. Whether there exist any lacunas within the current grievance redressal system of the banking sector?
2. Whether ODR can be referred to as one of the ways to improve the grievance redressal system?

III. Research Methodology

This research paper is non-doctrinal research which is formulated on the basis of secondary sources (journal articles, internet articles and research papers) and is in the form of an Applied Research. Various books, journal articles and research papers have been used by the researcher to develop a comprehensive understanding of the topic which aided in writing the article. The data is collected from online data base for law journals like Jstor, Scopus, ETC.

Citation of the research paper is done by referring to the Blue Book of Citation – 21st Editions.

IV. Literature Review

Although there has been a significant amount of work done in the subject of grievance redressal in the insurance sector, only a limited amount of study has been done in the field of bank grievance redressal, according to the review of existing studies. A number of studies have also revealed a relationship between quality of service and client satisfaction. Debasish (2009)⁵ conducted a comparative

examination of the quality of service in a selection of commercial banks in Delhi and found that public sector banks, which constitute of more than 3-quarters of the country's banking industry, have failed to sufficiently satisfy their clients. Uppal (2011)⁶ conducted an analysis of bank customer complaints and recommended many methods to decrease them. The study examined the extent to which complaints were lodged against three distinct kinds of bank groups: PSB's, Indian private sector banks, and international banks. He discovered that public sector banks receive the most complaints and that the majority of concerns are about deposit, credit cards, and housing loans, all of which have a negative impact on consumer satisfaction. Tandon (2012)⁷ investigated the telecom firms' complaint redressal mechanism and its link to customer satisfaction. He stated that customer satisfaction is critical for service sector marketers because, like service quality, it is widely acknowledged to be a significant predictor of consumers' future behavioural intentions.

Issues in the Banking system

1. Robotic response to grievances –

There was a time when bank branch managers were practically ubiquitous, developed personal relationships with clients, and nipped problems in the bud. With a few notable exceptions, they are frequently absent from work or so preoccupied with their objectives that the average consumer receives no quick attention to his or her plight. A spoken grievance is rarely taken into consideration, whereas a mail receives a reference number and a canned answer devoid of thought.

Likewise, in regard to concerns reported with banks' social media accounts like twitter handles and Facebook pages, the complaints are brushed aside as 'feedback' or 'concerns.' Numerous 24-hour helpline appear to be trained to just regurgitate complaint numbers

Development: <https://www.oecd.org/daf/fin/financial-markets/48892010.pdf>

⁴Cartwright, P. (2015). Understanding and Protecting Vulnerable Financial Consumers. *Journal of Consumer Policy*, 38, 119-138.

⁵ Debasish, S.S., (2009), A Comparative Analysis of Service Quality in Selected Commercial Banks in Delhi" *IJCRB*, 1(7) pp. 172

⁶Uppal R. K. (2011) "Customer Service in Banks: Mapping excellence in Emerging new Competitive Era" *Information Management and Business Review*, 2(5), pp. 193

⁷ Tandon, M.S., (2012) "Service Quality Analysis & Complaint Redressal System of the telecom sector", Ph. D. thesis, Punjabi University, Patiala

without recognising the underlying issue, which may wind up serving as an accidental treatment for low blood pressure! What might easily be resolved is allowed to fester. Customers lose patience, and their predicament deteriorates.

2. Managers of 'relationships' : Marketing resources disguised as trouble-shooters -

When clients, particularly those of private MNC banks, achieve the 'illustrious' status of being assigned a 'Relationship Manager,' they first feel a feeling of significance. The realistic expectation would be support in an emergency situation – such as barring a lost card, obtaining an urgent demand draught, or assisting with questions about the status of deposited checks. When clients really seek to contact these authorised officials in times of crisis or to address concerns, the bubble explodes with a loud crash. Contrary to their expectation that the Relationship Manager would have client numbers on fast dial, inquiries find that such representatives are allocated to hundreds of consumers! There is no such thing as uniqueness or a select few in a group. Banks cast a broad net in order to make consumers feel unique and to create a marketing channel that would not otherwise exist. The legal principle "you cannot do something indirectly that you cannot do directly" applies squarely to banks' fraudulent practise of attempting to sell credit cards, loans, and a host of other financial goods via a primarily marketing resource disguised as a grievance redressal method.

3. Cyber Crimes –

The twenty-first century has also been referred to as the internet era. This is because of the use of digital space has exploded across all industries. As soon as we begin to use the internet and cyber space, there is no way out since all of our data is kept indefinitely. The more digital space is used, the greater the threat to cyber security. As a result, cyber fraudsters have found electronic banking to be an easy and profitable target. Cyber assaults on the e-banking industry have risen significantly in recent years, owing to the fact that people's usage of online banking systems has only expanded in the last few years.

Several of them are as follows:

- a) **Unsanctioned Access to a Computer System or Networking Infrastructure:** It is referred to as hacking.
- b) **Theft of Electronically Stored Information:** This covers the theft of information stored on computer hard drives, removable storage devices, and the like.
- c) **E-mail Bombing:** E-mail bombing is the practise of sending a huge number of e-mails to a target, forcing the victim's email account or email servers to crash, therefore provoking the transaction to crash.
- d) **Data Diddling:** It is a type of attack which entails modifying unprocessed data shortly before it is processed by a computer and then reverting to its original state after the processing is complete. This is accomplished by inundating computer resources with more demands than they are capable of handling.
- e) **Virus/Worm:** Viruses are programmes that infect the computer or the file and then spread to other files and computers connected to a network. This often modifies or deletes data on a computer. Unlike viruses, worms do not require a host to survive.
- f) **Salami Attacks:** The goal here is to make the change minor enough that it will not catch the eye in the first instance; Eg, the employee of a bank puts a software into the bank's server that subtracts a little sum from each customer's account.
- g) **Physically Destructing a Computer System:** This offence entails physically destroying of a computer or any of its accessories.
- h) **Credit Card Theft:** The majority of frauds relating to credit card occur against retailers. When a person uses their credit card to purchase items online and the funds debited from their account are not credited to the merchants account for the purchase of the product. The digital thief steals it. If the consumer has evidence of his order and does not get it, the merchant will often compensate him to preserve the client's faith in the firm.

4. Nomination facility

While banks insist that they are not accountable for damages or losses to the contents of lockers since they do not keep an inventory of what is inside, the customers counter that the bank does maintain an inventory and would thus have to compensate the clients. Even if claimants present Death Certificates, Legal Heirship Certificates with evidence of name and residence, and a bank's legal protection under Sections 45 ZC to 45 ZF of the Banking Regulation Act, the bank needs an Indemnity Bond with a Surety.

The Indian banking regulator, the Reserve Bank of India (RBI), advised banks to use due diligence in determining whether or not locker contracts should be seen as similar to bailor/bailee arrangements rather than landlord/tenant contracts.

In *Canara Bank Vs Agnes D'Mello*⁸, the National Consumer Disputes Redressal Commission used Section 73 of the Contract Act in determining that the bank could not relieve itself of liability for locker contents loss. Excessive caution does not have to morph into an exacerbated kind of paranoia. In *Rama Chakravarty vs Manager, Punjab National Bank*⁹, the Calcutta High Court found that the Bank is not obligated to behave erratically or acquire a headache over the subject, but is expected to take a cooperative, rather than combative, approach toward its customers or their representatives.

Customer Grievance Redressal System

Background

In reaction to the Talwar Committee (1975) and the Goiporia Committee (1976), banks were obliged to create customer service committees at the branch level (1990). Nonetheless, this did not result in the anticipated improvement in customer service levels. The Banking Ombudsman Scheme (BOS) was created by the Reserve Bank of India (RBI) in 1995 to provide a process for resolving complaints against banks. Banks were then required to build internal mechanisms in line with BOS criteria. With the Scheme, the goal was to establish a method for

swiftly and inexpensively addressing consumer complaints. According to the requirements of the Banking Regulation Act of 1949 and the Customer Protection Act of 1986, it examined complaints and settled disputes. For each bank, a "Standing Committee on Customer Service" (SCCS) chaired by the Executive Director and composed of senior executives and well-known public personalities must be established and overseen. Additionally, the formation of a "Executive Committee on Customer Assistance" is needed in order to provide customer service to individuals while simultaneously overseeing the operation of the SCCS. Additionally, a Nodal Officer and other authorised authorities are necessary to be appointed in order to address grievances and complaints at the corporate headquarters. If a customer has a problem or complaint, he or she has sixty days to file it with the bank. If the bank does not reply adequately after thirty days of filing the complaint, the customer may contact the BO. Subsequently the Damodaran Committee (2010) assessed the present CGRS in banks, as well as the functioning of BOS, and recommended that banks select a "Internal Ombudsman" to address routine complaints effectively and without cost or time overruns. A two-tier system may best be defined as follows: an internal CGRS administered by the bank's internal machinery in line with BOS standards (Internal CGRS) and an external CGRS handled directly by the Banking Ombudsman (Banking Ombudsman-BO) (External CGRS).

Current Scenario

In today's banking environment, with a big variety of services and a broad client base, it is a given that there would be an increasing number of consumer grievances about bank services. An efficient bank is one that has an effective process in place for delivering good, and resolving client concerns. A well-functioning grievance redressal mechanism is critical in assisting managers and banks in increasing customer satisfaction. Customer happiness is critical to the success of any firm. Satisfied consumers are steadfast in their support of their service provider. The banking sector's whole scale of activity and revenue creation revolves around the client. Thus, it is

⁸I (2006) CPJ 8 NC

⁹AIR 1991 Cal 128

important to determine the banking industry's critical success criteria in terms of client satisfaction. Customer grievance redress is an effective technique for improving customer service. The term "grief" is the furthest thing from what any businessman wants to hear. Unresolved grievances result in uncontrollable discontent. Client grievances must be resolved in order to ensure customer retention and satisfaction. Banks are obligated to fulfil their obligations. Grievances arise when banks fail to offer services in a timely or proper manner. Customer satisfaction cannot be reached in the banking sector without an effective system for resolving dissatisfied customers' concerns.

V. Procedure

A complaint might be made in writing or through an e-mail by attaching the form available on the RBI website. Typically, a bank resolves a client issue at the counter level. Trained personnel should resolve the customer's question by describing it in the simplest feasible terms in the regional language. If the issue is not resolved at the counter level, it is forwarded to the manager for resolution. If adequate counselling is insufficient, a management refers the complainant to a Senior Official. If a client is dissatisfied, he or she may send a complaint to the circle officer, requesting a resolution to the issue. In the case of a circle, if the officer is unable to resolve the issue, it is sent to Main Branch Officials. Customers may submit a written complaint to the Banking Ombudsman to accelerate the process. The written complaint should mention clearly the name and the address of the complainant along with that of the branch against which the complaint is being made. It should contain the facts causing the complaint, nature and extent of the loss along with the supporting documents.

Grounds of complaint

1) Complaints about deficiencies in any of the banking services, such as non-payment or late payment of checks, draughts, or invoices, etc.

- Without giving a justification, small value notes are not accepted, and a commission is charged in their place.
- Failure to give drafts to consumers

- Failure of branches to adhere to authorised operating hours
- Non-performance of a guarantee or letter of credit
- Claims involving unauthorised withdrawals or unauthorised encashment of a check or a bank draft
- Complaints regarding any of the accounts including delays or non-credit of revenues to the parties' accounts
- Complaints alleging non-adherence to RBI directives governing interest rates on deposits or other instructions
- Exporters' complaints about delays in receiving export revenues, the processing of export bills, and the collection of bills.
- Complaints from non-resident Indians (NRIs) about remittances from outside
- Complaints about banks' reluctance to create deposit accounts without any legitimate reason

2) Loans & Advances Complaints

- Non-compliance with RBI's interest rate directions
- Delays in loan application approval or payout
- Denying of loan application, without a legitimate cause.
- Failure to follow any of the RBI's directives.

Lacunas

1. Consumers must adhere to extremely technical and onerous processes in redress forums. All complaints to the Ombudsmen must be made in writing. In 2018-19, the BO rejected an astounding 32% of complaints due to improper representation or inability to give comprehensive information in the complaint¹⁰. Consumers must prove their complaint with pertinent documented proof. This may be particularly challenging in financial transactions, which are frequently opaque and in which customers face a lack of

¹⁰Reserve Bank of India. (2019, January 31). *FAQs-The Ombudsman Scheme for Digital Transactions, 2019*. Retrieved from Reserve Bank of India: <https://m.rbi.org.in/commonperson/English/Scripts/FAQs.aspx?Id=2844>

information¹¹. Similar concerns restrict consumers' access to meaningful recourse through consumer dispute resolution venues.

2. High rejection rates: Complaints filed with redress forums are frequently rejected due to consumers failing to adhere to jurisdictional and procedural standards. Redress forums have the authority to reject complaints on a variety of grounds, including lack of geographical jurisdiction and failure to submit the issue to the FSP first. For example, more than half of all complaints filed with the BO in 2018-19 were denied on such technical reasons^{12,13}.
3. Slow redress: Disputes before redress forums typically take a long time to resolve (TAT). Additionally, the grievance redressal procedure may be too lengthy for customers. The Digital Transactions Ombudsman considers only complaints that have been denied or handled incorrectly by the FSP. Consumers, on the other hand, may have to wait up to one month for a response from the FSP¹⁴. Such lengthy TATs might function as impediments to meaningful remedy¹⁵.
4. High pendency rates: Redress forums such as the Civil Courts, consumer forums, and Ombudsmen appear to be hampered by high pendency rates. At the conclusion of the financial year 2018-19, the BO had received close to 12,069 complaints.
5. Ombudsmen have a limited geographical reach and capacity: The Ombudsmen's

offices are mostly situated in metropolitan and urban regions around the nation. For example, India currently has just four NBFC Ombudsman offices to service all NBFC clients¹⁶. The Office of the Ombudsman for Digital Transactions is located exclusively in urban regions. This limits customers' access to dispute resolution venues. For example, just 11.67 percent of complaints received by the BO in fiscal year 2018-19 came from rural areas.

Comparative Study between India and Australia

An independent grievance redress function that banking services consumers can access in the event that their grievances are not resolved satisfactorily through banking services providers' in-built grievance redress processes is a critical component of the larger customer protection frameworks in place in India (even though it is limited to being ex post in nature). External grievance resolution mechanisms such as this one play a critical role in market behaviour oversight. The redress function has the ability to perform two critical functions: Firm misbehaviour puts costs on society and can erode the confidence of the public within the banking system. This might contribute to a withdrawal of banking services consumers from the formal system. A robust and expeditious redress system will significantly alleviate this issue.

The study of complaints received through the redress process, in particular their influence on institutional and systemic stability, may provide guidance for future regulation/regulatory action on micro-prudential and market behaviour issues.

¹¹Consiglio, J. A. (2020). *Insights on Financial Services Regulation*. Emerald Publishing Limited

¹²Reserve Bank of India. (2019, December 17). *Annual Report of the Banking Ombudsman Scheme and Ombudsman Scheme for Non-Banking Financial Companies for the year 2018-19*.

¹³Borate, N. (2019, December 23). *Did banking ombudsman reject your complaint?* Retrieved from Livemint: <https://www.livemint.com/money/personal-finance/did-banking-ombudsman-reject-your-complaint-11577092475746.html>

¹⁴Reserve Bank of India. (2019, January 31). *FAQs-The Ombudsman Scheme for Digital Transactions, 2019*. Retrieved from Reserve Bank of India: <https://m.rbi.org.in/commonperson/English/Scripts/FAQs.aspx?Id=2844>

¹⁵Cartwright, P. (2015). Understanding and Protecting Vulnerable Financial Consumers. *Journal of Consumer Policy*, 38, 119-138

¹⁶Reserve Bank of India. (2017, July 14). *FAQ on the Banking Ombudsman Scheme, 2006*. Retrieved from Reserve Bank of India: <https://m.rbi.org.in/Scripts/FAQView.aspx?Id=24#:~:text=The%20Banking%20Ombudsman%20Scheme%20is,RBI%20with%20effect%20from%201995>

	Financial Ombudsman Service, Australia	RBI Banking Ombudsman
Complaint submission channel	Online lodging, toll-free calling lines, E-mail, letter, fax and in person	Offices are distributed around India in 18 places, including online lodgings
Disputes classification	A dispute is usually categorised according to several criteria, like - complexity of the dispute, the demographic makeup of the parties, the type of the banking service being provided, and so on.	Disputes can be characterised by many aspects, including the type of goods involved, the characteristics of the parties involved, the legal standing of the parties, and the FSP to which the issue has been brought.
'mis-selling' captured as a separate category	Inappropriately giving a customer personalised counsel is considered a type of mis-selling, although disagreements over this are classed under more explicit categories such as: non-action in the client's best interests, unsuitable guidance, and incorrect advice.	There is no such category. Despite that, the Section on "Mis-selling of Third Party Products (Insurance and Pension)" was included in the Annual Report 2015-16.
Complaint satisfaction levels	Indeed, every year, FOS conducts a satisfaction survey to find out how satisfied the complainants are.	The lack of a systematic approach to finding out whether the complainants are satisfied, prevents surveys from giving reliable information. To see if there was any identifiable cause for the rise in complaints, a sample poll was performed in the New Delhi region last year. Complainant satisfaction with the Ombudsman was also included in this study.
Authority to whom an appeal can be made -	The courts of Australia are the appellate authority.	The deputy governor in charge who is administering the BOS is the appointed appellate authority
Classifications based upon urgency	The complaints are divided into the different categories. These categories would include standard, fast track and complex.	No such classifications are made

Online Dispute Resolution System

ODR has been defined as a technique that utilises information and communication technology (ICT) to offer redress¹⁷. Initially, ODR was used to conduct conciliation, mediation, negotiation, and arbitration processes (together referred to as "Alternative Dispute Resolution" (ADR)) by electronic means. Outside of the regular court system,

ADR processes assist parties in resolving conflicts peacefully and promptly. Disagreeing parties employ impartial mediators (neutrals) to assist them in resolving their differences via the processes. In conciliation, mediation, and negotiation processes, neutrals assist parties in reaching mutually agreed settlements, and act as adjudicators in arbitration proceedings when parties are unable to reach an agreement¹⁸.

¹⁷UNCITRAL. (2017, May). *UNCITRAL Technical Notes on Online Dispute Resolution*. Retrieved from https://www.uncitral.org/pdf/english/texts/odr/V1700382_English_Technical_Notes_on_ODR.pdf

¹⁸Sharma, L. (2021, February 7). *Evolution of ADR Mechanisms in India*. Retrieved from SCC Online: <https://www.sconline.com/blog/post/2021/02/07/evolution-of-adr-mechanisms-in-india/>

Through e-mail or teleconferencing, parties utilising ODR systems can resolve conflicts peacefully and remotely.

Today, ODR mechanisms are utilised as end-to-end redress solutions, assisting parties throughout the dispute's lifecycle with complaint filing, process and documentation, dispute pre-settlement and settlement, case management, and escalation. Additionally, ODR is utilised to analyse customer grievances in order to influence future redress mechanisms and consumer protection policies. Additionally, instances of increased automation are emerging as a result of the use of artificial intelligence (AI) technology for a variety of reasons, including the retrieval of evidence and the negotiation of settlements in the course of settling disputes^{19,20}.

Consumers can receive end-to-end help from ODR systems, from the time they file a complaint until the time their issue is resolved completely. ODR systems have been demonstrated to help both customers and providers in the following ways:

- facilitating access to redress procedures through a number of methods;
- establishing alternative and independent reparation venues outside of the established redress system;
- minimising the amount of time required to settle disputes;
- enhancing the process of redress's openness, and
- establishing feedback loops with consumers that might give knowledge at the grass-roots level to guide policy²¹

Similar advantages might accrue to financial sector customers and suppliers if ODR systems

are used in conjunction with the existing redress mechanism.

The Reserve Bank of India (RBI) has stated its aim to establish an integrated redress mechanism for banking and payment-related issues dubbed the Integrated Ombudsman²². The Integrated Ombudsman would be comprised of the Banking Ombudsman, the NBFC Ombudsman, and the Digital Transactions Ombudsman. The RBI intends to accomplish this by -

- (i) expanding the redress system to include a broader range of entities and grounds for complaint
- (ii) establishing a centralised complaint receipt and processing centre
- (iii) reducing the time required to resolve complaints
- (iv) delegating authority to provide redress for specific types of complaints.

The Ombudsman has the potential to significantly improve the availability and quality of redress for consumers. ODR has the potential to be a critical component in operationalizing the Ombudsman and facilitating reparation.

ODR systems can accomplish four main purposes, in addition to a number of other tasks, to assist customers with redress.

- ODR may assist customers in the initial step of their redress journey (searching for and finding redress channels) by providing consultation and hand-holding services to help them understand the restitution system. For example, it appears as though the Chinese Online Dispute Diversification Resolution Platform and the Canadian Civil Resolution Tribunal offer complainants with the necessary legal information to proceed with their case. Additionally, ODR can enable several routes for customers to register concerns, even at the last-mile.
- In the second stage (filing a complaint), ODR can assist customers in simplifying the process of submitting complaints by obtaining evidence and supporting

¹⁹NITI Aayog Expert Committee on ODR. (2020, October). *Designing the Future of Dispute Resolution: The ODR Policy Plan for India*. Retrieved from NITI Aayog: <https://niti.gov.in/sites/default/files/2020-10/Draft-ODR-Report-NITI-Aayog-Committee.pdf>

²⁰Narain, R., & Parsheera, S. (2021, April 14). *Online dispute resolution in India: Looking beyond the window of opportunity*. Retrieved from The Leap Blog: <https://blog.theleapjournal.org/2021/04/online-dispute-resolution-in-india.html>

²¹Schmidt-Kessen, M. J., Nogueira, R., & Cantero, M. (2019, April 18). *Success or Failure? – Effectiveness of Consumer ODR Platforms in Brazil and in the EU*. Retrieved from SSRN: <https://bit.ly/3xjTSHs>

²²Reserve Bank of India. (2020, August 6). *Online Dispute Resolution (ODR) System for Digital Payments*. Retrieved from Reserve Bank of India: https://m.rbi.org.in/Scripts/BS_CircularIndexDisplay.aspx?Id=11946

documents. The RBI accomplished this by requiring payment system operators to create ODR systems capable of retrieving required information about a complaint instantly and without imposing any cost on customers (Reserve Bank of India, 2020).

- ODR can assist in the third step (Processing by the forum) by streamlining communication and enhancing transparency throughout the redress process. For example, the NPCI's UPI-Help programme offers customers with proactive updates on their concerns²³.
- In the fourth step (Obtaining redress and escalating grievances), ODR can assist in gradually escalating grievances, beginning with pre-settlement and concluding with adjudication, in order to address complaints promptly. For example, the New Zealand Banking Ombudsman appears to utilise telephone pre-settlement to attempt amicable resolution of complaints prior to advancing them to the mediation stage²⁴. Additionally, automating settlements (such as Cybersettle) might assist customers in settling disputes without the need for formal legal counsel. By connecting restitution forums and giving customers with a unified front-end, ODR can assist streamline the redress process.

Together, these changes may make it easier for consumers to traverse the redress system and alleviate some of the substantial barriers they presently encounter.

VI. Conclusion

Consumers should not be required to traverse a complicated banking industry and difficult redress procedures in order to get remedy. Access to redress should be as simple as purchasing a product or service from the

supplier. Points should be taken from the system that is being followed in Australia. Within the country there are numerous ways within which the complaint can be submitted. Further client satisfaction is one of the most important things. Within Australia a survey is conducted on yearly basis in order to find out the customer satisfaction level, which is missing in India. With the use of ODR, the RBI's Integrated Ombudsman for banking and payment-related issues may significantly enhance the efficacy of consumer redress. However, the efficiency of an all digital-based ODR arrangement may be limited in the Indian context. The most glaring constraint is the stark disparity between customers' access to and capacity to use digital services.

²³NPCI. (2021, March 15). *UPI-Help for Digital Payments goes live on BHIM UPI*. Retrieved from NPCI: <https://www.npci.org.in/PDF/npci/press-releases/2021/NPCI-Press-Release-Online-Dispute-Resolution-for-Digital-Payments-goes.pdf>

²⁴Gill, C., Williams, J., Brennan, C., & Hirst, C. (2014, October 31). *Models of Alternative Dispute Resolution: A report for the Legal Ombudsman*. Retrieved from Virtual Mediation Lab: <https://www.virtualmediationlab.com/wp-content/uploads/2014/12/ombudsman.pdf>

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ANALYSIS ON THE LEVEL OF JOB SATISFACTION AMONG NURSES IN PRIVATE AND GOVERNMENT HOSPITALS

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ABSTRACT

Purpose: The study examines the level of job satisfaction among working nurses in private and government hospitals in Noida District of Uttar Pradesh, India. The study also compared the level of job satisfaction among nurses working in private and public hospitals.

Methodology: The survey was conducted among the nurses working in private and government hospitals in the Noida District of Uttar Pradesh. The selected variables for the research are monetary and non-monetary benefits in the form of salary, responsibilities, relation with colleagues, reward, rules, and regulations to get the measure of the level of job satisfaction, using a Five-Point Likert Scale. A total of 200 working nurses has been selected from private and government hospitals were included in the sample by using purposive sampling for this study. The Chi-Square test is used to assess the level of job satisfaction among nurses. One-Way ANOVA is used to investigate the difference between the level of job satisfaction.

Limitations: It was difficult to get the questionnaire filled by the nurses due to their hectic schedules. The nurses were not ready to fill it at once, the researcher visited the hospital, again and again, to get it filled. The results of the study cannot be generalized to the other areas of the country because this study is only restricted to the Noida District of Uttar Pradesh.

Findings: The study reveals that there is a significant impact of monetary and non-monetary benefits in the form of salary, responsibilities, relationship with colleagues, rewards, rules, and regulations on the level of job satisfaction for nurses of private as well as government hospitals. In addition, the researchers found that there is no significant difference between the job satisfaction among nurses of Private and Government Hospitals.

Contribution: The study will assist the administration of private and government hospitals in framing policies for the nurses working there. Also, in understanding the factors by which job satisfaction can be increased. This investigation makes a substantial contribution to the existing literature on the topic of working nurses' job satisfaction in private and government hospitals.

Keywords: Job Satisfaction, Nurses, Private and Government Hospitals, Monetary Benefits, Non-Monetary Benefits

I. Introduction

An organization's success depends on the satisfaction of its employees. While a job is a set of roles that have essentially the same duties, responsibilities, skills, and knowledge, job satisfaction is the result of a person being assigned a set of tasks and responsibilities, and the sense of accomplishment that comes with the performance of these activities. Kalisch *et al.*, (2010) results of this study suggest that within nurse teams on acute care patient units, a better level of cooperation and perceptions of adequate staffing leads to greater job satisfaction with their present position and occupation. Laranjeira, C. A. (2011) As a result

of organizational changes and current globalization processes, exposure to psychological elements in the professional realm has become more regular and intensive. When these are detrimental to the development of professional activity and the individual's quality of life, they result in increased stress for the professional. Portero de la Cruz, S., & Vaquero Abellán, M. (2015) Over the most recent twenty years, there has been a developing worry about the impacts of weight on the nursing professionals, which address the most various gathering of wellbeing experts who convey care to patients 24 hours each day. As per the Word related Wellbeing also,

Wellbeing Review of the American Medical caretakers Affiliation, the primary worry for the nursing staff concerning wellbeing and security in the workplace is the intense or ongoing impact of stress. The work conditions in nursing infer the openness to torment and demise, relational conflicts, absence of self-rule and expert for dynamic, and the absence of a definition of the expert job, which produce a condition of ongoing stress. The individual reaction to these circumstances can be mental, including side effects like uneasiness, bothering and sorrow, or psychosomatic, including cerebral pains, sickness, and rest issues, with conceivable adverse consequences for patient wellbeing and the quality of care. The experts report average stress and job satisfaction. Emotional weariness is likewise average, but depersonalization is high and personal accomplishment is low. Professional burnout dimensions are associated with the following factors: the level of global work-related stress, having trainees under one's supervision, living with relatives, and the mean global satisfaction level. Supervising trainees and age are the variables associated with stress and job satisfaction levels, respectively. Finally, training in self-control and stress management strategies is regarded as critical for increasing optimism and self-esteem.

II. Literature Review

Selebi, C., & Minnar, A. (2007) job satisfaction survey was conducted among nurses working at a public hospital in South Africa, using the Minnesota satisfaction questionnaire. They discovered that nurses were dissatisfied with components of their job such as responsibility, opportunities for creativity and innovation, decision making, and acknowledgment. Nurses were also dissatisfied with the hygienic aspects of their jobs, specifically the interaction in the workplace, supervisors' decision-making ability, supervision, working conditions, policies, job security, and remuneration and perquisites. As a result, hospital administration must reconsider their nurses' remuneration, supervisory methods and relationships, and the implementation of their health programs. Hamid *et al.*, (2014) There was a considerable difference in satisfaction levels between nurses

working in the commercial and public sectors. They discovered that nurses in government hospitals in Pakistan were more satisfied with their jobs than their counterparts in private hospitals, owing to factors such as salary and working circumstances. Gupta *et al.*, (2014) sought to analyze nursing staff job satisfaction in both private and government hospitals, because of their working conditions and pay, they determined that nursing personnel in government hospitals were more satisfied than those in private hospitals.

III. Job Satisfaction

It focuses on employees' satisfaction with promotions, contingent incentives, and the quality of their jobs, as well as their working conditions, fringe benefits, supervisors, coworkers, contact, motivating factors, and compensation. An individual is satisfied when he or she feels that the needs, wants, hopes, and goals are getting fulfilled. Garcia *et al.*, (2013) Supervisor support is a compilation of employees' feelings and ideas regarding their current job. An employee's level of job satisfaction might range from extremely satisfied to extremely dissatisfied. In addition to having an attitude toward his profession as a whole, an employee can have an attitude toward certain components of his employment, such as the type of work to be done, his interactions with coworkers and supervisors, and the compensation and benefits.

IV. Research Gap

Although much research has been undertaken on the subject in the past, only a few have examined the impact of job satisfaction on working for nursing staff in private and government hospitals. However, none of the studies compare the level of job satisfaction of nursing personnel working in private and government hospitals. This research study is an attempt to assess the level of job satisfaction among the nurses of private and government hospitals. And also analyze the difference between the level of job satisfaction.

V. Research Objective

1. To analyze the impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

2. To analyze the impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.
3. To investigate the difference between the job satisfaction among nurses of private and government hospitals.

VI. Research Methodology

A quantitative method has been used to analyze this study, the researchers prepared a questionnaire and distributed it to working nurses staff of Private and Government Hospitals of the Noida District of Uttar Pradesh. The questionnaire consisted of two sections based on age group, and the selected variables of monetary and non-monetary benefits viz salary, responsibilities, relationship with colleagues, reward, rules, and regulations. The survey was conducted at Private and Government Hospitals of the Noida District of Uttar Pradesh. Nurses filled the survey form. The data was collected on Five Point Likert Scale and Chi-Square test Hypothesis testing is used to interpret the data using SPSS as the statistical analysis tool while descriptive statistics were calculated and used in the interpretation of findings. The ANOVA One Factor is used to investigate the difference between the level of job satisfaction among nurses of Private and Government Hospitals. All the testing was performed using SPSS. The population of this study is approximately 200 working Nurses. Data for this study was collected through a Multi-Factor Questionnaire (MFQ) distributed to the nurses working in the Selected Private and Government Hospitals. The Responses were taken on the Five Point Likert Scale for data analysis and interpretation. The collected data were analyzed using the Chi-Square test Hypothesis to investigate the job satisfaction among nurses working in Private and Government Hospitals of Noida District of Uttar Pradesh.

VII. Hypothesis For The Study

Statement 1: To analyze the impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

H_0 = There is no significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

H_1 = There is a significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

Statement 2: To analyze the impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

H_0 = There is no significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

H_1 = There is a significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

Statement 3: To investigate the difference between the job satisfaction among nurses of private and government hospitals.

H_0 = There is no significant difference between the job satisfaction among nurses of private and government hospitals.

H_1 = There is a significant difference between the job satisfaction among nurses of private and government hospitals.

VIII. Data Analysis

Table 1: Distribution of respondents based on age.

Age Group	Nursing Staff(%)
18 – 23 Years	20
24 – 29 Years	31
30 – Above	49

Table 2: Responses of Statements from the respondents of private and government hospitals on the Five Point Likert Scale.

S No.	Responses to the statement	SA (%)		A (%)		N (%)		D (%)		SD (%)	
		P	G	P	G	P	G	P	G	P	G
	Hospitals										
1	I feel I am being paid a fair amount for the work I do.	13	11	27	27	15	15	25	22	20	25
2	I am satisfied with the monetary benefits I receive.	21	31	27	12	3	7	24	28	25	22
3	I am satisfied with the non-monetary benefits.	20	21	31	33	4	18	37	9	8	19
4	My efforts are appreciated the way they should be.	29	20	16	22	31	15	5	14	19	29
5	My seniors always help me.	24	26	32	13	10	18	16	33	18	10
6	I have too much responsibility.	32	37	40	21	1	2	18	27	9	13
7	I have too much work pressure.	24	16	41	36	9	8	10	25	16	15
8	I am comfortable working with my colleagues.	33	17	37	29	11	21	7	26	12	7
9	I feel satisfied with the increment policy of the hospital.	27	22	29	30	13	3	18	19	13	26
10	The behavior of doctors is good in my hospital.	35	24	23	12	9	2	18	28	15	34
11	Many rules and regulations in my hospital make my job difficult.	26	29	13	16	18	31	33	5	10	19
12	There is plenty of opportunity for nursing staff in the administrative tasks and decision-making.	37	14	21	32	2	20	27	16	13	18
13	My hospital has a good grievance handling system.	23	17	29	15	8	14	25	21	15	33
14	I am satisfied with the leave policy of my hospital.	27	9	8	16	29	33	24	20	12	22

Abbreviations: P- Private Hospitals, G- Government Hospitals, SA- Strongly Agree, A- Agree, N- Neutral, D- Disagree, SD- Strongly Disagree.

Table 3: Findings Goodness of fit Chi-Square Test:

For Government Hospitals	
Mean	301.78
Degree of Freedom	13
Chi-Square Statistic Value	29.5495
Chi-Square Tabulated Value Significance Level 5%	22.36

For Private Hospitals	
Mean	329.92
Degree of Freedom	13
Chi-Square Statistic Value	23.711
Chi-Square Tabulated Value Significance Level 5%	22.36

ANOVA One Factor

ANOVA: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
277	13	3948	303.6923	665.8974		
288	13	4331	333.1538	489.3077		
ANOVA						

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	5641.885	1	5641.885	9.767762	0.004599	4.259677
Within Groups	13862.46	24	577.6026			
Total	19504.35	25				

Data Interpretation:

Chi-Square Tabulated Value at 5% Level of Significance with Degree of Freedom 13 is 22.36.

Chi-Square Calculated value for nursing staff working in Government hospitals is 29.54.

Chi-Square Calculated value for Private nursing staff is 23.71.

For Government Hospitals:

Chi-Square Calculated value > Chi-Square Tabulated value i.e. $29.54 > 22.36$

For Private Hospitals:

Chi-Square Calculated value > Chi-Square Tabulated value i.e. $23.71 > 22.36$

ANOVA One Factor Analysis between nurses of private and government hospitals of Noida District of Uttar Pradesh.

F Value > F Critical value $9.76 > 4.25$

Hence,

Statement 1: To analyze the impact of monetary and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

H₀ = Rejected, There is no significant impact of monetary and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

H₁ = Accepted, There is a significant impact of monetary and non-monetary benefits on the level of job satisfaction among nurses of private hospitals.

Statement 2: To analyze the impact of monetary and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

H₀ = Rejected, There is no significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

H₁ = Accepted, There is a significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals.

For Statement 3: To investigate the difference between the job satisfaction among nurses of Private and Government Hospitals.

H₀ = Rejected, There is no significant difference between the job satisfaction among nurses of Private and Government Hospitals.

H₁ = Accepted, There is a significant difference between the job satisfaction among nurses of Private and Government Hospitals.

IX. Results

The result of this research study is that there is a significant impact of monetary and non-monetary benefits on the level of job satisfaction among nurses of private hospitals. There is a significant impact of monetary benefits and non-monetary benefits on the level of job satisfaction among nurses of government hospitals. There is no significant difference between the job satisfaction among nurses of Private and Government Hospitals.

X. Findings & Conclusion

In the context of monetary benefits and non-monetary benefits of the private hospital nurses, the results presented that $23.71 > 22.36$, which shows a significant impact on the level of job satisfaction. Whereas in the case of nurses working in government hospitals $29.54 > 22.36$, which depicts a significant impact on the level of job satisfaction. In the comparison of both, the nurses of government hospitals are more satisfied as compared to the nurses working in private hospitals. Based on ANOVA One-Factor Analysis, the F calculated value is 9.767762, and the F-critical value is 4.259677 (tabulated value). The probability of obtaining results at least as extreme as the observed results of a statistical hypothesis test is 0.004599. The results of ANOVA One-factor analysis show that there is a significant difference between the level of job satisfaction of private hospital nurses and nurses working in government hospitals.

XI. Limitations & Future Scope of the Study

The main limitation of the study is that it uses the subjects themselves, that is, nurses, as respondents for understanding the level of job satisfaction. It would perhaps have been more pertinent to elicit the responses from others

employees like doctors, patients, employers, and other staff members of the hospitals. Another limitation of the study is the findings of the research study are based on the responses given by the nurses of Noida District. The results of the study cannot be generalized for the other areas of the country.

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TRIPLE TALAAQ & NIKAAH HALALA – THEIR RELEVANCE IN MODERN TIMES**Momina Zahan**Faculty of Law, JBSLS, Banasthali Vidyapith, Rajasthan, India
E-mail: zahan.momina06@gmail.com**ABSTRACT**

Talaaq or Divorce, even though recognised in Islam, is considered to be worst among all permitted things. One of the forms and controversial one is the triple talaaq or talaaq-e-biddat. It is a form of instant divorce availed by Muslim husbands by pronouncing 'talaaq' thrice in one sitting and it is irrevocable one. In case, the husband wants to re-marry his wife, then the wife has to undergo nikaah halala. Triple talaaq and nikaah halala are two evils prevalent in Islamic society and there are lots of controversies surrounding it. Even the Quran does not recognize the concept of triple talaaq and it is an alien concept. Whatever may be the reason behind such practices, it violates the basic human right of a woman and questions the dignity and integrity of a woman. Realizing this as human right violation, the Parliament has criminalized 'triple talaaq' following the judicial decision of Shayra Bano's case but to some Muslims, it is an unexpected interference in the personal laws and fundamental right to freedom of religion. Thus, the author aims to investigate through this paper, the reality behind the prevalence of such evils in Islam and if the changes can be implemented amongst Muslims.

Keywords: Halala Nikaah, Human Rights, Islam, Triple Talaaq, etc

Triple Talaaq and Nikah Halala – Human Rights Violation:

Talaaq or Divorce, even though recognised in Islam, is considered to be 'worst among all permitted things'²⁵ indicating the practical outlook on all human affairs. One of the forms and controversial one is the triple talaaq or talaaq-e-biddat. It is a form of instant divorce availed by Muslim husbands by pronouncing 'talaaq' thrice in a single sitting and it is irrevocable one. Because of its irrevocable nature, the divorced wife becomes unlawful for the husband to remarry. And in case, the husband wants to re-marry his wife, then the wife must undergo a practice called nikaah halala in which the wife has to marry another man, consummate the marriage and then if the second husband divorces her, she can re-marry her first divorced husband. Triple talaaq and halala nikaah are two evils prevalent in Islamic society in India and there are lots of controversies surrounding them. Even the Quran does not recognize the concept of triple talaaq or instant talaaq and it is an alien concept as it violates the basic human right of women and questions the dignity and integrity of a woman. The right of divorce and remarriage, which was guaranteed equally to both male and

female, were being used as a tool of patriarchy against the women to dehumanize her. In most cases, it has been observed that the news of talaaq came through sms, whatsapp message, skype and postal letter along with the mehr amount and such a practice is definitely against dignity of women and the concept of gender justice.²⁶ It is the wrath of man that takes the form of triple talaaq which releases her from his bondage without her wish and she is declared as haram for erstwhile husband. Realizing this as human right violation, the Indian Judiciary has held that 'the practice of triple talaaq as inconsistent with the right to equality under Article 14 of the Constitution of India, as such practice granted unilateral and arbitrary power to men to divorce Muslim women'²⁷. This practice is against the basic human rights of women only when it is practised without any reconciliation as mandated by the Islamic jurisprudence as there is no consultation done with the women before the finalization of the talaaq or divorce. And this difference in

²⁶Triple Talaaq: India Criminalises Muslim 'instant divorce' (2019). BBC News India, (30th July). Date of Access: 03/01/2020. <https://www.bbc.com/news/world-asia-india-49160818>

²⁷Justice R. F. Nariman and U. U. Lalit held in *Shayara Bano v. Union of India & Ors.* (2016). See Ashiya, Bhagirath, (2017), Triple Talaaq and Women's Rights in the Indian Supreme Court, Oxford Human Rights Hub, 13th October. Date of Access: 30/10/2019 <https://ohrh.law.ox.ac.uk/triple-talaaq-and-womens-rights-in-the-indian-supreme-court/>

²⁵Hadeeth – this was said by Prophet Mohammad (PBUH), as narrated by Al-Shaykh Ibn Uthaymeen (May Allah have mercy of him)

behavior by men towards women is also discriminatory as compared to Convention on Elimination of All Forms of Discrimination Against Women. However, some Muslims feel that banning of triple talaq is a judicial interference in the personal laws and fundamental right to freedom of religion.²⁸ There was hue and cry among the so called orthodox conservatists and the Muslim Personal Law Board. They criticized the women's rights activists, the judiciary and the government for bringing out the law for the protection of the Muslim women on the ground that it is the state's interference with personal law. The census of 2011 shows that out of 14.23% of Indian Muslim population, almost 0.33% Muslim population are divorced and out of that, 15% are males and 49% are females.²⁹ The difference in the rate of divorce in men and women indicates that men generally get remarried while women do not marry again. Thus, the author aims to investigate through this paper, the reality behind the prevalence of such evils in Islam and the reasons as to why people oppose from doing away with such heinous practice. The author will first see what the *Quran* says regarding such practices with aim to investigate if the domination of women has its origin in the religious scripture itself. The second part will see why and how these practices came into existence if the Quran has not permitted it and how the Indian Judiciary has interpreted these practices from time to time. Lastly, the author will try to investigate those jurisdictions which have banned such evil practices and how the people there reacted to such changes and finally conclude the paper with necessary conclusion. However, the author will not look into the types and kinds of divorce in Islamic law as it does not seem to be necessary for the understanding of the main concept. The paper will be based on primary

source, *i.e.* *Quran* along with some secondary sources *i.e.* available literature.

What Quran Says About Talaq and Nikaah Halala:

The Holy Quran is the source of all laws and regulation that regulate the life of a Muslim. Therefore, in case of any doubts, it is always the holy Quran that is referred to seek its answer. Islam, as a religion, has conferred many rights upon women through the verses of the holy Quran in the matters of *nikaah*, *talaq*, inheritance of property, custody of children, *etc.* when women were treated no more than a chattel or property. Marriage in Islam was made contract-like and the bride was given the right to accept or reject the proposal of marriage. In Islam, although marital relationship is seen as a social contract, it has to be respected mutually and has to be continued till the time both parties can continue without hardship. Once they feel, there is irretrievable breakdown of the relationship and there is no scope or future for that relation to continue without bitterness, they are allowed to divorce each other. Not only man but the woman in Islam is empowered with a delegated right to divorce (*i.e.* *talaq-e-tafwid*), whereby the woman can divorce herself on behalf of her husband. Also, there is the right of *khul'a*, granted to Muslim women whereby she can take divorce with consent from her husband at the instance of the wife and she agrees to pay some consideration for her freedom from the marital tie. The concept of *khul'a* was based on the injunction provided in the Quran which means that 'those who feel/fear that they cannot maintain the limits provided by Allah and perform their marital duties sincerely, must free his wife. As a sign of gratitude, if the wife gives something to her husband for her freedom, the husband can take it as consideration and it is permitted by the verses of *Quran*³⁰.

Although the holy scripture permits either party to divorce in case of necessity, yet the

²⁸Krishna, Murali (2019). Triple talaq: Instant divorce ban draws mixed reactions in India. DW-Made for minds. 31st July 2019. Date of Access: 29/12/2019.

<https://www.dw.com/en/triple-talaq-instant-divorce-ban-draws-mixed-reactions-in-india/a-49830803>

²⁹Taken from Census 2011 – C-3 Marital Status by Religious Community and Sex – 2011. See Divorced Hindu Couple (2016) ummid.com (20th October) Date of Access; 29th Dec 2019.

<https://www.ummid.com/news/2016/October/20.10.2016/divorce-rate-among-hindus-and-muslims-in-india.html>

³⁰ Holy Quran, Verse 229 of Surah Al Baqarah. It states that "If ye [judges] do indeed fear that they would be unable to keep the limits ordained by Allah, there is no blame on either of them if she gives something for her freedom. These are the limits ordained by Allah so do not transgress them; if any do transgress the limits ordained by Allah, such persons wrong [themselves as well as others]"

primary source of Muslim law does not speak anything about the single irrevocable *talaq*, rather it mandates Muslim men and women to value the relationship of marriage. Accordingly, the Quran provides an elaborate and clear procedure for men to divorce women in *Surah Al-Baqarah* and *Al-Talaq*. *Surah Al-Baqarah* provides that “a divorce is only permissible twice which can be revoked and after the second pronouncement, the parties should either try to reconcile back on equitable terms, and in case, they feel that they cannot continue together, they may separate from each other with gentleness. Regarding the gifts bestowed during the relationship, the Quran provides that it is not lawful for the husband to take back any of the gifts from the wives, unless when both the parties feel that they would be unable to keep the limits designed by the Almighty”³¹. Through *Al-Talaq*, the Quran states that anyone who divorces woman must do so in the prescribed periods, *i.e.* period of *tuhr* or period of purity. It further states that the women should not be sent out of the husband’s house unless they are guilty of some open grumpy behaviour.³² It further states that “if both the husband and wife fulfil their necessary terms and conditions, they should either reconcile and stay together on equitable terms and if they feel there is no scope of togetherness, they must part on equitable terms. The Quran mandates that whole of this process must take place in the presence of two

witnesses who may be from among their family members”³³.

The concept of *Nikaah halala* does not find mention in the holy Quran as such but in *Surah Al Baqarah* there is a provision of re-marrying a divorced wife. It provides that after a valid *talaq* by third pronouncement, a wife will not remain lawful (*halal*) for the husband to reconcile back. And in such case, if the husband who divorced her, wants to re-marry his divorced wife, he can do so only if she marries another man and in case, that second husband either divorces her by chance or meet with death, the former husband can marry her.³⁴ However, if the wife marries another man only to get divorced so that she can come back to her former husband, such marriage will not be valid and she will still remain unlawful for the former husband. This is the limit that the Almighty has stated in the holy scripture when it mentioned that “if they [husband and wife] think that they can keep (within) the limits of Allah. These are the limits of Allah, which He makes clear to a people who know”. This provision was provided in Quran so as to deter the husband and wife from divorcing each other and so that they do not take divorce lightly and pronounce them at their will. There are instances³⁵ when pronouncement of triple *talaq* without intention was considered as single *talaq* and the wife was made to return back to her husband. In *Fatawa-Ibn-Taymiah*³⁶,

³¹ Holy Quran, Verse 229 of *Surah Al Baqarah*. Here it provides that “a divorce is only permissible twice; after that, the parties should either hold together on equitable terms, or separate with kindness. It is not lawful for you [men] to take back any of your gifts [from your wives], except when both parties fear that they would be unable to keep the limits ordained by Allah. If ye [judges] do indeed fear that they would be unable to keep the limits ordained by Allah, there is no blame on either of them if she gives something for her freedom. These are the limits ordained by Allah so do not transgress them; if any do transgress the limits ordained by Allah, such persons wrong [themselves as well as others]”

³² Holy Quran, Verse 1 of *Surah Al-Talaq* provides that “O Prophet! When ye do divorce women, divorce them at their prescribed periods, and count [accurately], their prescribed periods. And fear Allah your Lord; and turn them not out of their houses, nor shall they [themselves] leave, except in case they are guilty of some open lewdness, those are limits set by Allah. And any who transgresses the limits of Allah, does verily wrong his [own] soul: thou knowest not if perchance Allah will bring about thereafter some new situation”.

³³ Holy Quran, Verse 2 of *Surah Al-Talaq* provides that “when they fulfil their term appointed, either take them back on equitable terms or part with them on equitable terms; and take for witness two persons from among you, endowed with justice, and establish the evidence [as] before Allah. Such is the admonition given to him who believes in Allah and the Last Day. And for those who fear Allah, He [ever] prepares a way out”

³⁴ Holy Quran, Verse 230 of *Surah Baqarah* “And if he has divorced her (for the third time), then she is not lawful to him afterward until (after) she marries a husband other than him. And if the latter husband divorces her (or dies), there is no blame upon the woman and her former husband for returning to each other if they think that they can keep (within) the limits of Allah. These are the limits of Allah, which He makes clear to a people who know”³⁴

³⁵ There is a Hadith reported by Rokana-bin-Abu Yazid that he had pronounced an irrevocable *talaq* to his wife Sahalmash, without intention and when he told about this to the Prophet (PBUH), the Prophet made his wife return back to him after confirming about the truthfulness of the fact. See Khan, Prof. I.A. (Ed.) (2009) *Aqil Ahmad Mohammedan Law*, Chapter – 9 Divorce (*Talaq*). 23rd Edition, Allahabad: Central Law Agency. pp. 176.

³⁶ *Fatawa Ibn Taymiah*, Vol. III, p. 141. See Khan, Prof. I.A. (Ed.) (2009) *Aqil Ahmad Mohammedan Law*, Chapter – 9

it is mentioned that jurists like Ibn Ishaq, Akram and Ibn Abbas hold that three pronouncements of talaq in single sitting will constitute as single *talaq*. During the initial years of caliphate of Hazrat Omar (PBUH), it is reported that he used to punish people who used to pronounce triple talaq indicating that he wanted to discourage such practices from taking place.

Deviation from the Original Concept:

Triple *talaq* was not in practice during the lifetime of Prophet Mohammad (PBUH), which indicates that his approval was not present for such practice. It was during the time of second Caliph Hazrat Omar that the practice of triple *talaq* was given its validity under unusual situation.³⁷ The declaration of triple talaq having validity was taken an administrative measure taken to meet the urgency of the situation to control the mis-happenings, but the Hanafi jurists declared such form of divorce as valid and granted religious sanction to such inhuman practice. Thus, the triple *talaq* in one sitting came into existence during the second century of Islam when the then monarchs found the check imposed by the Prophet quite harsh and they wanted to find an escape route from the strictness of law and it is not provided in *Quran*. As provided in holy scripture that once a valid talaq take places, the wife become unlawful for the husband. And in such case, a person cannot re-marry his divorced wife and undergoing the procedure provided in the Quran will be tough, so people worked out a short cut called *nikaah halala*, i.e. to make his wife lawful (*halal*) for the first husband, there

developed a concept of temporary marriage of wife to someone on payment and getting a divorce from that second husband. Once divorce from the second husband takes place, the wife may go back to her previous husband. Such horrible practice is being made by some manipulative patriarchal mindset.

Parmar (2018) has stated in a report that the *nikah halala* is planned and often done with local cleric or some male family members to have 'one-night stand' with the divorced wife against payment of some money. The report further states that there are instances when the so called 'one-night stand' drags further when the person refuses to divorce her and the trauma of sleeping with the stranger continues for days till the family of the divorced woman pays more money. Further the woman when comes back to her husband, he also accuses her of being 'impure' and 'used'.³⁸ According to an investigative report in BBC News (2017), a woman would pay money to marry, consummate the marriage and divorce the stranger to go back to her first husband. Even that report found out that there are commercialized *halala* services on Facebook.³⁹ In some cases, it was found out that women who seek such services are at risk of being blackmailed and sexually abused by the stranger. If this is the situation in U.K., one can well imagine what is the condition of Muslim woman in India, who is divorced in the rage of a moment through triple *talaq*.

The Muslim Law in India were the outcome and interpretation of the colonial judges, who did not have expertise in Arabic and Persian languages in which the sources of Islamic Law were written. As a result, they have to count on translations and commentaries that were not authentic and spurious in nature (Ahmed, 2001). Also, the legislators never bothered to correct the prevalent situation due to the political motives resulting in legitimizing the un-Islamic practices like triple *talaq*, *halala nikaah*, reckless polygamy, etc. Thus it seems

Divorce (Talaq). 23rd Edition, Allahabad: Central Law Agency. pp. 177.

³⁷ It is stated that when the Arabs conquered Syria, Egypt, Persia, etc., they found their women more beautiful than the Arabians and hence they wished to marry them. When the Arabs presented their wish to marry such women, they insisted on divorcing their wives instantly by pronouncing triple talaq. The condition was instantaneously accepted by the Arab men as they knew such divorce did not have validity and legality in their society and as a result, they can, not only marry these women but also retain their existing wives. When Caliph Hazrat Omar came to know about the incidents, he declared through decree that such pronouncements of talaq thrice at one sitting would dissolve their marriage irrevocably and this was done to prevent the corrupt husbands from playing with the laws of marriage and divorce. See Khan, Prof. I.A. (Ed.) (2009) *Aqil Ahmad Mohammedan Law*, Chapter – 9 Divorce (Talaq), 23rd Edition, Central Law Agency, pp. 174 – 175.

³⁸ Nikita Parmar -4 July 2018 *Nikah Halala: Violation Of Fundamental Rights Of Muslim Women*. Date of Access: 20-12-2019 <https://www.sirfnews.com/nikah-halala-violation-of-fundamental-rights-of-muslim-women/>

³⁹ Ahmad, Athar (2017). The women who sleep with a stranger to save their marriage. BBC Asian Network & Victoria Derbyshire programme (5th April). BBC News. Date of Access: 2-1-2020 <https://www.bbc.com/news/uk-39480846>

that these social evil practices in Islam were the outcome of the patriarchal values to dehumanize women that developed and gathered legal sanction in the due course of time.

Judicial Interpretation of Triple *Talaq* and *Nikaah Halala*:

The Judiciary had tried to interpret the relevance of such a custom like triple *talaq* and *nikaah halala* in a number of cases understanding. In *Sara Bai vs. Rabia Bai*⁴⁰, the then Bombay High Court said that the triple *talaq* is not proper scripturally. Again, in *Fazlur Rahman vs. Aisha*⁴¹, the Patna High Court had accepted the fact that the verses of the Quran have been interpreted differently by the different schools as per their convenience. In *Rukia Khatun vs. Abdul Khalique Laskar*⁴², the Gauhati High Court referred to the Quran and held that the pronouncement of *talaq* must be for a reasonable cause and it must be preceded by the reconciliation process between the parties by arbitrators, one chosen by the wife from her family and other by the husband from his family. It further stated that only failed attempts of reconciliation may validate the *talaq*. Justice Baharul Islam, the then Chief Justice of Guahati High Court had given epiphany verdict by referring to the ultimate guide of Islam and he had stated that “logical conclusion of original sources of Islam relating to *talaq* reveals that neither the husband nor the wife has the unbridled and arbitrary power to divorce each other. In view of these analysis, the unintentional pronouncement of triple *talaq* at single occasion are against the *Sharia*”⁴³. In *Shamim Ara vs. State of U.P.*⁴⁴, the apex court observed that triple *talaq* or the unequivocal *talaq* is not valid theologically. The court further added that there have been no religious scriptures where such form of *talaq* finds its mention. Even there is no text wherein it is provided that a document containing the statement of divorce by the husband can result in an effective divorce.⁴⁵

The Lucknow High Court in one of the case in 2004, has negated the validity of a *talaq* that was sent by registered post, reasoning that the condition for *talaq* according to *Shariam* must be pronounced over three sittings.⁴⁶ In *Masroor Ahmad vs. N.C.T. of Delhi*⁴⁷, Justice BadarDurrez Ahmad held that triple *talaq* in one sitting ought to be regarded as a single *talaq* which is revocable during the period of *iddat*. Moreover, he emphasized that the reconciliation process must be strictly followed before initiating the procedure of divorce. The apex court had observed in *Shamim Ara’s* case⁴⁸ that the Quran requires that a *talaq* has to be pronounced in order to have an effective divorce. The court said that the term ‘pronounce’ means to utter formally, utter rhetorically and to declare. Thus, there is no such scripture or text in Islam that provides that a divorce can be validated by sending a written document mentioning the divorce for the wife without the process of reconciliation.⁴⁹ Justice Baharul Islam had stated in *Jiauddin vs. Anwara Begum*⁵⁰, that the husband does not have unconstrained right to break the marriage unless the wife has showed unfaithfulness and disobedience towards the husband. He further observed that though marriage in Islam is only a civil pact yet the rights and responsibilities resultant out of the bond are of such importance to the welfare of humanity, that high degree of sanctity is attached to the relation of marriage or *nikah*. Even Justice Krishna Iyer⁵¹ has observed that the view that the Muslim men enjoys an arbitrary power to inflict the instant divorce does not accord with Islamic injunctions, is just a fallacy. The Quran does not grant the man an unbridled authority to liquidate the marriage. But in spite of the sanctity of the marriage tie, Islam recognises the concept of divorce out of necessity or exceptional circumstances so that a peaceful separation may take place (Islam, 1981).

⁴⁶ In this case, the wife was thrown out of her husband’s house on account of non-fulfilment of dowry demand and after sometime, she and her two years old son filed an application seeking maintenance under Sec. 125 of Cr.P.C.. The husband filed an objection stating that he had already divorced her and had sent the *talaqnama* by registered post.

⁴⁷ MANU/DE/9441/2007

⁴⁸ (2002) 7 SCC 518.

⁴⁹ *Ibid.*

⁵⁰ (1981) Gau.L.R. 358

⁵¹ Yousuf vs. Swaramma, AIR 1971 Ker 261, 264.

⁴⁰ (1906) 30 Bom 537

⁴¹ (1929) 8 Pat 690

⁴² (1981) 1 Gau.L.R.368

⁴³ *Ibid.*

⁴⁴ (2002) 7 SCC 518

⁴⁵ *Ibid.*

Thus, from the above consideration of various judgments given by the Indian Judiciary from time to time, it is observed that the triple *talaq* does not have validity in the Muslim law and hence cannot be enforced. In spite of the pronouncements, the practice seems to have continued in the society indicating that it receives express or implied acceptance from the community. Since the community continued to practice it in spite of upholding the illegality of such practice by the Indian judiciary, it had no other option but to criminalise it in *Shayra Bano's* case. According to this, the practice of triple *talaq* is considered as a criminal act and the person, who practices it, shall be punished under the Muslim Women (Protection of Rights of Marriage) Act⁵² with imprisonment. But the concern still remains as to who will inform the State regarding the incident if such practices have received support from the community as there will be no one to complain regarding it resulting in failure of implementation mechanism.

Muslim Countries That Got Rid of These Evils:

A large number of Muslim countries like Egypt, Jordan, Sudan, Bangladesh, Pakistan *etc.* have done away with such evil practice to safeguard the wife's right and enable a proper opportunity of reconciliation. Egypt⁵³, Iraq⁵⁴, Jordan⁵⁵, Kuwait, Sudan⁵⁶, *etc.* have made unilateral *talaq* ineffective if the husband was drunk, provoked, shocked, depressed, ill, uncontrollable angry, under duress, or asleep while pronouncing the *talaq*. Also, these countries have done away with such practice by legislating new laws that provides that three *talaq* at one go will be considered as only one and it will be open to the parties to continue the

marriage if reconciliation is brought about within specified time. Egypt has done away with the practice in as early as 1929. In countries like Jordan, the presumption is that every *talaq* by the husband will be considered to be arbitrary unless he proves otherwise by himself. The practice of the so-called *nikaah halala* for legalizing remarriage has been done away with in the above-mentioned countries. Even our neighbouring countries like Pakistan⁵⁷ and Bangladesh⁵⁸ too have invalidated the practice. In both these countries, the *talaq* has to be first notified to the local government official (*Qazi*) by the husband so that an arbitration board can be set up. The arbitration board shall consist of the government as the chairperson and one representative from each side of the parties and this board shall try to reconcile the parties till 90 days from the date of notice. During this period, the *talaq* will remain ineffective and in case, the reconciliation process fails, the parties will be granted the certificate of divorce. The wife will maintain the *iddat* and during the period of *iddat*, the husband has to pay the maintenance for her. Prior to granting of the divorce or *talaq*, the wife has to be paid her *dyn mehr* (unpaid *dower*) for the completion of the process.

Regarding the maintenance, the tenure differs in different countries if the husband has divorced his wife arbitrarily. In Jordan, Kuwait and Yemen, the period of maintenance is for 1 (one) year while in Egypt, it is for two years and in Qatar and Syria, the period of maintenance is for three years. In Tunisia and Turkey, a husband or wife who insists on divorce against the will and without the fault of the other party, the Court can direct the other party to suitably indemnify through suitable compensation. The duration and amount of the compensation are to be fixed by the Court when the husband arbitrarily divorces the wife and that too without valid reasons in the countries like Malaysia, Morocco, Oman, Sudan and UAE.

⁵² Sec. 4 of Muslim Women (Protection of Rights of Marriage) Act, 2019 penalises Muslim males who practise triple *talaq* 6

⁵³ Article 3 of Law 25 provides that a *talaq* having a number affixed expressly or impliedly shall not be effective and it shall be counted as a single *talaq* and Article 5 states that "every *talaq* shall be revocable one except the third *talaq*, that is given before the consummation, that for a consideration and that expressly described as irrevocable one in this law".

⁵⁴ Article 37 of Iraqi Code of Personal Status, 1959 provides that triple *talaq* in single sitting shall be treated as one.

⁵⁵ Section 60 of Jordanian Code of Personal Status, 1976 provides that triple *talaq* shall be counted as only one

⁵⁶ Section 3 of Sudanese *Manshur-i-Qadi al-Qudat* provides that triple *talaq* shall be considered as one

⁵⁷ Section 7 of Muslim Family Law Ordinance, 1961 provides that traditional form of divorce is not in force in its original form. See Hussein, Samreen. (2010). Triple Talaq: A Socio-legal Analysis. *Indian Law Review*. Vol. 1 (1). pp. 129 – 150 at p. 146.

⁵⁸ Marriage & Divorce (Registration) Act, 1974

These countries have even worked out the right to residence of the divorced wife. The Egyptian wife having custody of her children must be provided with a proper and independent house and in case, she was in possession of a home used by the husband and wife before the divorce, the divorced wife may retain the possession over it. In Iraq, the divorced wife may remain in the pre-divorced home for a period of 3 (three) years after the divorce, unless she was divorced due to her own fault. The Algerian divorced wife having children, must be provided with the accommodation by the divorced husband while in Tunisia, the judge in the divorce suit must provide directions regarding the residence of the parties while granting the divorce of the parties. Similar is the law of residence in Morocco after the divorce by the husband. The concept of *halala nikaah* for legalizing remarriage of the parties with each other is being abolished in the countries viz. Egypt, Iraq, Jordan, Kuwait, Morocco, Philippines, Sudan, Syria, UAE and Yemen.

Mahmood (2016) has stated in his book that all the reforms in the law of divorce in the Islamic countries are based on juristic opinion that lies on the Islamic jurisprudence and not on any concept alien to Islam. It is worth noting that there was no reluctance or protest from the community in accepting the change in the law of divorce and re-marriage. This might be due to the reason that the laws were based on juristic opinion and Islamic jurisprudence and any objection to these changes will be considered baseless and unjustifiable and will have no effect.

Conclusion – Their Relevance in Modern Times:

The *Quran* and original sources of Muslim Law grant permission to the successive generation to study and interpret the law so as accommodate the correct intention the religion and solve the concerns of future times (Ahmed, Anees 2001). The study of the various Islamic jurisdictions outside India has shown that the true Islamic spirit can be protected by being progressive in thoughts and actions. However, in India, the scenario is different as there has been protests exhibiting the reluctance to the change provided by the Supreme Court backed

by the Holy *Quran* and it might be due to the religious intolerance. Although it is believed that Quran is divine in the sense that it was revealed from Allah to Prophet (PBUH) yet the rules provided therein seems to have been manipulated during the British reign due to ignorance of the people whom the British appointed for interpreting the religious laws. Also, some misguided and ill-educated clerics had spread their faulty understandings of the Quranic law of divorce among the common public (Ahmed, Furqan, 2003). Hence Justice Islam (1986) had stated that we must not forget that the *Quran* has been revealed to Prophet (PBUH) hundreds of years ago and it must be interpreted by man from time to time for a better and progressive implementation. This is what is being done by the other Islamic countries while bringing change to their personal laws. Even the *Quran* has stressed upon conferring gender justice when it reveals that men and women are equal in the eyes of Allah.⁵⁹ Also it must be remembered that the reservations like *nikah halala*, *dower*, *iddat*, etc. in Muslim custom were put to prevent husbands from misusing the rights granted to the men. The learned in the Muslim community understands these facts but since the community is composed of majority of ignorant people, it is easier to manipulate them by certain selfish and narrow-minded religious clerics. Thus, the changes in the scenario and the Muslim personal law may only be possible when the community is educated and made aware of the Islamic jurisprudence. Without the support of enlightened public, the changes in Muslim personal law will not be appreciated and allowed to be implemented. Besides, the Muslim clergies should do their duties with utmost sincerity and they must be well read. Such issues are bit less in other Muslim countries as the subjects are enlightened and they tend to know their religion. Keeping in view the Indian scenario, many activists working for the protection of Muslim women's rights feel that even after criminalizing triple *talaq*, such practice will not stop unless the patriarchal mindset of the society changes and literacy level among Muslim women improves

⁵⁹Holy Quran Verse 35 of *Surah Al-Ahzab*,

so that they understand the religion and the rights conferred upon them.

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IMPACT OF COVID-19 ON BLACK PEPPER PRICE IN SELECT COUNTRIES**Geemon Korah¹, Dr. S Mohankumar²**

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ABSTRACT

The Covid – 19 pandemic has affected all spheres of the economy across the globe. The black pepper market has been showing remarkable growth recent years. Continuous hike in price of black pepper price in the world market is attributed to the ever increasing demand for black pepper in food, cosmetic and pharmaceutical industry. During the pandemic period the price of black pepper also considerably declined. Researches were conducted on how the Covid - 19 pandemic has impacted several sectors of the economy, including agriculture. However, no such studies are conducted to understand its impact on Black pepper price in the global market. Hence, this study intends to analyse the impact of Covid-19 pandemic on black pepper price in major pepper producing and exporting countries.

Keywords: Black pepper price; Covid-19; price sensitivity; price volatility

Introduction

COVID-19 was first reported in Wuhan in China on December 31, 2019. It was reported to the local World Health Organization Office. By January 3, 2020, 44 cases of patients were reported to the WHO. The virus spread leaked out of China on January 13, 2020, with the first report of imported infection from Thailand, followed by a similar case on January 15 from Japan. Republic of Korea followed suit on January 20. On January 30, 2020, the WHO declared the outbreak of the virus as a Public Health Emergency of International Concern (PHEIC). On the same day, nearly six percent of tourism destinations across the world had implemented travel restrictions, specifically prohibiting travelers from China.

Background of the study

The pandemic is expected to impact agricultural markets over the next decade (OECD, 2020a). The economic impact could adversely affect food security, farm livelihoods, and trade. Even though food being an essential commodity exempted from movement regulations, the Covid-19 period has seen significant adverse impact on food markets (Varshney, Roy, & Meenakshi, 2020). Such effects of the pandemic are not unique to any particular country, but spread across the world (Chetty et. Al., 2020). Though the shock to the commodity markets has been significant, the magnitude of shock has been different for

different commodities (World Bank, 2020b). Monthly Commodity price indices represented in the graph shows that energy has suffered the largest shock during the Covid period. Slightly lower levels of shock are found in the agricultural commodity index, which subsequently recovered.

Energy prices dropped by a staggering 60 percent during the four month period between January to April 2020, while food prices across the world dropped by 10 percent. The fact that almost two-thirds of the emerging markets and developing economies (EMDEs) and more than three-fourth of low income nations around the world depend very heavily on commodity extraction and export. Where severe shocks are exerted by Covid-19 on agricultural commodity prices, these countries can suffer very badly (World Bank, 2020b). In the state of Kerala, during March and April 2020, the total losses in crop sector in agriculture, which includes plantation crops, were estimated to be Rs. 1571 crore. The losses suffered by agriculture labourers due to loss of wages were about Rs. 200 crore for the same period (Kerala State Planning Board, 2020).

Objective of the Study

The main objective of this study is:

- To analyse the black pepper price trends in Pre-covid and post covid period

Methodology

Based on the evidences of the impact of Covid-19 on economies of countries across the globe, and on agricultural commodities, an attempt is made to understand how the pepper prices have performed under the impact of the pandemic. The study is limited to the prices of pepper in the five countries under consideration – India, Sri Lanka, Vietnam, Brazil and Indonesia. Monthly average prices of pepper for the period commencing from September 2018 to June 2021 are used to identify the trend in prices. Since the World Health Organization declared the outbreak of the virus as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, the study adopts the period till January 2020 as a pre-Covid period. Hence, monthly average prices from September 2018 to January 2020 (17 months) represent a pre-Covid price, and the monthly average prices from February 2020 to June 2021 (17 months) represent a post-Covid price. Country-wise analysis is presented to highlight the trend in prices during the entire study period, categorized separately for the pre- and post-Covid periods. The Linear trend line, and the two-month moving average of the prices is also plotted to understand the behaviour of prices during the study period.

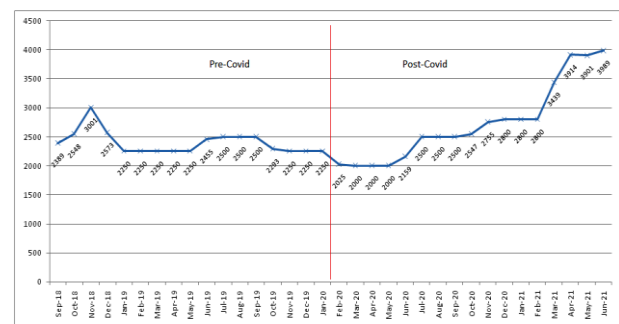
Results and Discussion

Black Pepper price trends during Pre-Covid and Post Covid Period for select countries - India, Sri Lanka, Vietnam, Brazil and Indonesia is analyzed here.

Brazil

The price of pepper in Brazil was found to vary between USD 2389 per MT (September 2018) to USD 3989 per MT (June 2021) during the study period. Refer to Figure 5. A comparatively visible spike is seen in November 2018 (USD 3001 per MT). The trend of prices in the pre-Covid period (Figure 6) is found to be relatively stable except for the above spike. The Linear trend line is found to be downward sloping with time. The two-month moving average line follows a cyclical pattern with repetitions below and above the trend line. A significant fall in prices is witnessed during the transition phase, during January-February of 2020, translating to a ten

percent fall in prices. This evidences a significant impact of Covid-19 on prices in Brazil. During the post-Covid era (Figure 7), prices remained lower under Covid pressure till the second half of May, 2020. By June 2020, recovery of prices started with a gain of eight percent. During July 2020 and November 2020, there were visible upward spikes in price trends, followed by a significant upward spike in March and April, 2021 where there was a forty percent increase in price. The trend evidences significant recovery of pepper prices in Brazil after Covid-19 impact. The recovery was visible within a short time span of four months since January 30, 2020. The linear trend in prices during the post-Covid period is upward sloping with time, reiterating the strong recovery of prices.



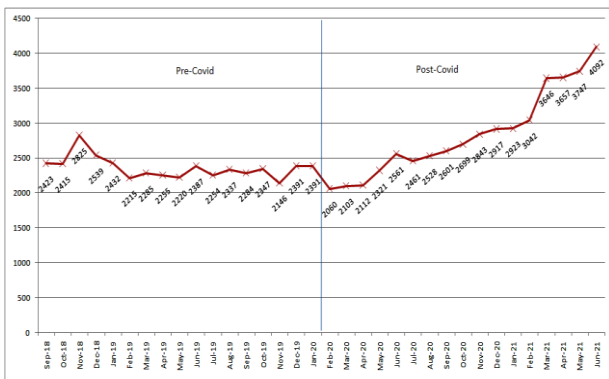
Brazil: Monthly average prices (September 2018 - June 2021)

Figure 1

Vietnam

The price of pepper in Vietnam was found to vary between USD 2432 per MT (September 2018) to USD 4092 per MT (June 2021) during the study period. Figure 8 gives the pattern of pepper prices over the entire period. Similar to the price pattern in Brazil, there is a significant spike in prices in November 2018. During the pre-Covid era, the prices are found to be relatively stable. The linear trend line shows a slightly downward sloping behaviour with time, while the two-month moving average is slightly below the linear trend line for a significant part of the period (Figure 9). During the transition period from January 2020 to February 2020, there is a significant fall in prices, translating to a fourteen percent loss. During the post-Covid period (Figure 10), March and April 2020 remained low in prices, with strong signals of recovery seen in May

2020. Prices continued to rise gradually till February 2021, followed by a significant upward spike in March 2021 with nearly 20 percent gain. Thus, the overall results show that though the impact of Covid was significant on pepper prices in Vietnam, the impact was short-lived, with recovery signals being visible within a two-month period. The linear trend line shows an upward sloping nature with time, with similar behaviour shown by the two-month moving average moving upward towards the end of study period.



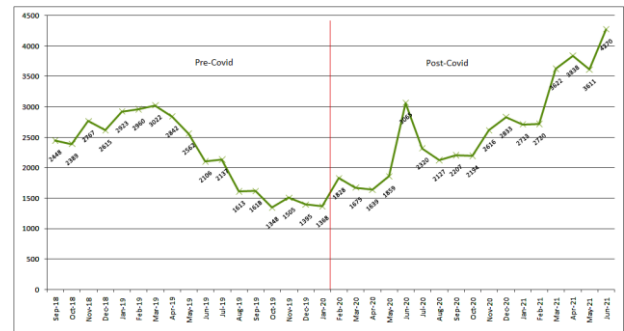
Vietnam: Monthly average prices (September 2018-June 2021)

Figure 2

Indonesia

The price of pepper ranged from USD 2448 per MT (September 2018) to USD 4270 per MT (June 2021) during the study period. Figure 11 gives the price trends for the entire study period. The prices remained buoyant during the January to March 2019 period, while there is a significant spike in June 2020. The Figure 12 gives the details of price trends during the pre-Covid period. Since the buoyancy in March 2019, prices continued to fall and reached a lowest of USD 1368 per MT in January 2020, losing about fifty four percent during a one year period immediately before the Covid impact. The linear trend line is downward sloping over time, while the two-month moving average price closely followed the linear trend line. Unlike Brazil and Vietnam, the transition phase of January 2020 to February 2020 witnessed a rise in prices, with a gain of nearly thirty-four percent. Figure 13 shows that prices immediately dropped for next two months, followed by the significant spike in June 2020, with a gain of eighty-three percent over the precious three-month period.

Significant gains in prices were seen during the post-Covid period with the highest price recorded in June 2021, representing a significant gain of one hundred and thirty four percent during the post-Covid period. The linear trend line is bullish, with a strong upward trend over time. The two-month moving average line closely followed the linear trend, with an upward cross-over towards the end of the study period.



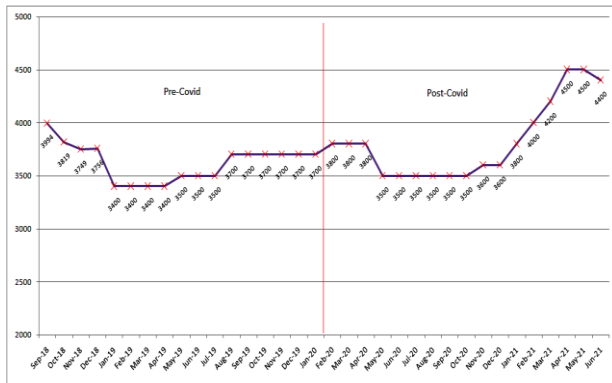
Indonesia: Monthly average prices (September 2018-June 2021)

Figure 3

Sri Lanka

The pepper prices in Sri Lanka over the study period is found to be comparatively stable, with a range lying between the lowest USD 3400 per MT (January 2019) and highest USD 4500 per MT (May 2021). Figure 14 gives the representation of the price trends over the study period. From Figure 15, the pre-Covid period price trends are revealed to be very stable, except for January 2019 to April 2019 period where there was a loss of nearly ten percent in price over December 2019. Subsequently prices recovered with visible spikes in May 2019 and August 2019. Prices continued to be rock stable till the onslaught of the Covid pandemic. The linear trend line for the pre-Covid period is almost a horizontal line representing stable prices, while the two-month moving average significantly lies above the linear trend line. Similar to Indonesia, Sri Lanka also witnessed a surge in prices during the transition period of January 2020 to February 2020, showing a gain of three percent. Figure 16 gives the trends during the post-Covid period. After an initial stable period for three months, prices fell during May 2020, and remained low till October 2020. With gradual gains till January 2021, prices

significantly and continually increased since February 2021, showing a gain of nearly thirty percent. The linear trend line is showing a gradual upward sloping shape, representing recovery of pepper prices during the post-Covid period. The two-month moving average is seen to make an upward cross over towards the end of the study period signifying gains over lagging prices.



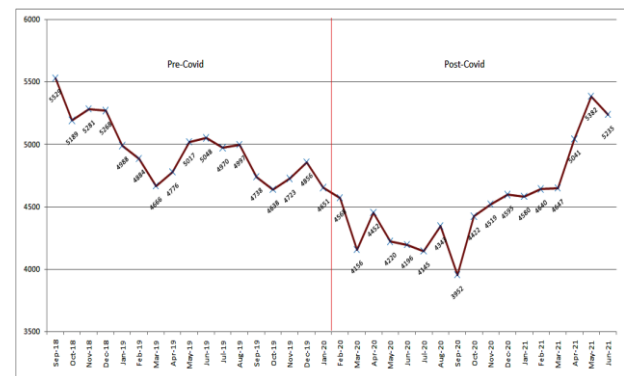
Sri Lanka: Monthly average prices (January 2019-June 2021)

Figure 4

India

Pepper prices in India during the study period is found to be comparatively volatile, with the highest price of USD 5529 per MT in September 2018 and lowest price of USD 3952 per MT in September 2020, which represents a loss of twenty-nine percent over the two year period. There are visible and consistent volatilities during the entire study period, as is seen from the Figure 17. During the pre-Covid period, the prices are found to be consistently falling, with significant troughs in March and October 2019. Prices also show some recoveries during May-June 2019, and during December 2019. The gain in June 2019 translated to more than eight percent over the immediately preceding three months. The linear trend line during the pre-Covid period is found to be stoop downwards over time. The two month moving average is troughs and crests signifying significant volatilities in prices. During the transition period of January 2020 to February 2020, prices fell resulting in a marginal loss of nearly two percent. In the post-Covid period, till September 2020, prices exhibited extreme volatility, followed by a significant gain in October 2020 (twelve percent gain over the previous month). Figure

19 gives details. Till March 2021, the prices showed gradual and slow gains. During April through May 2021, prices increased substantially, with gains of twenty-two percent over the previous six month period. The linear trend line shows a gradual upward sloping trend, showing slow but stable price recovery during the post-Covid period. The two-month moving average for the period follows the actual price trend showing consistent prices with low gains. Towards the end of the study period, the moving average line shows an upward cross over, showing strengthening current prices over historical prices.



India: Monthly average prices (September 2018-June 2021)

Figure 5

Mean Prices, Price Volatility and Price Sensitivity

Mean prices of pepper were computed separately for the entire study period and for the pre-Covid period and post-Covid period. The volatility (measured by standard deviation of prices) in prices over the same time horizons were computed. The sensitivity of prices is computed using R^2 which is the coefficient of determination, generated by regressing price over time.

Table 1: Country-wise Price of Pepper: Volatility and Mean

Country	Price Volatility (Std Dev)			Mean Price		
	Overall	Pre-Covid	Post-Covid	Overall	Pre-Covid	Post-Covid
Brazil	526.23	199.61	684.07	2570.20	2397.60	2742.90
Vietnam	506.12	154.89	617.84	2601.70	2361.50	2841.90
Indonesia	738.46	620.11	797.66	2434.00	2212.80	2655.10
Sri Lanka	300.33	174.90	366.62	3724.10	3624.60	3823.50
India	386.20	253.51	387.32	4744.50	4954.10	4534.90

Source: SPSS Results

Brazil

The Table 1 shows that the mean price of pepper in Brazil was USD 2570.20 per MT for the entire study period. During the pre-Covid period, the mean prices were found to be USD 2397.60 per MT, while it was USD 2742.90 per MT during the post-Covid period. This signifies a stronger market mechanism that bounced back after the impact of the pandemic. The volatility of market prices for the entire study period was 526.23. During the pre-Covid period, the volatility was a very low 199.61, compared to the post-Covid period volatility of 684.07. The higher price volatility during the post-Covid period may be attributed to the strong upward rising price trend, with significant gains. This symbolizes a resurgent pepper market in the post-Covid period. This is corroborated by the price sensitivity values (R^2). Table 2 shows that the price sensitivity is very high (0.883) during the post-Covid period, and very low (0.169) during the pre-Covid period.

Vietnam

The mean price of pepper in Vietnam was USD 2601.70 per MT for the entire study period (Table 1). During the pre-Covid period, the mean prices were found to be a lower USD 2361.50 per MT. In comparison to it, the mean prices in the post-Covid period were a higher USD 2841.90 per MT. The higher prices during the post-Covid period may indicate a strong market sentiment. The volatility in market prices is very similar to that of the Brazil market. While during the entire study period, the volatility of prices was a significant 506.12, it was a very low 154.89 during the pre-Covid period. Volatility was significantly higher at 617.84 during the post-Covid period. This is again attributed to strongly recovering and bullish pepper market in Vietnam, with

very strong and consistent price gains that were recorded in the post-Covid period. Table 2 shows that the price sensitivity (R^2) is the highest during the post-Covid period (0.922), while it was significantly lower (0.200) during the pre-Covid period.

Indonesia

The Table 1 shows that the mean price of pepper in Indonesia for the entire study period was USD 2434.00 per MT. The pre-Covid period recorded a mean price of USD 2212.80 per MT, while the post-Covid period recorded a mean price of USD 2655.10 per MT. Thus, it can be inferred that the Indonesian price was relatively stable within a broad range throughout the study period. The price volatility is the highest in Indonesia among the countries under study. The entire study period recorded a volatility of 738.46. The pre-Covid period had a volatility of 620.11, while the post-Covid period had a volatility of 797.66. In all the three cases, the volatility is found to be the highest among the countries under study. The time sensitivity of price in Indonesia for the entire study period is found to be low at 0.106. But, taking the pre-Covid period and post-Covid period separately, the sensitivity of price is found to be very high: 0.679 (pre-Covid period) and 0.772 (post-Covid period). This is indicative of the fact that the behaviour of prices was different in the two time periods, signaling a very strong impact of Covid on pepper market in Indonesia. This impact is exacerbated by the inherent high price volatility in the country.

Sri Lanka

The Table 1 shows that the mean price of pepper in Sri Lanka was USD 3724.10 per MT for the entire study period. While the mean price was a slightly lower USD 3624.60 per MT for the pre-Covid period, it was a slightly

higher USD 3823.5 per MT during the post-Covid period. This is indicative of prices becoming stronger after the initial impact of Covid. As regards the price volatility, the standard deviation was 300.33 during the entire study period. During the pre-Covid period, the volatility was a low 174.90, while during the post-Covid period, the volatility was a very high 366.62. The measures are indicative of a stable and low price trends during the pre-Covid period, and a reclaiming and vigorously moving price in the post-Covid period. As regards the sensitivity of prices (R^2), the pre-Covid period show nearly zero (0.009) sensitivity, which also recounts for the very low price volatility. The price sensitivity is comparatively higher (0.481) during the post-Covid period. Overall, it may be concluded that the market prices of pepper in Sri Lanka are the most stable, which has withered the threat of the pandemic.

India

The Table 1 shows that the mean price of pepper in India is the highest during all the study periods. In the entire period, the mean

price is found to be USD 4744.50 per MT. Unlike all other countries, the mean price during the pre-Covid period (USD 4954.10 per MT) is found to be more than the mean price during the post-Covid period (USD 4534.90 per MT). This indicates a relatively weak market structure since there are significant losses during the post-Covid period. The market has failed to bounce back after the Covid impact, while it is seen to happen in all other countries. As regards the volatility of prices, it is seen that the fluctuations are relatively lower: 386.20 (entire study period), 253.51 (pre-Covid period) and 387.32 (post-Covid period). This shows that the higher volatility seen in the post-Covid period aggravates the market mechanism coupled with the loss in prices. As regards price sensitivity, the overall study period shows a low sensitivity of price with time (0.171). Conversely, the pre-Covid period (0.582) and the post-Covid period (0.574) show a relatively high sensitivity. This is indicative of strong time-specific behaviour of prices, separated by the Covid impact.

Table 2: Sensitivity of Prices

Country	Price Sensitivity (R^2)		
	Overall	Pre-Covid	Post-Covid
Brazil	0.303	0.169	0.883
Vietnam	0.451	0.200	0.922
Indonesia	0.106	0.679	0.772
Sri Lanka	0.236	0.009	0.481
India	0.171	0.582	0.574

Source: SPSS Results

Paired Sample T-Test: Difference between Pre-Covid and Post-Covid Prices

Paired Sample T Test was run to evaluate the statistical significance of the impact of Covid on the price trends of pepper in the countries under study. The difference in mean prices during the pre-Covid period and post-Covid period are tested for significance in difference. A significant result (p value < 0.05) would indicate a statistically significant difference in mean price across the two time periods separated by Covid. Pearson’s correlation coefficient was also computed to identify the significance in correlation between the two

pairs of prices (pre-Covid period price and post-Covid period price).

Table 3: Paired Samples Correlations

Pair (Pre-Covid Price & Post-Covid Price)		N	Correlation	Sig.
Country	Brazil	17	-0.478	.052
	Vietnam	17	-0.367	0.147
	Indonesia	17	-0.756	0.00
	Sri Lanka	17	0.500	0.041
	India	17	-0.316	0.216

Source: SPSS Results

The paired sample correlations results (Table 3) shows that the correlations between the pre-Covid period price and post-Covid period price is negative for Brazil (-0.478), Vietnam (-0.367), Indonesia (-0.756) and India (-0.216).

In case of Sri Lanka, the relation is positive (0.500). Though in all cases the correlation is moderately high, it is found that the correlation is statistically significant (p value < 0.05) only in case of Indonesia and Sri Lanka.

Table 4: Brazil: Paired Samples Test (Pre-Covid Price & Post-Covid Price)

Country	Paired Differences					T	Sig.
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Brazil	-345.29	798.92	193.76	-756.06	65.47	-1.782	0.094
Vietnam	-480.41	689.88	166.32	-835.12	-125.71	-2.871	0.011
Indonesia	-442.29	1329.9	322.54	-1126.05	241.47	-1.371	0.189
Sri Lanka	-198.94	317.54	77.02	-362.20	-35.68	-2.58	0.020
India	419.18	525.76	127.52	148.86	689.49	3.287	0.005

Degrees of freedom = 16

Source: SPSS Results

The paired sample T-test reveals (Table 4) that the difference in mean pepper price across the pre-Covid period and post-Covid period is statistically significant in case of Vietnam (t (df 16) = -2.871; p value = 0.011), Sri Lanka (t (df 16) = -2.580; p value = 0.020) and India (t (df 16) = 3.287; p value = 0.005). In case of Indonesia and Brazil, the difference in price over the two time periods is not statistically significant.

Conclusion

The above analysis leads to the conclusion that India may be the worst affected market in pepper by the Covid pandemic. The prices are significantly lower in the post-Covid period compared to the pre-Covid period. Indonesia

can be considered to be the most turbulent market in terms of volatility of prices particularly in the post-Covid period. Sri Lanka presents a comparatively stable market condition with lower volatilities, and comparatively higher mean prices during the post-Covid period, evidencing strong recovery trends from the Covid impact. In general, it may be concluded that there are strong evidences to suggest impact of Covid on the market prices of pepper across the countries under study, and the impact has by and large been negative. It is also to be noted that the market has shown strong levels of resurgence in a short period of time to recover to losses in price.

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A STUDY OF THE PROFILE AND ANTIBIOGRAM OF STAPHYLOCOCCUS AUREUS, IN A TERTIARY CARE HOSPITAL, NAVI MUMBAI, INDIA

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ABSTRACT

Methicillin resistant staphylococcus aureus is an important nosocomial pathogen showing a disconcerting propensity to develop resistance to antimicrobial agents. Hence the present study was undertaken to determine the percentage of distribution of MRSA in various clinical specimens and to carry out antimicrobial susceptibility testing.

Methods: A total of 100 strains of Staphylococcus aureus were subjected to MRSA screening using conventional microbiological methods. Subsequently antibiotic sensitivity testing was performed.

Results: Out of 100 S. aureus isolated 36 (36%) showed resistance to Methicillin and 64 (64%) were sensitive to Methicillin. Majority of the MRSA isolates were from pus, followed by nasal swabs. In the present study, all the 36 MRSA isolates (100%) were resistant to penicillin, erythromycin (75%), ciprofloxacin (72.23%), Cotrimoxazole (69.45%), Gentamicin (38.89%). All the MRSA strains were sensitive to Vancomycin and Linezolid.

Conclusion: Detection of MRSA and their antibiotic sensitivity profile will guide the treating clinicians for first line treatment in referral hospitals, and stringent infection control measures can be employed to prevent the spread of nosocomial MRSA infections.

Keywords: *Staphylococcus aureus, hospital, tertiary care hospital*

I. Introduction

Staphylococcus aureus are gram- positive cocci that occur in grape- like clusters. They are ubiquitous and form the most common cause of localized suppurative infections in human beings.

It can cause skin and soft tissue infections like folliculitis, furuncle [boil], abscess, wound infections including postoperative infections, respiratory infections like lung-abscess, pneumonia and C.N.S. infections like abscess, meningitis, e.t.c.

S. aureus is found in the external environment and in the anterior nares of 20-40% of the adults. Other sites of colonization include intertriginous skin folds, the perineum, the axillae and the vagina.

Originally, staphylococci were treated successfully with penicillin. Soon after, clinical strains came to be recognized which were found to be resistant to penicillins, first in the hospitals, then in the community at large. Then Methicillin became available in the late 1950s. Soon, clinical strains resistant to methicillin were discovered in 1961 in the U.K. It is now found worldwide. These strains came to be recognized by the name "M.R.S.A" [

Methicillin-Resistant-Staphylococcus

Aureus]. This type of bacteria causes "staph infections" that are resistant to treatment with usual antibiotics. MRSA occurs most frequently among patients who undergo invasive medical procedures or who have weakened immune systems and are being treated in hospitals and healthcare facilities. [99], such as nursing homes and dialysis centres, and are called EMRSA [Epidemic Methicillin Resistant Staphylococcus aureus], or HA-MRSA [Hospital-acquired MRSA]. [2,3]. Serious infections due to MRSA such as endocarditis, pneumonia and bacteremia have become more common [22, 23]. In addition to health-care associated infections, MRSA can also infect people in the community and are called CA-MRSA [Community-acquired MRSA]. Such infections are generally mild and may often cause skin infections in otherwise healthy people.

Methicillin resistance is conferred by the *mecA* gene, which encodes a penicillin-binding protein [PBP2A] with decreased affinity for beta-lactam antibiotics. *mecA* is a part of a mobile genetic element called the "Staphylococcal cassette chromosome [scc] *mec*" [24].

II. Materials And Methods

Clinical samples like pus, blood, urine, nasal swabs, eye exudates, etc. from patients attending out-patient departments and admitted in Padmashree Dr.D.Y.Patil Medical College, Hospital and Research centre, Nerul formed the material for the study.

Laboratory Procedures:

Direct Microscopy:- Heat-fixed smears were prepared from the samples and Gram-staining was done. The smears were examined and Gram-positive cocci arranged in clusters, pairs and singly were seen along with pus cells.

Culture:- Specimens were inoculated onto blood agar, chocolate agar and Mac-Conkey'agar. The media were incubated aerobically at 37 degree centigrade overnight and observed for growth next day.

Blood agar;- Golden –Yellow ,large[2-3mm diameter] ,circular, smooth, shiny, opaque,convex, easily emulsifiable, colonies surrounded by a zone of beta- haemolysis, were seen.

Chocolate agar:- Large white ,smooth, shiny, opaque, convex, easily emulsifiable colonies were seen.

Mac-Conkey's agar:- There was no growth noticeable on this medium.

The colonies resembling Staphylococcus aureus on morphology were selected for further charecterisation and confirmation.

On a clean, grease- free glass slide, smear was prepared from blood agar, air-dried and heat-fixed. Gram-staining was done.

Results:- Gram-positive cocci arranged in clusters, pairs, singly, size ranging from 0.5-1µm were seen.

The following testa were done for the identification of Staphylococcus aureus:

- 1] Catalase test
- 2]Slide-Coagulase test
- 3] Tube-Coagulase test

Methods used for isolation and identification of Staph aureus

1) Direct gram stained smears

Direct gram staining of clinical isolates was performed

Results: Gram positive cocci are arranged in clusters, pairs singly ranging from 0.5 to 1 µmtr. were noted

2. Isolation from clinical specimens

For recovery of Staphylococci all clinical specimens were inoculated on to 1) sheep blood agar 2) chocolate agar 3) Macconkey's agar.

Colony Morphology

Small distinctive smooth butyrous colonies of about 1 to 3 mm in size, some of which were pigmented (golden yellow) were noted and a secondary smear made from this colony.

3. The catalase test (4)

Staphylococci were differentiated from the streptococci, enterococci and streptococci – like bacteria by performing the catalase test. This test is used to detect the presence of cytochrome oxidase enzymes.

Test: The catalase test was performed using three percent hydrogen peroxide.

i) A drop of 3 % hydrogen peroxide was placed on a glass slide. A small no of colonies was picked up from the top with the help of a glass rod and touched to the hydrogen peroxide drop on the slide

ii) A positive test was indicated by the appearance of immediate and vigorous bubbling wherein the hydrogen peroxide was converted to water and oxygen gas.

4. Coagulase test (ref 37)

Once the catalase was found to be positive, coagulase test was performed with each one of the clinical isolates by the following methods

i) Slide coagulase test (8)

The colony was emulsified in a drop of rabbit plasma on a glass slide. Bacterial clumping within 10 seconds was taken as an indication of the presence of bound coagulase and the test was considered to be positive. Positive or negative test was followed up by performing the tube coagulase test also.

ii) Tube coagulase test (8)

0.1ml of an overnight culture was mixed with 0.5ml of reconstituted plasma. The mixture was incubated at 37 deg c. in a water bath for 4 hrs. and the tube was observed for clot formation by slowly tilting the tube 90 deg from the vertical . Any degree of clotting was considered as a positive test. Tests which were negative at 4 hours were incubated overnight and observed again at 21 hours for clotting.

Antibiotic sensitivity profile and Detection of MSSAand MRSA[Methicillin-sensitive s.aureus and Methicillin-resistant-S.aureus]

Antibiotic discs were put up on Mueller-Hinton Agar according to the CLSI guidelines[75]

The following antibiotics were put up:-

- 1]oxacillin
- 2]Methicillin
- 3] Penicillin
- 4]Erythromycin
- 5]Ciprofloxacin
- 6]Trimethoprim-Sulfamethoxazole
- 7]Gentamicin
- 8] Linezolid

RESULTS

Duration of study 1 year
Total number of Staphylococcus aureus isolated: 100

Table No.: 2

Age wise distribution of patients (from whom S.aureus was isolated)

Age	Number	MRSA		MSSA	
		nos	(%)	nos	(%)
0-1month	5	3	60%	2	40%
2months-18years	12	3	25%	9	75%
19-30 years	39	13	33.33%	26	66.67%
31-40	19	6	31.57%	13	68.43%
41-50	11	7	63.63%	4	36.37%
51-60	11	2	18.18%	9	81.82%
>61	3	2	66.66%	1	33.34%
Total	100	36	36%	64	64%

Graph showing age wise distribution of Patients

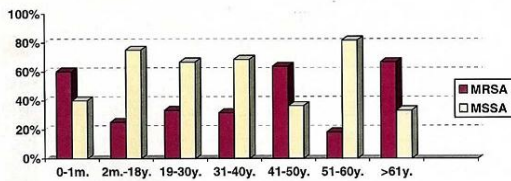


Table No.: 3

Sex wise distribution of patients

Sex	S.aureus Number	S.aureus Percentage
Male	72	72%
Female	28	28%
Total	100	100%

Graph Showing Sex wise Distribution of Patients

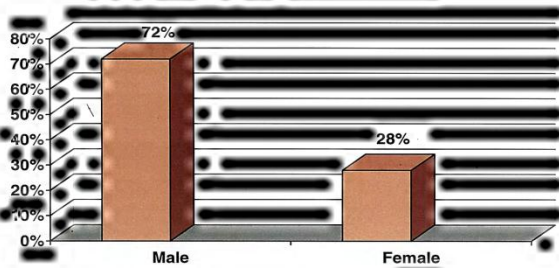
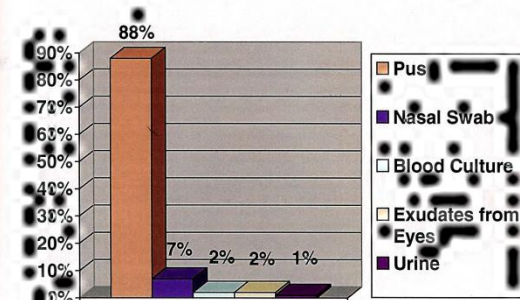


Table No.:4

Isolation of Staphylococcus aureus from various clinical specimens:

Clinical specimen	No. of S.aureus isolated	Percentage
Pus	88	88%
Nasal swab	7	7%
Blood culture	2	2%
Exudates from eyes	2	2%
Urine	1	1%
Total	100	100%

Graph Showing Distribution of S.aureus from various clinical specimens



clinical specimens

Table No.: 5

Methicillin resistant Staphylococcus aureus(MRSA) and Methicillin sensitive Staphylococcus aureus in Staphylococcus aureus isolates.

Total No. of S.aureus isolates	MRSA		MSSA	
	Number	Percentage	Number	Percentage
100	36	36%	64	64%

Out of 100 S.aureus screened, 36% of the isolates showed resistance to Methicillin and 64% showed sensitivity to Methicillin.

Pie chart showing Methicillin resistance & sensitivity in S.aureus isolates.

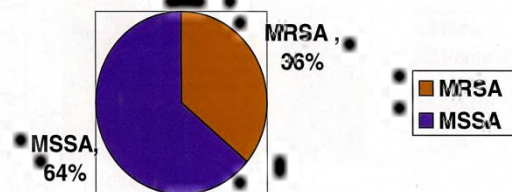


Table No. : 6

Sex wise distribution of MRSA and MSSA

Sex	MRSA Numbers	MRSA Percentage	MSSA Numbers	MSSA Percentage
Male	27	27%	45	45%
Female	9	9%	19	19%
Total	36	36%	64	64%

Graph Showing Sex wise Distribution of MRSA and MSSA

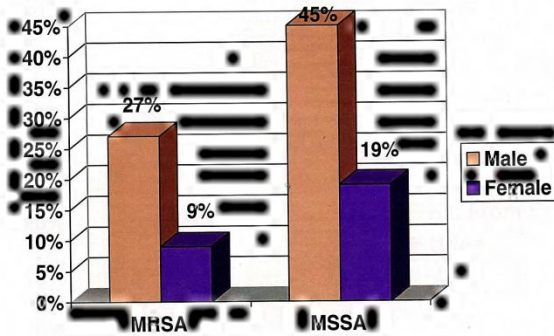


Table No.: 7

Specimen wise distribution of MRSA and MSSA

Clinical specimen	MRSA Numbers	MRSA Percentage	MSSA Numbers	MSSA Percentage
Pus	31	31%	57	57%
Nasal swabs	04	04%	03	03%
Blood culture	02	02%	-	-
Exudates from eye	-	-	02	02%
Urine	01	01%	-	-
Total	38	38%	62	62%

Graph showing specimen wise distribution of MRSA and MSSA.

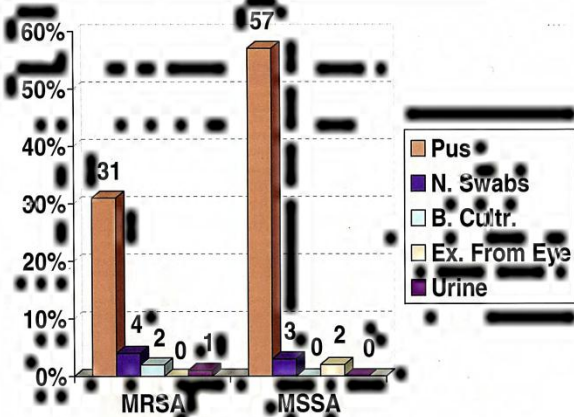


Table No.: 8

Isolation of MRSA and MSSA in different clinical wards:

Ward	Total Number of cases of S.aureus	MRSA Numbers	MRSA Percentage	MSSA Numbers	MSSA Percentage
1.Surgery	42	11	26.20%	31	73.80%
2.Orthopaedics	25	13	52%	12	48%
3.Skin	09	04	44.4%	05	55.55%
4.General medicine	04	01	25%	03	75%
5.Paediatrics	06	03	50%	03	50%
6.OBGY	08	03	37.5%	05	62.5%
7.ENT	04	01	25%	03	75%
8.Ophthalmology	02	00	00%	02	100%

Graph Showing MRSA and MSSA in different Clinical Wards

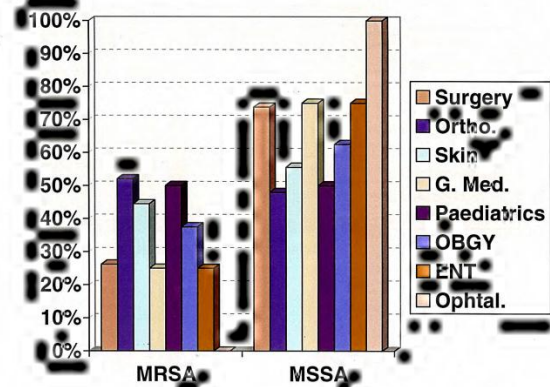


Table No.:9

Antibiotic susceptibility pattern of MRSA :

Antibiotics	Disc content	Resistance %	Sensitivity %
1.Penicillin	10 units	100%	00%
2.Methicillin	5ug	100%	00%
3.Oxacillin	1ug	100%	00%
4.Co-trimoxazole (Trimethoprim/ sulphamethoxazole)	1.25/23.75ug	69.45%	30.55%
5.Ciprofloxacin	5ug	72.23%	27.77%
6.Gentamicin	10ug	38.89%	61.11%
7.Erythromycin	15ug	75.00%	25.00%
8.Linezolid	30ug	00%	100%
9.Vancomycin	30ug	00%	100%

Graph Showing Antibiotic Susceptibility Patterns of MRSA

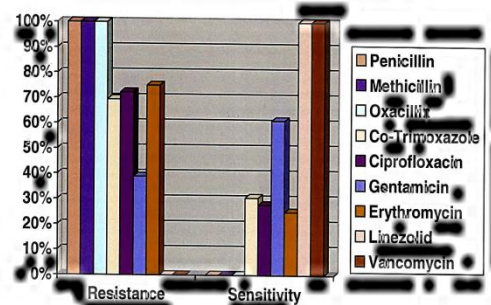
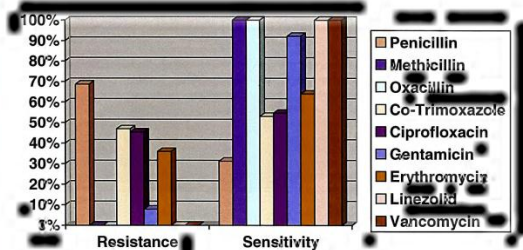


Table No.: 10

Antibiotic susceptibility pattern of MSSA

Antibiotics	Disc content	Resistance %	Sensitivity%
1.Penicillin	10 units	68.75%	31.25%
2.methicillin	5ug	00%	100%
3.Oxacillin	1ug	00%	100%
4.Co-trimoxazole (Trimethoprim/sulphamethoxazole)	1.25/23.75ug	46.88%	53.12%
5.Ciprofloxacin	5ug	45.32%	54.68%
6.Gentamicin	10ug	7.82%	92.18%
7.Erythromycin	15ug	35.94%	64.06%
8.Linezolid	30ug	00%	100%
9.Vancomycin	30ug	00%	100%

Graph Showing Antibiotic susceptibility pattern of MSSA



9] Vancomycin

The antibiotics were put up on Mueller-Hinton agar media inoculated with freshly isolated strains of Staph. Aureus and the plates incubated at 37deg.centigrade overnight. The plates were read the next day and the different zones of inhibition noted for different antibiotics.

Depending on the sensitivity pattern of Staphylococcus aureus to oxacillin discs, the strains were identified as MSSA orMRSA.

III. Discussion

Staphylococcus aureus is a versatile microorganism which is an important hospital and community pathogen. [59] S.aureus infections are important causes of morbidity in hospitals and the community. The spectrum of diseases produced by this organism varies from toxin mediated phenomenon to pyogenic infection, either primary or post-operative, both in the community as well as in hospitals [15, 74].

The enzyme penicillinase produced by S.aureus is responsible for its resistance to penicillin group of antibiotics.

The development of the semi- synthetic penicillinase- resistant penicillin, Methicillin, in the late 1950s was followed by the emergence of strains of S.aureus that were resistant to the agent. These strains were called Methicillin Resistant S.aureus [MRSA], and

were also found to be resistant to isoxazyl penicillins such oxacillins, cloxacillin and dicloxacillin.

This study was undertaken to isolate both MSSA and MRSA from different clinical specimens, to study their antibiotic susceptibility pattern, During the one year study , a total of 1589 samples were received in the department of microbiology, out of which 100 strains of S.aureus were isolated from different clinical specimens and screened for Methicillin resistance and sensitivity, also antibiotic susceptibility testing was done.

Out of the 100 isolates of S.aureus, 72 [72%] were isolated from males and 28 [28%] were from females. The percentage of MRSA was found to be higher in males i.e. 27% as compared to 9% in females.

Out of the 100 isolates of S.aureus, 88 were from pus samples obtained from patients from medical, surgical, orthopedic, ObGy, skin departments etc, 7 were from nasal swabs, 2 from blood cultures, 2 from exudates from eyes and 1 from urine.

Out of the 100 isolates of S.aureus screened for Methicillin resistance, 36[36%] showed resistance to Methicillin and 64[64%] were sensitive to Methicillin.

Out of these 100 isolates, age-wise distribution is as follows:

- 1] 0-1 month: 3 out of 5 isolates of S.aureus were MRSA i.e.60%
- 2] 2mths-18years: 3 out of 12 isolates were found to be MRSA i.e. 25%
- 3] 19years-30 years: 13 out of 39 isolates of S.aureus were found to be MRSA i.e.33.33%
- 4] 31 years- 40years: 6 out of 19 isolates of S.aureus were found to be MRSA i.e. 31.57%
- 5] 41years-50 years: 7 out of 11 isolates of S.aureus were found to be MRSAi.e.63.63%
- 6] 51 years-60years: 2 out of 11 isolates of S.aureus were found to be MRSAi.e.18.18%
- 7] Above 61 years: 2 out of 3 isolates of S.aureus were found to be MRSA i.e. 66.66%.

In our study, the percentage of MRSA is seen to be high [60%] in the younger age group i.e. neonates [0-1 month] and in the older age group of above 61 years i.e.66.66%, which correlates with the general consensus that these two extreme age groups are more susceptible to MRSA infections.

Maximum isolation of MRSA was from pus and wound swabs i.e. 31 out of 88 samples of pus [35.22%]. In the study done by S. Anupurba et al, the maximum isolation of MRSA was from pus and wound swabs.[54]

MRSA infection was found to be more common in orthopedic ward [52%], followed by pediatrics [50%], skin [44.45%], OBGy [37.5%], surgery [26.20%], E.N.T. [25%] and general medicine [25%].

In our study, the percentage of MRSA isolated is 36%, which more or less correlates with the percentage of MRSA in a 5-year study done by Mehta A.P. et al between 1992 and 1995, which ranged between 31.8% and 36.8% [43]. In another study done in a hospital in Kuwait, 32% of the isolates of S.aureus were found to be Methicillin-resistant.[83]. One study done by S.Vidhani, P.L.Mehndiratta et al [77], showed the percentage of MRSA to be 51.6%. In the study done by S.Anupurba et al [54], the percentage of MRSA was found to be 54.85%. The percentage of MRSA in our hospital has been found to be comparatively much lower than in these two other studies.

Hospital- acquired MRSA was found to be seen in 3 out of the 100 isolates whereas 97[97%] were found to be community-acquired. In a study by Amy V.Groom, Darcy H Wolsey, 74% of MRSA infections were classified as community- acquired. [77] In one study by Krishna B.V.S et al CA-MRSA was found to be 46%[79]. In another study by R.Monina Klevens Melissa Morrison et al, 58.4% were CA-MRSA infections. [99] In another study by Michael Hawkes et al, CA-MRSA exceeded 70% in Houston[16]. Our study shows a higher percentage of CA-MRSA as compared to both these studies. Recent reports show that CA-MRSA infections are increasing. [53]

Susceptibility of all the 100 S.aureus isolates was put up by the disc- diffusion method to various antimicrobial agents.

The patterns of antibiotic susceptibility for the MSSA strains were as follows:

Sensitivity to penicillin: 31.25%
Sensitivity to co-trimoxazole: 53.12%
Sensitivity to ciprofloxacin: 54.68%
Sensitivity to erythromycin: 64.06%
Sensitivity to gentamycin: 92.18%
Sensitivity to vancomycin: 100%

Sensitivity to linezolid: 100%

The patterns of antibiotic susceptibility in this study for the MRSA strains were as follows:

Sensitivity to penicillin: 0%
Sensitivity to cotrimoxazole: 30.55%
Sensitivity to ciprofloxacin: 27.77%
Sensitivity to erythromycin: 25%
Sensitivity to gentamycin: 61.11%
Sensitivity to vancomycin: 100%
Sensitivity to linezolid: 100%

The reported percentage of MRSA isolation from clinical specimens by different workers varies over a wide range in India [15, 43, 65, 57, 54, 50, 76, 79, 72, 77, 78, 91]

1] S.K.Mathur et al	1994	Lucknow	32.8%
2] C.Udayashankar et al	1997	Pondicherry	20%
3] Mehta A.P. et al	1998	Mumbai	32.8%
4] Majumdar D et al	2001	Assam	52.9%
5] Krishna B.V.S.	2001	Hubli	18.1%
6] Vidhani S. et al	2001	New Delhi	51.6%
7] Tanhnkiwale Supriya et al	2002	Nagpur	19.56%
8] Hanumanthappa et al	2002	Davangere	43%
9] S.Anupurba et al	2003	Varanasi	54.85%
10] Umashanker N et al	2004	Mangalore	10.9%
11] S.Sreenivasan et al	2006	Pondicherry	33%
12] Dr. D. Y. Patil Hospital	2008	N. Mumbai	36%
13] Summaiya Mulla et al	2007	Surat	39.5%

There was a marked difference in antibiotic sensitivity pattern of these MRSA vs MSSA isolates. None of the MRSA isolates were found to be sensitive to penicillin while 20 out of 64 MSSA strains [31.25%] were found to be sensitive to penicillin. 34 of the MSSA [53.12%] were found to be sensitive to cotrimoxazole whereas only 11 of the MRSA [30.55%] were found to be sensitive to it. Sensitivity to Quinolone group of drugs like ciprofloxacin was seen in 35[54.68%] of MSSA strains while only 10 [27.77%] of MRSA showed sensitivity to ciprofloxacin. Sensitivity to the macrolide group like erythromycin was found to be 64.06% i.e. among 41 MSSA isolates, while it was only 25% i.e. among 9 MRSA isolates. Sensitivity to the aminoglycosides like gentamicin was found in 59 [92.18%] of the isolates, while the sensitivity was only 61.11% i.e. among 22 of the MRSA isolates. All the strains of S.aureus

[MRSA as well as MSSA] were found to be 100% sensitive to linezolid and vancomycin, which are the drugs of choice for treating MRSA infections. In a study by Dr.Hanumanthappa A.R et al, all the S.aureus isolates were also found to be uniformly sensitive to vancomycin[72]. In another study done by A.A Mehta, CC Rodrigues et al, vancomycin was considered to probably be the only reliable choice for treating MRSA infections [73].In study by S.K.Rai et al [89], all the MRSA strains were found to be resistant to penicillin, correlating with the findings in our study. In a study by S.Srinivasan et al [56] all the isolates were sensitive to linezolid, correlating with the sensitivity pattern of linezolid in our study. In one study conducted by K.Rajadurai pandi et al[94], resistance to gentamycin was found to be 62% while it was found to be only 38.89% in our study. In one study by S.K.Kandle[86], resistance to erythromycin was found to be 92% whereas resistance to erythromycin was found to be 75% in our study. In our study, resistance to cotrimoxazole was found to be 69.45% which is slightly more than the findings of K.Rajadiraipandi[94] with a resistance of

63.2% to cotrimoxazole. Resistance to ciprofloxacin was found to be 72.23% which is more than that of the findings of S.K.Kandle et al i.e.50.8% [86]. In our study all the isolates of MRSA were found to be sensitive to vancomycin and linezolid. This was followed by a lesser resistance to gentamycin, cotrimoxazole . MRSA strains are also found to be resistant to quinolones like ciprofloxacin and the macrolides e.g. erythromycin.

IV. Conclusion

Indiscriminate use of multiple antibiotics prolonged hospital stay, intravenous drug abuse and carriage of MRSA in nose are few important risk factors for MRSA acquisition. The good news is that MRSA is preventable. Health care facilities need to make MRSA prevention a greater priority. The first step to prevent MRSA is to prevent healthcare infections in general. Infection control guidelines produced by CDC and the Healthcare infections control and Prevention Advisory Committee (HICPAC) are central to the prevention and control of Healthcare infections and ultimately MRSA in Healthcare settings.(3).

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Baker's Vendi

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ABSTRACT

Today in the world technology is given the utmost importance and is further revolutionizing with time. Thus, industries are also exploring around transforming or manufacturing new types of vending machines which are more efficient and time-saving. Therefore, the aim is to contribute towards the technology of vending machines in the automation world. The paper elaborates the designing and fabrication of a bakery item delivering vendig machine. This machine is designed by implementing mechatronic systems and designs, which includes mechanical structures, electronics and computer logics combined. The operation of this particular vending machine is distinguished from the pre-existing spring vending machines available in Pakistan currently. Due to the fact that it has been designed keeping in mind the handling of delicate bakery items. The aim is to deliver bakery items by maintaining their delicacy and freshness through faster and effective means of automated machines. It also shows the design methodology that has been adopted to create this machine that will be controlled via controller through programming logics and gives a description of how these efficient automated machines will replace our future bakeries.

Keywords: Vending Machine, Conveyors, Automation, Coin Acceptor, Temperature Controlling

1. Introduction

Technology is advancing day by day. Automation is the current hype around the world and the entire world is progressing at a great speed towards automation. The manual working phenomenon is gradually decreasing [1-3]. The machine revolution has empowered people to concentrate more towards automation of things from simple household chores to huge industrial based projects.

This vendi is about further revolutionizing the vending machine world. Up until this point, many different types of item and luxury holding vending machines have been fabricated for human use and those things could be purchased from a vending machine such as food, beverages, medicinal drugs, toys and even cars [4-10]. Therefore, in order to further revolutionize the vending world in Pakistan it was thought upon to design a vending machine that would serve the people with confectionary items and bakery eatables. The vending machines are a bigger step towards the automation field. Not only do they provide comfort and save time and money but also solve bigger problems of space occupancy and increased market competition. Bakeries are

well-known to occupy huge space and require huge capital investments on their establishment and later on their maintenance. Therefore, vending machines are a smart solution to end these problems. However, it wasn't as apparent as thought. Since it isn't easy to deliver a confectionary item without it getting the presentation look destroyed or reshaped into something unappealing. It is a known fact that dealing with confectionary items requires a lot of care since they are extremely delicate. This is one reason that no one so far has made a vending machine for bakery or confectionery items in Pakistan. Springs are the most well-known mechanism utilized in vending machines to drop packed food items such as chips, biscuits, beverages etc. but bakery items are such delicate eatables that they can get decimated with a fall. To counter such an issue a new transportation system had to be developed which would not annihilate the appearance of the confectionary item and will transport it easily without making it look like a massacre.

Therefore, the feature in this particular vending is that this project uses a combination of conveyors and lift mechanism. The technique needs to be subtle and not too time consuming

as vending machines have been designed for the sole purpose of faster service. In order to tackle the problem of efficient delivery and faster service also keeping in mind the delicacy of the items, the design had to be switched upon from conventional spring mechanism to conveyor and lift mechanism [11-12]. This transportation framework comprising belt conveyors and lift had to complete the entire extraction of the packed confectionery items from the placement counter to the positioned exit without any fail. Upon further thinking and assumptions there arose certain problems, one of which was the prime issue of maintaining the confectionery items at a certain temperature to keep them fresh. Therefore, the need of temperature-controlled compartments also had to be implemented inside the vending machines.

2. Literature Review

In 2017 a study by a bunch of students structured a smart newspaper vending machine. Machines are the most noteworthy advancement towards automation of industries since they not only reduce human efforts and risk but also are precise and effective in all sorts of conditions and situations. Their main objective was to decrease manual/human exertion of delivering or selling paper from door to door also, sparing time as opposed to remaining in long queues to purchase newspapers and to actualize a blunder free method for payment in order to stay away from all sources of cash error and miscalculations. They have structured a digitized payment strategy utilizing RFID as a client interfacing technique. They have used a combination of mechanical designs, electrical and electronic selection and computer interfacing so as to summarize it to a mechatronic framework plan. An RFID is utilized for client validation and membership purposes, a mechanical instrument of slider and rods being driven through DC motors are utilized to administer each newspaper in turn utilizing micro-controller (MS430G2553) as an embedded system with low power utilization interfaced with an ultrasonic sensor to abstain from dispensing more than a single paper at once making it a

successful attempt. Besides, the ultrasonic sensor is utilized to monitor the width of the paper utilizing its reverberation (echo) detecting technique. This concept is similar to our project i.e., the thought behind designing a vending machine for bakery items is to abstain from standing in long queues during rush hours and festivities when bakeries are flooding with people and to execute an accurate approach towards payment to dodge manual cash miscounting. In addition to this, a vending machine does not consume excess space in contrast to a bakery and has 24/7 accessibility to it. However, Bakers' Vendi differs from this one since it has not been proceeded towards a cashless and digitized payment strategy rather has utilized a coin acceptor as a payment technique. Also, the mechanical framework is a combination of conveyors and lift considering the delicacy of eatables. Furthermore, this project differs from Bakers' Vendi due to the simplicity of the newspaper vending machine of having a single column of dispensing whereas, we have multiple columns and rows to deal with making our vending a bit complex and diversified [13].

In the University of Science and Technology of Southern Philippines, a research/survey was carried by a student of that university regarding the selling of loose sheets at the printing shop to students for different purposes such as examination answer sheets were particularly of yellow color, A4 sheets, long sheets, short sheets, bond papers, etc. The survey conducted states that among all the tasks the counting and selling of loose sheets is the most painful task for retailers and so it is for the customers (students) to wait for their turn just to buy a few sheets of papers. Retailing papers is a very hectic and time-consuming job which also includes dishonesty of few retailers deliberately and at times it happens mistakenly under the pressure of multitasking since there are thousands of students in a university with few resource availabilities. Therefore, to make it efficient a 20" tall, 13" wide and 18" long paper vending machine was designed for students to purchase loose sheets whenever required without wasting time at the book shop crowded with students. This not only reduces manual efforts but is a step towards automation and saves plenty of time. This machine has

been designed keeping in mind the busy schedule of students and it consists of a printer dispensing section used for storing and dispensing of papers. Outdated printer parts driven by a servo motor have been used in designing this particular vending machine. A selector switch is used to select the type of paper you intend to buy, indication button indicates the ongoing status/task being performed by the machine, IR proximity sensors are used to check the availability of papers, PIC16F84A microcontroller device was interfaced with a motor driver to regulate the working of the dc motor. A coin acceptor machine is being used which can accept Php 1, 5 and 10 coins only. The machine will dispense the number of sheets equivalent to the amount inserted in the form of coin. However, there is no way for dispensing change out of this machine. After being assembled the machine was set up at the University for Evaluation Purposes. The performance of the machine was not up to the mark due to inaccuracy of the machine which was probably due to the old/outdated recycled parts that were put to use in the machine but the portability of the machine was highly appreciated and the retailers were willing to invest in such machines which would save their time and effort however in more accurate and precise version of such machines. To overcome this issue the machine needs to be designed with excellent quality printer parts, motors, and money operators for complete accuracy of service [14].

Programming Logic Controller operated vending machine was designed based on Mitsubishi PLC rather than Arduino or Raspberry Pi as micro-controllers. A vending machine is a money-driven machine therefore, a coin slot is compulsory in this particular kind of vending machine. It has a coin slot mechanism installed in it which will accept money in the form of coin. However, the disadvantage of this vending is that the machine can't identify forged coins and the purchaser can't discount the cashback if the product is unavailable in the slot of the machine which isn't the case in Bakers' Vandi [15].

The smart coffee vending machine is based on RFID rather than coin or currency system in

order to prevent machine misuse under any circumstances. RFID based cards are mainly used for security purposes or identification purposes. In this case, it is used as an employee ID in order to get coffee from the vending machine. However, the vending is programmed to evaluate per person requirement using Arduino as a microcontroller due to its cost-efficiency and ease to program in order to allow only the particular set number of coffee cups as assigned by the company for a single employee per day to avoid overconsumption. Exceeding the number of cups is allowed but at the cost of payment from the salary account. Coffee is only dispensed after the identification procedure is completed using the RFID card. The machine has a storage compartment for all the ingredients such as coffee powder, milk, and sugar. A hot water mechanism is controlled using a temperature controller interfaced with the microcontroller. The microcontroller used is ARDUINO UNO. The controller in this coffee machine is interfaced with RFID for identification of employees, IR sensor for detection of coffee cups, EPROM is an erasable memory chip to store data regarding the number of coffee cups consumed, motor to manage the consumption of coffee powder and LCD to display consumer details. Also, the quantity of each item is controlled using a microcontroller. The counter in the machine keeps a track of the number of coffee cups consumed per person [16].

The Chocolate vending machine is a very simple device that has been designed using RFID and Arduino UNO. The whole idea of this machine stands on the grounds of using RFID rather than using currency or coin acceptance-based system due to their lack or inability to dispense the remaining change out of the system. RFID is used to detect the user ID and the balance account which is also displayed on the LCD. Arduino is used to interface RFID with the LCD screen to display the price of the items. Microcontroller Arduino UNO is a user-friendly interfacing device and can be also used to interface display and keypad which is the point of concern for Bakers' Vendi [17].

The Cold drink vending machine with a reverse vending system for empty bottles has been basically designed keeping the idea of being

environment-friendly. The globe has been polluted due to plastic bottles which cannot be decomposed and remain on the planet for thousands of years, making it more polluted. Therefore, the basic concept is to recycle plastic bottles contributing to an eco-friendly environment. The working of this machine involves a coin acceptor module which will be working on the basis of the diameter and thickness of the coins. If the coin has been identified to be correct the machine will further proceed on otherwise it will reject the coin and initialize the machine. If the coin has been accepted then the customer can select the cold drink bottle using the keypad. Once selection has been made the servo which is working in accordance with the microcontroller will dispense the bottle out of the machine. Meanwhile, the LCD will be displaying the status of the vending machine operations. However, for the reverse vending procedure the barcode on each bottle is already saved. For reverse vending, the machine will scan the barcode on the bottle and compare with the saved barcode in the system. If it matches the microcontroller will allow the servo to open the shutter for the bottle recycling compartment. The monitoring system keeps a check on the number of bottles in the container. Once the container has crossed a certain level the monitor generates an alert beep. When it gets full the monitoring system stops the machine from further accepting any bottle. The reverse vending system will have a great impact on creating a cleaner and better environment [18].

Bakery Items Shelf Life

According to book, bread has a time span of usability of around a couple of days while cakes have a more prominent time span of usability particularly known as shelf life of around half a month since they are food sources with moisture substance in the range $18\pm 30\%$ of the mass of the item. Biscuits, cookies, and crackers comprise of moisture in them which is commonly below 5% of the item mass and the low moisture combined with the thinness of the items gives them their crispness. The low moisture and low water

movement of items imply that they have a long mould-free shelf life of usability, normally many months. Pastries generally comprise of higher moisture than that in cookies and biscuits however it is lower than that of cake. Thus, pastries lie in the range between biscuits and cakes. Freshly baked pastries have a long shelf life but due to the movement of moisture from the filling content towards the crust content decreases their shelf life to a few weeks [19].

The most fundamental method of increasing the shelf life of bakery items during distribution and storing time period is through temperature control. But this case is not suitable with bread since upon refrigeration, although it does increase its shelf life but also builds up its pace of hardening and becomes firm making it inedible. This has been a common problem with sandwiches because for storing purposes refrigeration is the best option. However, it turns the bread firm which eliminates the fresh appeal of the food item turning away the consumers. Therefore, bakers consider freshly made bread to be sold on a daily basis due to the fact that these products lose their appeal within a day or two at the most. However, the refrigeration phenomenon supports the cakes and pastries department. Therefore, we will be utilizing a cold compartment for cakes and pastries section in our vending machine. Moreover, packaging is another basic technique to increase the shelf life of food items which will be similar in our case since all the items will be packed for convenient transportation from the conveyor to the lift and to the exit and for hygienic purposes as well since packaging of bakery items is done to restrict moisture flow within the product i.e., moisture flow from the filling of the pastries to the crust part. In biscuits, packaging helps avoid moisture absorption from the atmosphere [20].

The ways to increase mould-free shelf life are by adding preservatives, using packaging techniques, MAP (Modified Atmosphere Packaging), ingredients selection, maintain hygienic measures, keeping returned mouldy products away from bakery and other bakery products, keeping the bakery environment clean, avoid build-up of detritus on shelves, trays conveyors or machines, keep utensils

clean, clean all surfaces in contact with food and isolate flour-handling range from the packaging section and other sections[21-23].

3. Structure and designing

3.1. 3-D CAD Model

During this phase of the project the Literature review study became the source of guidance and help. Quite a number of procedures and approaches that have been implemented were derived from the help of those. After studying and analyzing a great deal of literature reviews of successful and unsuccessful attempts done previously in designing and implementing different kinds of vending machines helped to avoid repeating the errors that occurred previously. Furthermore, it helped to bridge the gap between the technologies lagging currently in Pakistan regarding the vending world. By pondering over all these errors and issues and making multiple design iterations and reviewing it for all errors, the design of Bakers' Vendi was finalized and concluded. Bakers' Vendi comprises three main mechanical mechanisms i.e., Conveyor Mechanism, Lift Mechanism and the Coin accepting criteria. The CH926 coin acceptor which has been interfaced with the Arduino MEGA (controller) is used for identification of any counterfeiting of coins and is used for payment methods. The conveyor mechanism functions as a transporting device in order to transport the confectionery item from the conveyor belt to the lift tray. The lift mechanism based on customized lead screws and pulleys that work in accordance to the requirements of the project are used for further transportation of items towards the exit pocket of the machine. Below is the CAD design model of Bakers' Vendi:

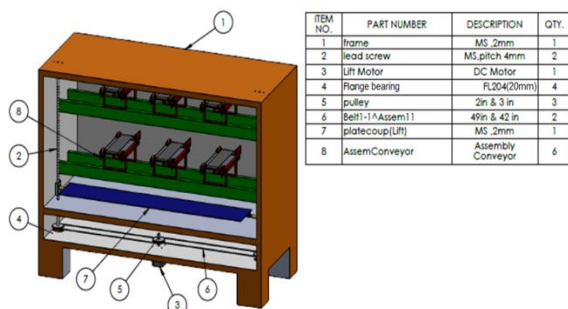


Figure 5. CAD Assembly of Bakers' Vendi

3.2. Design Analysis

The 3-D design of Baker's Vendi had to undergo simulation in order to determine the stress analysis and factor of safety of the critical areas identified the outer structure. Simulations were carried out on the base of outer structure. The base of the outer structure will hold the weight of the entire structure itself and the components housed within. Therefore, the material and design need to be firm enough to support the machine. Stress analysis and Factor of Safety are extremely essential parameters and need to be calculated and checked against the load (force) applied. As these analyses helps in the prevention of structural damage of the material used. In the stress analysis, the maximum induced stress and actual stress are simulated, which helps to determine whether the material can bear the load or not. While the Factor of Safety indicates the reliability of the material's design. The entire analysis was done on Solid works and results are shown below:

3.2.1 Stress Analysis of the Base Outer Structure:

The simulation results of the stress analysis are shown in figure 11, when the force is applied onto the base of the outer structure in the downwards direction according to the load that will be applied on to it. Yield Strength is found to be around 220 MPa whereas the maximum stress of mild steel is 247Mpa therefor load applied is under the safety limits hence the structure will not get deformed upon application of load.

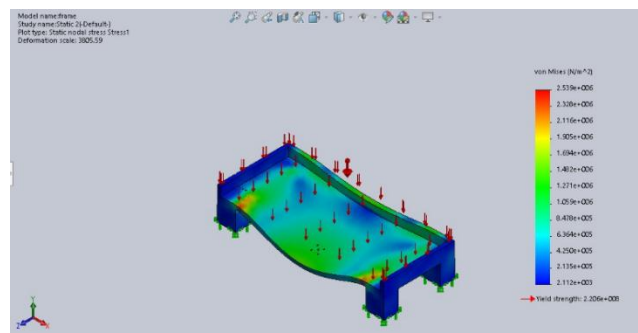


Figure 6. Stress Analysis of Base Structure

3.2.2 Stress Analysis of the Base Outer Structure:

The entire structure is under the range of FOS which is found to be 87, which indicates that the part is quite far away from fracture point and is reliable. Hence the design and material of the structure are reliable and suitable for carrying the load.

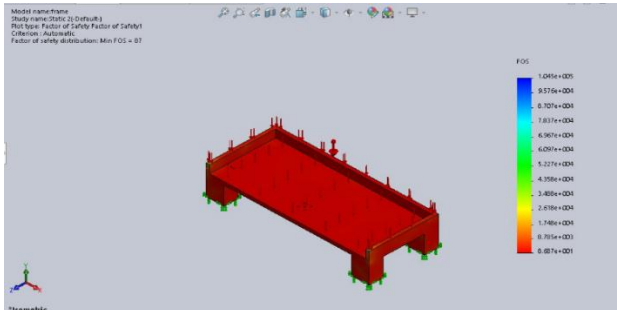


Figure 7. Factor of Safety Analysis of Base Structure

3.3. Block Diagram

Arduino MEGA is the controller, interfaced with sensors and actuators of the vending machine. It controls and monitors all the processes, starting from input to output. The Android application is connected via Bluetooth Module which transmits the data to Arduino. Moreover, the Coin Acceptor sends data to the Controller, regarding the coins being accepted or rejected. After the acceptance of coins, selection of items is done by the customer through an Android application. Then Arduino gives commands in sequence and monitors via sensors. Relays are activated accordingly, which controls the motors due to which conveyors and lift operate. It checks for the command and generates the suitable logic signal for the relay switching. Firstly, lift is moved up towards the respective floor, and the limit switch sends the signal to Arduino that lift has reached the floor in order to halt its movement. After which conveyors are moved until the Confectionary item is transported to the lift and monitored by the IR sensors. Finally, lift is moved down towards the exit. Moreover, the temperature is real-time monitored and controlled by Arduino. Thermocouple continuously sends signals to Arduino, which either turn on or off, Peltier Module or Heating Element, required to maintain the temperature. The following is a block diagram of the flow of information from the sensors, devices and actuators to the controllers:

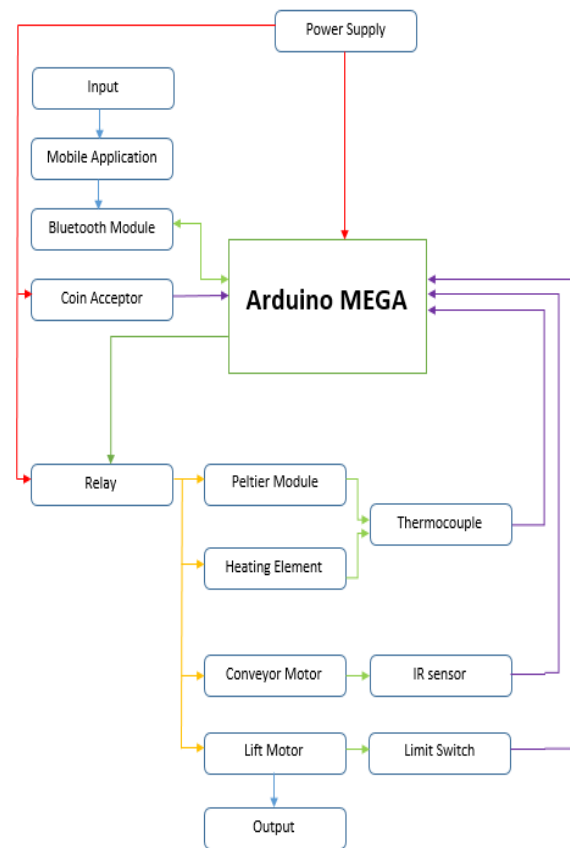


Figure 8. Vending Machine Block Diagram

3.4. Flow Diagram

The logical working of the project is demonstrated through the flow chart which explains in detail the working procedure of Bakers' Vendi. The flow diagram of the process explains the working principle of the vending machine i.e., the procedure to deliver bakery items from the vending to the exit as follows:

- *In order to select the desired eatable, the customer needs to select the item number using the mobile application that is interfaced to the vending machine.*
- *Then the customer will insert the amount of the product that he/she intends to buy into the coin acceptor. After the cash is accepted, the machine disposes away the cash in the money box. If the machine recognizes any counterfeit it will discard the coins and will not further proceed with the instructions.*

- When the machine acknowledges the sum of money deposited in it, the lift will move towards that designated floor of the selected conveyor item (there are two rows and each floor have three columns assigned to it in this vending machine).
- Once the lift has reached that floor, the conveyor will start moving and will consequently transport the item on to the lift.
- Then the lift will move towards the base pocket of the machine from where the customer can pick up the eatable and consequently the machine will halt.

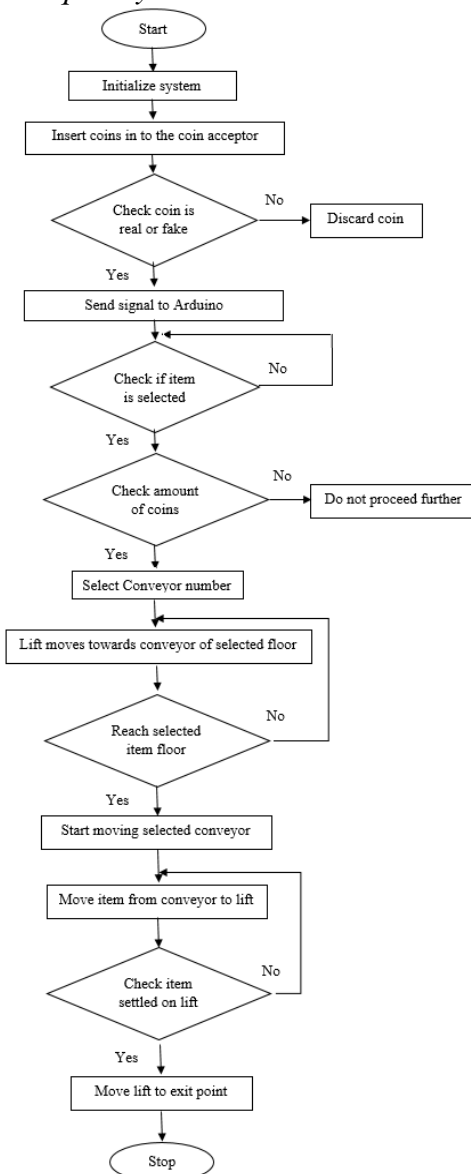


Figure 5. Process Flow Diagram

4. Working

4.1. Hardware Fabrication

With the success of an effectively designed CAD model and achieving relevant outcomes from the stress analysis and simulation model, the work proceeded on with the manufacturing and fabrication of the hardware. The hardware fabrication was executed with respect to the proposed CAD design and its dimensioning. First of all, the outer frame of the structure of the vending machine was fabricated using L-shaped Mild steel angle brackets of one-inch width as per the finalized dimensions i.e., 4 feet x 4 feet x 3.5 feet. The angle brackets were welded together to bond the structure together firmly. The dimensions were selected considering the overall architecture of the machine such that it could accommodate and withstand the weight of the conveyors, lift and other parts to be installed within the structure. The structural dimensioning and material strength are sufficient to hold and accommodate the load of six conveyors all together. Then the conveyors and lift were fixed onto the structure respectively. The conveyors were distributed among two floors with three conveyors on each floor. The conveyor assembly consists of a frame of mild steel of 5.5 inches x 40 inches with a rubber conveyor belt of 42 inches x 5 inches wrapped around two rollers of 2 inches diameter each that are housed at each end of the conveyor frame. Next, the DC geared motors of the conveyor were mounted on the flange adjustment plate which holds the flange bearing (FL204) having 20 millimeters diameter which were coupled with the ends of conveyor roller in order to drive the conveyor belt conveniently. Each conveyor assembly has been constructed similarly. Just beyond the conveyors the lift mechanism had to be assembled with minimal gap between the two in order to safely transport the confectionery item from the conveyor on to the lift by maintaining its delicacy. This is the sole reason of designing a confectionary based vending machine.

The lift mechanism comprises of two customized square threaded lead screws made of Mild steel having length of 3 feet and a pitch of 4 millimeters. The ends of the lead screws are coupled with a flange bearing (FL204) to fix them to the structure and consequently allow them to freely rotate from within. The lift

plate has been fabricated using Mild steel sheet of 35 inches length, 8 inches width and 2 mm thickness. The ends of the plate are coupled with the lead screws using threaded bearing so that the plate can freely move up and down. The bottom ends of the lead screws are coupled with one pulley on each lead screw and another in the center of the frame of the lead screws. Rubber V-belts are encircled around these pulleys. V-Belt are used to mechanically couple the three pulleys with the motor and lead screws. They are used to transmit the rotation of the motor from the pulleys to the lead screw. With completing this the final lift assembly was installed on the structure completing the basic hardware structure of the vending machine.

After mounting conveyor assemblies and the lift mechanism, the electronics and electrical components were mounted on their desired position for efficient working of the machine. The FC-51 IR sensors were mounted on the front end of the conveyor frames in order to control the movement of the motor in accordance to the availability and transportation of the item on the conveyor belt so as to avoid multiple item transport in a single purchase. The FC-51 IR module has a detection range of 2 to 30 cm and a detection angle of 35 degree. The processing speed is faster, precise and can be altered with the help of a potentiometer placed on the module. An optical encoder is attached to the conveyor motor to manage the speed and position of the motors to ensure single displacement of the item for every purchase. The encoder works as a feedback control system and monitors parameters such as speed, position, direction etc. It converts mechanical movement to electrical pulses in order to control the desired parameters or make adjustments are per requirement. Limit switches were mounted at the bottom of the lead screws for guiding and controlling the lift to reach its desired floor. The switch is made of steel and PVC and has a voltage specification of 250 V and energizing current of 10 A.

Next the temperature controlling was carried out for both the hot and cold compartments. The cooling compartment was the center of focus since it required well maintained temperature using Peltier modules.

Thermoelectric cooler TEC1-12706 works on the phenomena on creating a temperature difference between two semiconductor electrodes when voltage is applied. Due to which one junction cools while the other transfers heat towards it, making one side cold and the other hot. Moreover, this module works on 12V and 6A, compatible with the power supply installed. The temperature of the vending machine will be maintained at 15 degree Celsius for the cold compartment in order to keep the bakery items such as pastries, cakes and donuts fresh. A single Peltier module was not sufficient for the compartment. Therefore, in order to maintain the temperature of the entire compartment three Peltier modules were used.

For the warm compartment halogen bulbs which are commonly known as incandescent bulbs have been utilized. They comprise of tungsten filament with a combination of an insignificant quantity of halogen gas, for example, iodine or bromine along with an inert gas. This mixture causes a chemical reaction of halogen cycle. The evaporated tungsten is redeposit back on to the filament which expands the life of the bulb. It also permits the tungsten filament to work at higher temperature as compared to standard bulbs of the same power. The color temperature also contributes to its higher temperature, they give off the most amount of heat as compared to other types of LED bulbs. For e.g., a 50 W halogen bulb will emit about 48 W of heat. Therefore three 50 W halogen bulb will be needed according to the heat analysis carried out.

Thermocol is used to provide insulation from inside as it has very low thermal conductivity. Moreover, it is light in weight, economical and easy to use. The entire vending machine is properly insulated using a 4-millimetre thermocol sheet on all the sides of the vending machine to prevent any loss of heat due to any means of conduction or convection. Vending machine accepts coin as payment and for this machine a CH926 coin acceptor was installed for consumers to purchase food items. The coin acceptor has the capacity to accept six different coins. It can work with all coins universally available as long as it is within its acceptable diameter and thickness range. It has a coin

diameter acceptance range of 15 millimeters to 32 millimeters while thickness acceptance range of 1.2 millimeters to 3.8 millimeters. The identification of counterfeit coins in this machine basically works on weight, material and dimension identification and has an accuracy identification rate of 99.5%. Moreover, it can work in extreme temperature ranges with great stability which makes it more preferable over other coin acceptors. A HC-05 Bluetooth module is integrated with the Arduino ATMEGA 2560 (microcontroller) to receive signals from the mobile application and transfer the commands to the microcontroller. A power supply of 12 volts and 25 amperes was installed and connected to the system. One must be certain that there is enough power for all the components to draw and work on their optimum levels to acquire the best and most efficient machine it can be. The human access with this machine comes to be virtual when selecting the choice of food, they want and would be physical when inserting coins and picking up the food item they selected from the desired exit.

4.2. Hardware Working Principle

The working of the hardware is described as initially when the power is supplied to the vending machine only the Peltier module and the bulb will be in working state 24/7 without fail. The conveyors and lift will remain stationary until they receive any input operating command from the application. The Peltier and bulb need to remain working continuously since they maintain the temperature of the cold and hot compartments of the vending machine to keep the confectionary items fresh and healthy all day long and to protect them from humidity and moisture that might occur due to temperature variation. The entire vending machine is completely insulated using thermocol to prevent any heat loss and to maintain the temperature of the vending machine.

The item to be purchased is selected using a mobile application by selecting the predefined item number. The mobile application is interfaced with the vending machine using a Bluetooth module which is interfaced through the Arduino. The moment the item is selected on the application the Bluetooth initializes the

Arduino regarding the price of the item. The coin acceptor is also initialized. In order to purchase an item, the customer must insert the sufficient coins according to the price stated. As the customer inserts the amount to be paid, the coin acceptor runs scans for any counterfeit or fake coins and also scans whether the amount payable is equivalent to the cash inserted or not. Once the coin acceptor has completed this scanning and processing it signals the Arduino to carry on with the delivery of the item. If any of the following criteria has not been achieved the cash will be dispensed out and the Arduino will receive signal to stop further processing. The Arduino signals the lift motor to operate resulting in rotation of the v-belts which are coupled with the pulleys that rotate the lead screw to move the lift up or down to the respective floor on which the item is placed. Here the limit switches play an important role in guiding and directing the lift to the respective floor and also to synchronize it in line with the conveyor bed. Once the lift has reached the desired floor the respective conveyor motor starts moving and the item is moved from the conveyor bed on to the lift. The IR sensors that are mounted on the sides of the conveyor bed monitor and detect the item movement from the conveyor bed on to the lift and stops the conveyor motor when the IR detects that item displacement has been carried out. Once the conveyor motor stops it consequently turns the lift motor on and delivers the food to the base pocket of the vending machine from where the customer can collect the item. This way the entire process of the vending machine can be carried out.

4.3 Software

The programming of any project is the main core and soul of the Vendi project. The software comprises of Arduino coding inclusive of an Android application to begin the process of buying an item from the vending machine.

The software used to design the application for the vending machine is android studio [21]. Design layout was finalized and planned on the main frame whereas the coding of the process was compiled on the back end. The application can be downloaded onto any android phone and can be connected to the vending machine

through Bluetooth. Hence connecting the application with the main program which has been compiled and finalized on Arduino. Arduino is the microcontroller, in which the program has been installed and loaded on its software to instruct the working of the hardware.



Figure 6. Bakers' Vendi Application Icon

Vendi's software comprises of two parts. First one being an application designed on android studio which will show the items and their respective prices to the customer in order for them to purchase an item from the vending machine. The application has been developed on Android Studio and can be connected within all android users. However, only one mobile can be connected with the vending machine at a time. The interfacing of the machine and mobile will occur through Bluetooth pairing. Bluetooth is interfaced with the Arduino microcontroller to instruct the working of the project in accordance with the android application selection to provide an efficient transport system for the confectionery items.



Figure 7. HC-05 Bluetooth Pairing with Vending Machine

When a user connects the application with the machine using Bluetooth, a page will open on the mobile screen showing the products and their respective price. Once user selects the desired food item, it is required to make the payment which will be made through the coin acceptor installed on the Vendi. For example, the user selects an item which costs Rs. 10 then the user will have to enter two Rs. 5 coins as those are the standard coins that have been chosen for the coin acceptor to accept. Any other coin that does not match with the properties of this coin such as a different shape and size will be rejected.

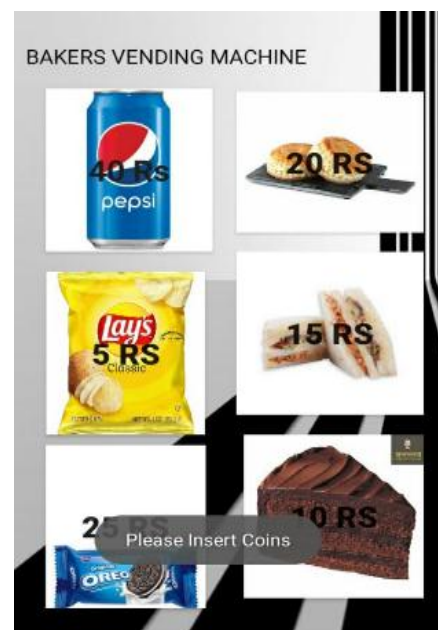


Figure 8. Bakers' Vendi Android Application

For every conveyor a unique string has been designed that is initialized by the Arduino upon the selection of that particular conveyor item and once the payment has been made. Once the Arduino is initialized, the further instructions that are to be carried out by the machine are activated. After the payment has been made, a string would be sent to the Arduino that will activate the lift motor first to move towards the respective floor of the selected conveyor and then initializes the conveyor motor to systematically operate as the lift reaches the floor. Consequently once the item has been transported from the conveyor on to the lift the IR sensor which has been installed at the front edge of the conveyor detects the item and instructs the Arduino to halt the conveyor motor and to initialize the lift motor to deliver the item towards the base pocket to be retrieved by the customer.

5. Observation and Analysis

5.1. Material Selection Criteria

The selection of the material depends on the capability of load handling that can be managed by the material without any sort of deformation. The weight of the entire structure plays an essential role in the material selection criteria. In order to select an appropriate material considering the weight bearing capability and other factors such as resistance to corrosion, ease of machining, price, yield strength etc. To mathematically support the selection of mild steel as the structure material the stress equation has been used. The Yield strength will be compared to the calculated stress. The Yield Strength of Mild Steel is 247 MPa. Therefore, any value that falls below the Yield Strength will be acceptable and will not cause the structure to deform.

The stress equation can be given as

$$\sigma = \frac{F}{A} \quad (8)$$

$$F = W = mg \quad (9)$$

$$\sigma = \frac{m * g}{A}$$

Substituting the estimated values of the parameters in to the above equation where the

estimated weight of the structure is about 50 kg. Since the structure is hollow from within therefore the cross-sectional area can be calculated through the following method

$$\sigma = \frac{50 * 9.81}{(0.9144 * 1.12776) - (0.887 * 1.10036)}$$

$$\sigma = 502.533 \text{ Pa}$$

Therefore, the calculated stress supports the fact that Mild steel is a suitable choice. Moreover, it is also cost-efficient, easy to machine and corrosion resistant.

5.2. Lead Screw Calculation

Lead screws have been used in order to convert rotary movement to linear movement. For Bakers' Vendi two lead screws have been utilized. One at each end of the plate for the upward and downward movement of the lift plate. Square threaded lead screws have been used due to the fact that they offer least friction during movement and are highly efficient. However, the torque that is needed to raise or lower the load which includes both the weight of the lift itself as well the weight item on the lift can be determined using the lead screw torque raising and lowering formulae.

The lead screws are made of mild steel having a pitch of 4 mm and has a single thread throughout the length of the lead screw so 'n' is 1.

Therefore, the lead 'l' of the lead screw can be found using

$$l = n \times p \quad (10)$$

$$l = 1 \times 4$$

$$l = 4 \text{ mm}$$

The minor diameter 'd_r' of the lead screw is measured to be 14 mm and major diameter 'd' of 20 millimeters while the pitch is determined to be of 4 millimeters, The mean diameter 'd_m' of the lead screw can be determined using

$$d_m = d - p/2 \quad (11)$$

$$d_m = 20 - 4/2$$

$$d_m = 18 \text{ mm}$$

The estimated load that the lift will carry can be determined using the below stated formula where mass includes the mass of lift plate as well as the estimated mass of the confectionery item itself.

$$F = W = m * g$$

$$F = 1.3 * 9.8$$

$$F = 12.753 \text{ N}$$

The coefficient of friction of the collar and the coefficient of friction for the thread are both 0.64 since both have been fabricated using the same material i.e., mild steel while the mean diameter of the collar is 27 millimeters.

5.2.1 Torque Required to Raise Load: The torque required to raise the load using a lead screw can be determined using

$$Tr = \frac{F * dm}{2} \left(\frac{l + \pi \mu dm}{\pi dm - \mu l} \right) + \left(\frac{F \mu c dc}{2} \right) \quad (12)$$

$$Tr = \frac{12.75 * 18}{2} \left(\frac{4 + (\pi * 0.64 * 18)}{(\pi * 18) - (0.64 * 4)} \right) + \left(\frac{12.75 * 0.64 * 27}{2} \right)$$

$$Tr = 195.584 \text{ Nm}$$

5.2.2 Torque Required to Lower Load: The torque required to lower the load using a lead screw can be determined using

$$Tl = \frac{F * dm}{2} \left(\frac{\pi \mu dm - l}{\pi dm + \mu l} \right) + \left(\frac{F \mu c dc}{2} \right) \quad (13)$$

$$Tl = \frac{12.75 * 18}{2} \left(\frac{(\pi * 0.64 * 18) - 4}{(\pi * 18) + (0.64 * 4)} \right) + \left(\frac{12.75 * 0.64 * 27}{2} \right)$$

$$Tl = 172.65 \text{ Nm}$$

5.2.3 Lead Screw Critical Speed Analysis:

As the lead screw has been assembled using flange bearings on each side of the lead screw so 'C' will be 1 for both ends simply

supported. The length between bearing supports 'L' is 36 inches while the smallest diameter of lead screw is 0.551181 inches.

The critical speed of the lead screw 'N' can be determined using

$$N = \frac{(4.67 * 10^6) dr * c}{L^2} \quad (14)$$

$$N = \frac{(4.67 * 10^6) * 0.551181 * 1}{36 * 36}$$

$$N = 1986.12 \text{ rpm}$$

5.3. Heat Analysis

Temperature controlling is another important factor that needs to be handled while fabrication of the vending machine since it contains confectionery items. The vending machine has been distributed into two compartments i.e., a hot and a cold compartment.

The entire vending machine is properly insulated using thermocol on all the sides of the vending machine to reduce loss of heat due to any means of conduction or convection. Therefore, in order to determine the number of Peltier modules and heat bulbs that will be required to maintain the desired temperature, heat analysis has been carried out on both the compartments in the below sections.

5.3.1 Heat Analysis of Cold Compartment:

The cold compartment temperature will be maintained using Peltier modules. The temperature of the vending machine will be maintained at 15 °C for the cold compartment in order to keep the bakery items such as pastries, cakes and donuts fresh.

$$\text{Inside Temperature} = T_i = 15 \text{ }^\circ\text{C}$$

$$\text{Outside Temperature} = T_o = 40 \text{ }^\circ\text{C}$$

$$\text{Area of Roof and Base surface} = A_r = 3 \text{ ft} \times 3.7 \text{ ft} = 0.9144 \text{ m} \times 1.1278 \text{ m} = 1.0313 \text{ m}^2$$

$$\text{Area of Right and Left surface} = A_l = 3 \text{ ft} \times 1.5 \text{ ft} = 0.9144 \text{ m} \times 0.4572 \text{ m} = 0.4181 \text{ m}^2$$

$$\text{Area of Front and Back surface} = A_f = 1.5 \text{ ft} \times 3.7 \text{ ft} = 0.4572 \text{ m} \times 1.1278 \text{ m} = 0.5156 \text{ m}^2$$

$$\text{Mild Steel Structure thickness} = \Delta x_m = 2 \text{ mm} = 0.002 \text{ m}$$

$$\text{Acrylic Door thickness} = \Delta x_a = 4 \text{ mm} = 0.004 \text{ m}$$

Thermocol insulation thickness = $\Delta x_t = 1 \text{ in} = 0.0254 \text{ m}$

Convection Heat Transfer Coefficient for inside air @ $15^\circ \text{C} = h_i = 25.5 \text{ W/m}^2 \text{ }^\circ \text{C}$

Convection Heat Transfer Coefficient for outside air @ $40^\circ \text{C} = h_o = 27.35 \text{ W/m}^2 \text{ }^\circ \text{C}$

Thermal conductivity of Mild Steel = $k_m = 44.97 \text{ W/m }^\circ \text{C}$

Thermal conductivity of acrylic = $k_a = 0.2 \text{ W/m }^\circ \text{C}$

Thermal conductivity of thermocol insulation = $k_t = 0.029 \text{ W/m }^\circ \text{C}$

The equation for thermal resistance for conduction can be given as $\frac{\Delta x}{kA}$. Similarly, the equation for thermal resistance for convection can be given as $\frac{1}{hA}$.

- **Total thermal resistance through the roof:** The total thermal resistance through the roof is calculated as:

$R_{\text{roof}} = \text{Convection resistance on inside} + \text{Conduction resistance in MS plate} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{roof}} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_m}{k_m \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{\text{roof}} = \frac{1}{25.5 \cdot 1.0313} + \frac{0.002}{44.97 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{27.35 \cdot 1.0313}$$

$$R_{\text{roof}} = 0.9228 \text{ }^\circ \text{C/W}$$

- **Total thermal resistance through the base:** The total thermal resistance through the base is calculated as:

$R_{\text{base}} = \text{Convection resistance on inside} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{base}} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{\text{base}} = \frac{1}{25.5 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{26.24 \cdot 1.0313}$$

$$R_{\text{base}} = 0.9243 \text{ }^\circ \text{C/W}$$

- **Total thermal resistance through the left and right surfaces:** The

total thermal resistance through the left and right is calculated as:

$R_{\text{left}} = R_{\text{right}} = \text{Convection resistance on inside} + \text{Conduction resistance in MS plate} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{left}} = R_{\text{right}} = \frac{1}{h_i \cdot A_l} + \frac{\Delta x_m}{k_m \cdot A_l} + \frac{\Delta x_t}{k_t \cdot A_l} + \frac{1}{h_o \cdot A_l}$$

$$R_{\text{left}} = R_{\text{right}} = \frac{1}{25.5 \cdot 0.4181} + \frac{0.002}{44.97 \cdot 0.4181} + \frac{0.0254}{0.029 \cdot 0.4181} + \frac{1}{27.35 \cdot 0.4181}$$

$$R_{\text{left}} = R_{\text{right}} = 2.2762 \text{ }^\circ \text{C/W}$$

- **Total thermal resistance through the front surface:** The total thermal resistance through the front surface is calculated as:

$R_{\text{front}} = \text{Convection resistance on inside} + \text{Conduction resistance in acrylic plate} + \text{Convection resistance on outside}$

$$R_{\text{front}} = \frac{1}{h_i \cdot A_f} + \frac{\Delta x_a}{k_a \cdot A_f} + \frac{1}{h_o \cdot A_f}$$

$$R_{\text{front}} = \frac{1}{25.5 \cdot 0.5156} + \frac{0.004}{0.2 \cdot 0.5156} + \frac{1}{27.35 \cdot 0.5156}$$

$$R_{\text{front}} = 0.1858 \text{ }^\circ \text{C/W}$$

- **Total thermal resistance through the back surface:** The total thermal resistance through the back surface is calculated as:

$R_{\text{back}} = \text{Convection resistance on inside} + \text{Conduction resistance in MS plate} + \text{Conduction resistance in thermocol insulation} + \text{Convection resistance on outside}$

$$R_{\text{back}} = \frac{1}{h_i \cdot A_f} + \frac{\Delta x_m}{k_m \cdot A_f} + \frac{\Delta x_t}{k_t \cdot A_f} + \frac{1}{h_o \cdot A_f}$$

$$R_{\text{back}} = \frac{1}{25.5 \cdot 0.5156} + \frac{0.002}{0.2 \cdot 0.5156} + \frac{0.0254}{0.2 \cdot 0.5156} + \frac{1}{27.35 \cdot 0.5156}$$

$$R_{\text{back}} = 0.4127 \text{ }^\circ \text{C/W}$$

- **Overall thermal resistance through all the surfaces:** Since all the surfaces are parallel to each other

therefore, thermal resistance 'Rth' will be determined as:

$$\frac{1}{R_{th}} = \frac{1}{R_{roof}} + \frac{1}{R_{base}} + \frac{1}{R_{right}} + \frac{1}{R_{left}} + \frac{1}{R_{front}} + \frac{1}{R_{back}}$$

$$\frac{1}{R_{th}} = \frac{1}{0.9228} + \frac{1}{0.9243} + \frac{1}{2.2762} + \frac{1}{2.2762} + \frac{1}{0.1858} + \frac{1}{0.4127}$$

$$\frac{1}{R_{th}} = 10.8494 \text{ W/}^\circ\text{C}$$

The overall heat transfer coefficient 'U' can be related to thermal resistance 'Rth' through the following relationship

$$UA = \frac{1}{R_{th}}$$

$$UA = 10.8494$$

The relationship of overall heat-transfer due to a combination of conduction and convection with the overall heat transfer coefficient 'U' can be stated in terms of the given relation $q=UA\Delta T$

$$q=UA (T_o - T_i)$$

$$q = (10.8494) (40-15)$$

$$q = 271.234 \text{ W}$$

The heat transfer in the cold compartment of the vending machine will be of 271.23 W.

5.3.2. Heat Analysis of Warm Compartment: For warm compartment halogen bulbs will be used. The temperature of the vending machine will be maintained at 25 °C for the warm compartment in order to keep the bakery items such as patties, samosas and croissants fresh.

$$\text{Inside Temperature} = T_i = 15 \text{ }^\circ\text{C}$$

$$\text{Outside Temperature} = T_o = 40 \text{ }^\circ\text{C}$$

$$\text{Area of Roof and Base surface} = A_r = 3 \text{ ft} \times 3.7 \text{ ft} = 0.9144 \text{ m} \times 1.1278 \text{ m} = 1.0313 \text{ m}^2$$

$$\text{Area of Right and Left surface} = A_l = 3 \text{ ft} \times 1.5 \text{ ft} = 0.9144 \text{ m} \times 0.4572 \text{ m} = 0.4181 \text{ m}^2$$

$$\text{Area of Front and Back surface} = A_f = 1.5 \text{ ft} \times 3.7 \text{ ft} = 0.4572 \text{ m} \times 1.1278 \text{ m} = 0.5156 \text{ m}^2$$

$$\text{Mild Steel Structure thickness} = \Delta x_m = 2 \text{ mm} = 0.002 \text{ m}$$

$$\text{Acrylic Door thickness} = \Delta x_a = 4 \text{ mm} = 0.004 \text{ m}$$

$$\text{Thermocol insulation thickness} = \Delta x_t = 1 \text{ in} = 0.0254 \text{ m}$$

$$\text{Convection Heat Transfer Coefficient for inside air @ } 25 \text{ }^\circ\text{C} = h_i = 26.24 \text{ W/m}^2 \text{ }^\circ\text{C}$$

$$\text{Convection Heat Transfer Coefficient for outside air @ } 40 \text{ }^\circ\text{C} = h_o = 27.35 \text{ W/m}^2 \text{ }^\circ\text{C}$$

$$\text{Thermal conductivity of Mild Steel} = k_m = 44.97 \text{ W/m }^\circ\text{C}$$

$$\text{Thermal conductivity of acrylic} = k_a = 0.2 \text{ W/m }^\circ\text{C}$$

$$\text{Thermal conductivity of thermocol insulation} = k_t = 0.029 \text{ W/m }^\circ\text{C}$$

The equation for thermal resistance for conduction can be given as $\frac{\Delta x}{kA}$. Similarly, the equation for thermal resistance for convection can be given as $\frac{1}{hA}$.

- **Total thermal resistance through the base:** The total thermal resistance through the base is calculated as:

$R_{base} =$ Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{base} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_m}{k_m \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{base} = \frac{1}{26.24 \cdot 1.0313} + \frac{0.002}{44.97 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{27.35 \cdot 1.0313}$$

$$R_{base} = 0.9217 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the roof:** The total thermal resistance through the roof is calculated as:

$R_{roof} =$ Convection resistance on inside + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{roof} = \frac{1}{h_i \cdot A_r} + \frac{\Delta x_t}{k_t \cdot A_r} + \frac{1}{h_o \cdot A_r}$$

$$R_{roof} = \frac{1}{26.24 \cdot 1.0313} + \frac{0.0254}{0.029 \cdot 1.0313} + \frac{1}{25.5 \cdot 1.0313}$$

$$R_{roof} = 0.9243 \text{ }^\circ\text{C/W}$$

- **Total thermal resistance through the left and right surfaces:** The total thermal resistance through the left and right is calculated as:

$R_{left} = R_{right} =$ Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{left} = R_{right} = \frac{1}{hi*Al} + \frac{\Delta xm}{km*Al} + \frac{\Delta xt}{kt*Al} + \frac{1}{ho*Al}$$

$$R_{left} = R_{right} = \frac{1}{26.24*0.4181} + \frac{0.002}{44.97*0.4181} + \frac{0.0254}{0.029*0.4181} + \frac{1}{27.35*0.4181}$$

$$R_{left} = R_{right} = 2.2736 \text{ } ^\circ\text{C/W}$$

- **Total thermal resistance through the front surface:** The total thermal resistance through the front surface is calculated as:

$R_{front} =$ Convection resistance on inside + Conduction resistance in acrylic plate + Convection resistance on outside

$$R_{front} = \frac{1}{hi*Af} + \frac{\Delta xa}{ka*Af} + \frac{1}{ho*Af}$$

$$R_{front} = \frac{1}{26.24*0.5156} + \frac{0.004}{0.2*0.5156} + \frac{1}{27.35*0.5156}$$

$$R_{front} = 0.1836 \text{ } ^\circ\text{C/W}$$

- **Total thermal resistance through the back surface:** The total thermal resistance through the back surface is calculated as:

$R_{back} =$ Convection resistance on inside + Conduction resistance in MS plate + Conduction resistance in thermocol insulation + Convection resistance on outside

$$R_{back} = \frac{1}{hi*Af} + \frac{\Delta xm}{km*Af} + \frac{\Delta xt}{kt*Af} + \frac{1}{ho*Af}$$

$$R_{back} = \frac{1}{26.24*0.5156} + \frac{0.002}{0.2*0.5156} + \frac{0.0254}{0.2*0.5156} + \frac{1}{27.35*0.5156}$$

$$R_{back} = 0.4105 \text{ } ^\circ\text{C/W}$$

- **Overall thermal resistance through all the surfaces:** Since all the surfaces are parallel to each other

therefore, thermal resistance ‘Rth’ will be determined as

$$\frac{1}{R_{th}} = \frac{1}{R_{base}} + \frac{1}{R_{roof}} + \frac{1}{R_{right}} + \frac{1}{R_{left}} + \frac{1}{R_{front}} + \frac{1}{R_{back}}$$

$$\frac{1}{R_{th}} = \frac{1}{0.9217} + \frac{1}{0.9243} + \frac{1}{2.2736} + \frac{1}{2.2736} + \frac{1}{0.1836} + \frac{1}{0.4105}$$

$$\frac{1}{R_{th}} = 10.9292 \text{ W/}^\circ\text{C}$$

The overall heat transfer coefficient ‘U’ can be related to thermal resistance ‘Rth’ through the following relationship

$$UA = \frac{1}{R_{th}}$$

$$UA = 10.9292$$

The relationship of overall heat-transfer due to a combination of conduction and convection with the overall heat transfer coefficient ‘U’ can be stated in terms of the given relation

$$q = UA\Delta T$$

$$q = UA (T_o - T_i)$$

$$q = (10.9292) (40-25)$$

$$q = 163.937 \text{ W}$$

Therefore, it can be concluded that three halogen bulbs of 50 Watt each will be sufficient for the warm compartment.

6. Result and Conclusion

Bakers’ Vendi after being assembled looked similar to the anticipated design which had been drafted on the CAD modeling software. The entire structure was fabricated from scratch, even the conveyors and lift mechanism. During the testing phase of the vending machine it has been noticed that acquiring input from the Android Application via Bluetooth was quite efficient and no glitches in the working of the software has been noticed so far. Furthermore, the payment method via coin acceptor has demonstrated working up to the mark with great counterfeit recognition. Moreover, calculations that have

been done were quite useful and beneficial for creating the machine with great precision. The temperature controlling of the cold compartment is a bit flexible and can be changed as per requirement of the items placed in it. The placement and working of the IR sensor for item detection is also up to the mark and has shown a great working response and accuracy. Adjustments have been made accordingly, in order to achieve the best results and to minimize the time delays.

The working of the bakers' Vendi demonstrates proper real-time response which is quite similar to the designed prototype. There is minimal possible time delay in the working structure of the machine. However, some externally forced vibrations have been noticed due to the oscillations occurring in the lift motor. The lift motor is quite powerful and

the base structure of the vending machine is also not fixed to the ground instead it is slightly above ground level and is based on structural framework. Therefore, due to the absence of solid base foundation, the ground cannot provide the damping effect in this case. Therefore, two options have been considered in order to solve this issue. The first is to provide damping to the machine in order to reduce the vibration. It has been thought upon to utilize a rubber foundation block at the empty base space in the later stages. While the second option is that lift motor speed will have to be slowed in order to avoid unnecessary vibration however this option might cause compromising a bit on the timing phenomenon of the vending machine.

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Hydro Discharging Chamber Kinematic Systems and Perspectives of their Application in Electric Drives

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ABSTRACT

Electrohydraulic systems/drives are widely used in propulsion devices in order to increase efficiency of energy transfer and to reduce energy losses. These systems/drives are generally used in high voltage power plants. Along with their advantages they have some disadvantages. In order to improve system characteristics on basis of results received in experiential research, the perspective of application of electrohydraulic effect in propulsion devices has been defined. It would result in improvement of electrohydraulic system, reducing of transmission rings that would cause efficiency rise.

Keywords: *Electrohydrodischarging Chamber, Piston Movement, device operation*

1. Introduction

The efficient control of high voltage power plants is one of the most important tasks both in maritime and shore-based power systems. Application of hydraulic systems turned out to be efficient in the power plants of variable load and high voltage. This gives universal opportunity to convert mechanical characteristics of driving engine in accordance with load. It is also easy to control and protect engine and executing sections/components from overloads. Electrohydraulic propulsion device (electric engine, pump, and hydraulic transmission system) in comparison with electromechanical gears is distinguished for reliable operation during fluctuation of number of revolutions from 1-4 rpm to 2500 rpm, by high power value transferred to unit of mass of the propulsion device. But hydraulic power ring has also some disadvantages that are, first of all, revealed in the pressure losses during long-distance energy transfer/transmission. In order to keep the pressure and the moment, several power rings are used in such systems. Increase of the number of central rings causes decrease of efficiency. This disadvantage may

be corrected by creation/formation of high-power ring near actuating/executive mechanism, that would cause decrease of central rings ([1], [5]) in the above-mentioned power system. From this viewpoint, it is necessary to consider application of electrohydraulic effect (EHE).

Since XVIII century mechanical damage of the surrounding objects resulting from the electrical discharge in water became the object of study of scientists (T. Lane, J. Priestly 1767–1769). The effect received by high voltage pulses in water was called electrohydraulic effect (EHE) and the research works of many scientists were dedicated to this effect (Fedorov I.V. – 1932, Frungel P. – 1948, Yutkin L.A. – since 1950, etc.). Primarily, it was thought that mechanical effect on the surroundings during power discharge took place only on liquid dielectrics, however in liquids having ionic conductivity it is spread only on short distance and is characterized by excessive production of gas and steam [2].

In technical field ([2], [4]) there are numerous examples of application of high pressure received by electrohydraulic effect for different purposes but none of them foresees application

of this high power in propulsion devices. Mechanical effect of liquid on objects, located/situated near electric discharge channel, is insignificant and practically cannot be observed. Effect in liquid dielectrics is radically different. Mechanical effect on the objects around discharge channel is defined by pressure value created in gas cavity around discharge area. In order to increase pressure, it is necessary to create conditions for strengthening hydraulic pulses.

Pressure value can be determined by the following formula [3]:

$$p = p_0 + B \left[\left(\frac{\rho}{\rho_0} \right)^\alpha - 1 \right] \quad (1)$$

Where,

p – pressure received in the discharge channel;

p_0 – atmospheric pressure ($p_0=10^5\text{Pa}$);

B – liquid characteristics is constant, for water $B=3,05 \cdot 10^8 \text{ Pa}$;

ρ – density of compressed liquid received by the effect of plasma channel during discharge;

ρ_0 – density of liquid in normal conditions;

α – the constant of the liquid and its value for water is 7,15.

Three main modes of electrohydraulic discharge are known [2]: hard mode with parameters $U \geq 50\text{kV}, C \leq 0,1\mu\text{F}$; average mode with parameters $20\text{kV} \leq U < 50\text{kV}, 0,1\mu\text{F} \leq C \leq 1,0\mu\text{F}$; soft mode with parameters $U \leq 20\text{kV}, C \geq 1\mu\text{F}$.

2. Main text

2.1. Problem Definition

As a result of EHE, the area of widespread of steamers in liquid depends on liquid properties and high voltage pulses parameters. Discharge is followed by creation of cavitation pocket with expansion and compression that are followed by sudden pressure variation in the environment/atmosphere. The result is formation of electrohydraulic blow (EHB) [2], [7], [8].

The research describing the effect of forces resulting from electrohydraulic blow (EHB) on the propulsion device is discussed in the present article.

Fresh water with temperature ranges from 18 to 23°C is used as working liquid in this experiment (PH 6-9, general mineralization 1000–1500 mg/l [6]). During electrohydraulic effect the received pressure value reaches several tens of megapascals ([3], [4]). On the laboratory stand (FESTO 501-(TP501), FESTO 601- (TP601)) the values of forces (Table 1) influencing cylinder piston with several Megapascal pressure have been revealed. Tests have shown that by moving piston it is possible to move/shift cargo of 90 N weight. The pressure values received during electrohydraulic effect are commensurable to the pressure values received during the present experiment.

Table 1

Pressure value in cylinder Bar.	Cargo shift time, sec.. $t_{\text{всв}}$	v_1 m/sec	V_3 10^{-4} m^3	Q m^3/sec 10^{-5}	P_3 Bar.	$N_{\text{всв}}$ Vt.	F б.
15	1,7	0,1176	1,56	9,17	15	137,56	1169,7
20	1,015	0,197	1,56	14,2	20	284	1441,6
25	0,76	0,263	1,56	20,5	25	513	1950,6
30	0,675	0,296	1,56	23,3	30	699	2361,5
35	0,5	0,4	1,56	31,2	35	1092	2730
40	0,46	0,43	1,56	33,9	40	1356	3153,5

As the plant should be near the user, the tests were implemented during non-standard working mode with parameters: $U < 5\text{kV}, C \leq 50,0\mu\text{F}$.

It is the issue of interest for researchers to see how efficiently can the received pressure be used for shifting/moving or driving the objects.

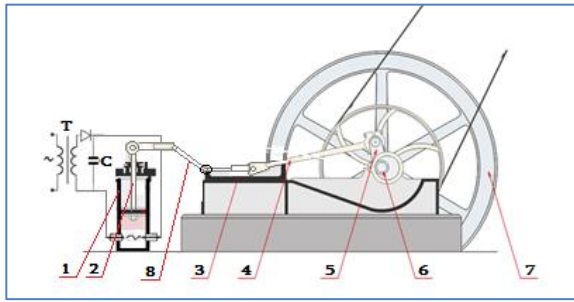


Fig. 1. Power ring comprising high voltage hydrodischarging chamber. 1-cylinder; 2-piston; 3-sliding bar; 4-connecting rod; 5-crosshead; 6-drum; 7- tracking wheel; 8-rocker

Cylinders of different sizes made of various materials have been fabricated, and also the components for connection to rotating wheel (see fig. 1.7). As sizes of sliding bar (see fig.1.3, connecting rod (see fig. 1.4), rocker (see fig. 1.8) were changed during tests, the approximate scheme of the system is shown in Figure 1.

During operation of typical crosshead-connecting rod mechanism, it turned out to be impossible to receive full revolution of the wheel (see fig. 1.7). The frequency action of blow force received from electrohydraulic effect on piston significantly exaggerates the frequency of periodical movement of sliding bar and connecting rod.

Disbalance caused by unbalanced rotating masses impedes formation of steady motion. Charging-discharging time of the condenser is not sufficient for complete piston stroke. Here it is necessary to take into consideration the friction forces induced between piston and walls of the chamber. In order to bring the friction forces to minimum, the piston diameter has been reduced. This violates the hermeticity of operating space of the chamber and during electrohydraulic effect, vacuum is not created during liquid compression. The striking force on piston surface is also reduced.

2.2. Proposed Method

Based on everything said above the “ratchet” mechanism has been invented that ensures the conversion of fore and back movement of the piston into unidirectional rotation (Fig. 2).

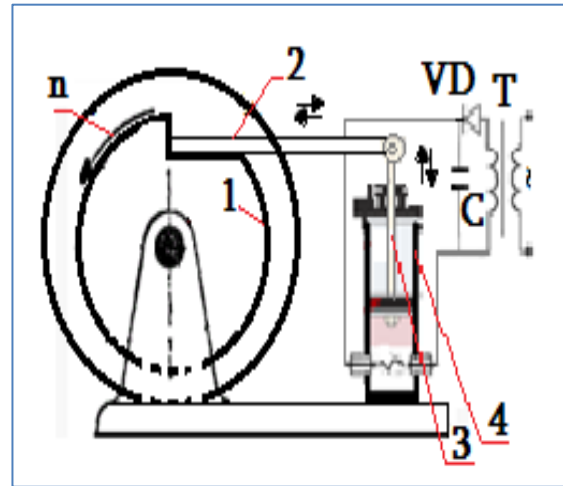
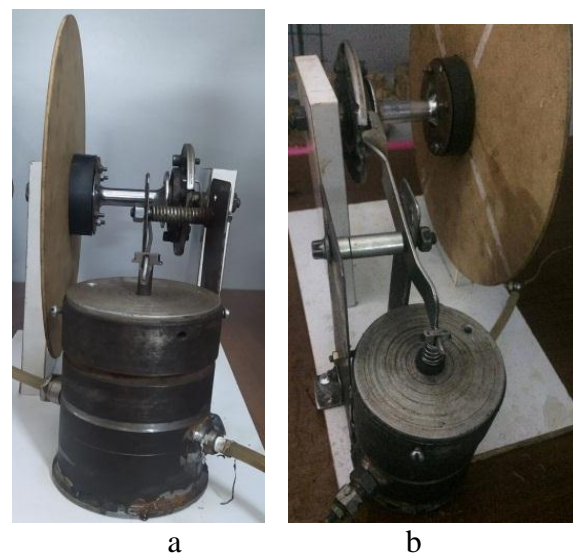


Fig. 2. Ratchet mechanism: 1- ratchet wheel 2- ratchet pawl; 3- cylinder; 4-piston;

In picture 1 we can see fabricated power transmitting mechanism – spring lock mechanism (picture 1a) and rocker transmitting mechanism (picture 1b). The rotating movement of tracking wheel is received in both cases.

On the present stage of research, the number of revolutions of tracking wheel is $n=4$ rev/min. If tracking wheel with radius 0,145 m is connected to shaft with radius that is 10 times smaller in comparison with the radius of tracking wheel, the number of revolutions will be increased 10 times:

$$n_{shaft} = \frac{n_{wheel} \cdot R_{wheel}}{R_{shaft}} \tag{1}$$



Picture 1. a- power transmission with spring lock mechanism; b- power transmission with rocker transmission mechanism

Conclusions and Offers

1. Two types of experimental models of power systems connected to high voltage electrodischarging chambers have been created;
2. Both models have disadvantages. They are:
 - Insufficient hardness during discharging by striking forces created on the piston – deformation of rocket and wear of connecting claw take place;
 - Instable value of cylinder piston movement, that is resulted in non-standard revolution/turn of the wheel;
3. Despite the indicated disadvantages, it is possible to use the generated power in the discharge chamber to drive the transmission mechanism;
4. In order to refine transmission mechanism, gear system and optimum parameters of spoke wheel should be developed.

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TRANSFORMATIONAL LEADERSHIP AND ITS EFFECT ON EMPLOYEE ENGAGEMENT

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ABSTRACT

Employee engagement is a trending topic among organizations and companies spend a lot of amount in building an environment where employees can feel engaged. There are three categories of employees, i.e. actively employed, disengaged and passively disengaged employees. Various implications of employee engagement and leadership plays as an important aspect build engagement among employees. Purpose is to understand various causes of employee engagement and understand the effect of various leadership styles on the employees. Methodology- systematic literature review along with research gaps and further study has been used where A+, A and B papers from ABDC list have been taken from the past three decades. Findings- it has been found out that amongst the three leadership styles, transformational leadership has been identified as the most effective measure to increase employee engagement. Implications- research reveals that organizations need to focus on employee engagement and build leaders which can understand employees needs and wants and create an environment where they can find meaningfulness in their work. Originality/Value- the research is taken from published journals and the results show a need for more transformational leadership style to build employee engagement. It emphasis on leadership styles and understanding what employees needs are.

Keywords: Employee engagement, Transformational leadership, leadership, job involvement

I. Introduction

[2]In recent years employee engagement is becoming a trending and important topic and consulting companies have stressed a lot on employee engagement activities in different industries. There has been a lot of growth in employee engagement over the last years. Others have reported that employee engagement predicts outcomes for staff, organizational progress and financial performance. Sadly, much of what was published about employee engagement came from the literature of consultants and consulting firms. Documentation on employee participation in academic literature is startlingly incomplete. Research has shown that employee engagement activities have a positive effect on employee outcome, success and performance of employees. [3]HR managers insist on enhancing their organization's workplace performance and productivity is one of the main causes. Highly involved companies minimize both recruitment and recruiting expenses, and disengaged workers are a significant contributing factor to a high turnover of staff. Engaging employees is crucial to maintaining desirable talent and is an

important piece of the puzzle of workplace satisfaction; as disengaged workers are more likely to abandon their jobs.

What is employee engagement?

[2] Employee engagement term has been given many meanings by consulting firms and companies (Robinson et al.,2004). There has been a lot of research on the academic and practical front of the same but not much research has been done on how communication can help leaders to increase employee engagement in organizations. Most of the research has been on the emotional and intellectual factors affecting the employee performance of the employees.

Engagement is defined as an experience of involvement of a person with personally satisfying activities that enhance his sense of professional efficacy. Schaufeli, Salanova, Bakker and Gonzalez-Roma (2002) also view engagement as a positive, work associated attitude that is associated with commitment, absorption and vigor. Engagement also includes where people employ their emotional, physical and cognitive skills during work performance. Emotional skills include aspects of employees concerning the positive and

negative behavior towards their leaders, superiors, mentors and the organization. Physical skills include the energies exerted by people during performance of their roles. Cognitive skills include the perception of employees towards their work, leaders, mentors and the organization.

Engagement as a psychological state embraced one or more of many similar ideas in different ways, each in turn reflecting some sort of concentration, commitment and/or enthusiasm. Operationally, the contribution tests consisted, for the most part, of a potpourri of things reflecting one or two of the four categories: work satisfaction, organization engagement, personal strength and dedication to work.

Robinson (2004) defines employee engagement as “a positive behavior held by the employee towards the organization and its value. An engaged employee is aware of business framework, and works with colleagues to improve performance in the job for the benefit of the organization. The organization must work to grow and nurture engagement, which needs a two-way relationship between an employer and an employee.” Gallup organization describes employee engagement as employee interest in the job. Employee engagement was also described as an individual and emotional contribution to the organization. Thus, when employees are passionate about their work, job and commitment towards the organization, it leads to employee engagement. This is a good strategy to help each company achieve strategic advantage over others.

[6] According to research, employee engagement is caused by several factors including emotional and rational factors that relate to employee's overall work experience. According to Kahn's (1990) research employees are- actively engaged employees, who work actively and have strong connection with the organization; disengaged employees, who work and are satisfied with their job but do not have strong connection with the organization; and actively disengaged employees, who are not happy with their job and are not connected to the organization as well. Employee engagement differs from job involvement as the later refers to employee actively participating in their own job.

Relation, connectivity, and interaction are the three most important aspects of an organization's development, both internally and externally. Companies also lose out on the key aspects of workplace happiness when managers believe the commitment is directly linked to pay and benefits. Owing to the lack of career incentives or the appeal of improved work offers elsewhere, most of the members believe workers quit.

[4] The activity- and research-driven literatures may benefit from various concepts of commitment. Additional meanings can be related to folk theory: the general intuitive sense about job motivation that people, and particularly leaders within organizations, have. Similar to these concepts is the idea that employee involvement is a positive state, has an operational intent and requires participation, dedication, zeal, motivation, concentrated effort and resources. Organizational commitment also varies from commitment in that it relates to the disposition and loyalty of a individual to their organization. Commitment is not an attitude; it's the degree to which an person is attentive and engaged in fulfilling their roles. And while OCB involves voluntary and informal behaviors that can help coworkers and the organization, the focus of engagement is the performance of one's formal role, rather than extra-role and voluntary behavior. Commitment is often distinct from work participation. Work engagement is the product of a rational decision on the job's need for fulfilling abilities, which is related to one's self-image. Engagement is about how individuals are supporting themselves in their job results. In addition to cognitions, communication requires the constructive use of feelings and behaviors.

II. Literature Review

[16] There are several antecedents related to and consequences of employee engagement (Alan M. Sacks, 2006). The major antecedents consist of factors like job characteristics, organizational support, mentor's support, compensation and benefits, and justice and the consequences are job satisfaction, organizational commitment, and employee behavior. Employees also want to work in organizations where their work is valued and

support is provided. Job characteristics refer to the task identity, skill variety, significance, autonomy and feedback of the job. Job enrichment is positively related to the meaningfulness of job of an employee which is further related to job characteristics and employee engagement. Organization and mentor's support are related to the environment and opportunities provided to an employee to perform at his job along with trusting and supportive relationship with the superior that promotes psychological safety. External rewards help employees build confidence and thus, be more engaged towards their job and organization. People vary in their engagements according to the rewards and recognition given to them. External rewards act as a meaningful way to employ engagement among the employees. Amongst the consequences, to get job satisfaction, employees have to find psychological meaningfulness in their jobs which can be achieved by challenging work, usage of different skills, personal discretion and number of opportunities provided. Employee engagement has also been positively related to work, organizational commitment, positive employee behavior while negatively related to employee's willingness to quit the job and turnover. Managers need to understand the importance of social behavior to foster employee engagement. They need to provide employees with an environment, resources and benefits that help them build higher levels of engagement. Moreover, employee engagement is a long-term process which need continuous efforts from the managers and the organization. [7] There are several determinants of employee engagement (Anitha J., 2014). These include work environment, leadership, team and co-worker, training and career development, compensation, organizational policies and workplace well-being. Sensitive work climate, one of the most significant aspects in employee engagement, focusing on employee wishes, expectations and emotions, contributes to concentrated performance and emotional satisfaction and is a core factor in employee engagement. Good leadership, through self-consciousness, openness, effective distribution of knowledge and social values, inevitably leads to workplace involvement because members are responsible for demonstrating to

staff that their actions play a significant role in the organization's overall performance. Teams and co-workers create to provide a transparent to welcoming atmosphere that makes staff feel secure in the workforce and take full responsibility. This helps promote involvement in promoting emotional unity and healthy relationships. Training and career growth help create focus on the work aspect which contributes to building up the morale of an individual which allows them to be more dedicated to their job. Compensation makes workers feel themselves more inclined to act with a high degree of loyalty. With high pay, an individual is inspired to perform to accomplish more, and therefore emphasis on perform and contact. Effective recruiting procedures, flexible schedules, harmony of job and life and motivational approaches have a positive effect on employee engagement. Towers Perrin Talent Study (2003) found that a key driver of commitment was the involvement of senior management in employee wellbeing. Once workers perceive social significance in the sense of importance and utility of their work, they continue to be more committed to their roles and the world surrounding them. Data on corporate goals, procedures, rules and regulations, improvements and factors for them in the organization help to create a more open connection between the activities of workers and the company's results.

[4] The employee engagement activities should be related to HRM processes and methods in order to have a fair and utter value (Simon L Albrecht, Jamie A Gruman, Arnold B Bakker, William H Macey, Alan M Saks, 2015). HRM engagement strategies such as socialization, performance management, recruitment and selection, training and development and organizational climate lead to more job demands and job resources further leading to employee engagement. The outcome of such HR practices leads to individual and organizational outcomes. Individual outcomes are in two aspects including attitudes (such as job satisfaction, commitment, turnover etc.) and performance and behavioral changes (like in role and extra role behavior). Organizational outcomes include team performance, motivation, financial returns etc. HRM

professionals would help promote interaction with the work by providing an ideal work environment and giving workers the right preparation. However, by selecting assignments, discussing specific job material, and assigning meaning to their assignments or occupations, workers themselves may also consciously alter or 'construct' their work design (Parker & Ohly, 2008). Wrzesniewski and Dutton (2001) described job shaping as individuals making physical and cognitive changes in their position or boundaries in relation. Visual changes lead to changes in form, design or number of work tasks, while cognitive changes lead to altering how you view your job.

[15] Organizational effectiveness can also be improved by the integration of psychological well-being of an employee along with his engagement (Ivan T. Robertso, Cary L. Cooper, 2009). In order to improve the organizational effectiveness, full engagement needs to be an important intervention for all the organizations. It not only includes commitment of an employee but also includes active engagement of the employee in form of good and positive mental well-being of the employee in the organization. Positive mental state of mind leads to a range of positive outcomes and behavior of the employees which leads to higher performance and overall growth of the organization. Research illustrates that high level of mental well being of employees leads to better decision making, problem solving and higher change management. On the other hands, low level of psychological well being leads to more resistance and disengagement of employees. Psychological well-being is associated with positive moods and emotions with overall life satisfaction.

[6] Workplace climate as well as the psychological well being of employee act as two major factors to improve employee engagement (Brad Shuck and Thomas G. Reio Jr., 2013). In order to understand the workforce climate around an employee, the latter's perception of the environment around him needs to be understood. Therefore, how employees understand and perceive the work environment around them has a major effect on their psychological well being and the level to which they are engaged. Research also states

that psychological well being and organizational climate not only affects the productivity and turnover but also demonstrates the level to which they are engaged. Further, employee engagement and workplace climate are positively related, which concluded that leaders and superiors continuously need to improve the workplace climate in order to improve their employees' performance. In addition to this, the major antecedents of employee engagement are workplace climate and employee well-being. Engagement also helps to reduce negative climate around an employee providing him to focus on job and giving a sense of commitment to the organization.

[15] There is a strong relationship between HIWPs (High Involvement Work Practices) and employee engagement (Sowath Rana, 2015). HIWPs consist of four main features including power, reward, information and knowledge. It consists of practices that are meant to empower the employees. Power means that employees have the autonomy to take decisions. In order to increase engagement, managers continuously need to design jobs in a way that it includes more and more decision making and autonomy in jobs of employees. When employees find psychological meaningfulness in their jobs in form of value and usefulness, they tend to be more attached to their jobs and the environment around them. Provision of information regarding organizational missions, policies, rules and regulations, changes and reasons behind the same in the organization help in building a more transparent and thereby helps in building link between employees' actions and the performance of the firm. Employees need to know what the organization's priorities and strategies are and what are the values and beliefs the organization holds. Providing rewards ensure that employees are contributing to the organization and represent return on investment of the effort and time employed by its employees. Knowledge refers to the skills and abilities of employees and provision of training and learning opportunities to the employees. They help to create a path for employees for their further growth and development and prepare them for challenges.

[18] Internal organizational interaction and supervisor interaction with the employee supports various workplace relationships and have a significant part to play in developing and maintaining optimum employee engagement (Emma Karanges, Kim Johnston, Amanda Beatson, Ian Lings 2015). It states that senior managers and leaders can achieve great and high levels of engagement through internal interaction that ensures that employees feel part of the organization and the workforce community. This can be achieved through interpersonal interaction that motivates employees to share their creative ideas and opinions within the organization and to their managers or supervisors. Organizations, leaders, managers and supervisors should also include employees in internal discussions about their individual roles and their contribution to organizational objectives more frequently. Further, internal interaction among employees and superiors leads to confidence amongst the employees with assurance of their contributions towards the overall success of the organization.

[11] There are several managerial implications of employee engagement (Nada Al Mehrzi, Sanjay Kumar Singh, 2016) which includes retention of employees, regular feedback and day to day informal recognition of their performance including organizational support to enhance their skills and opportunities to develop themselves. It also includes empowering employees, letting them know the importance of their contributions, decision making and towards the success of the organization and creating a culture that motivates and encourages employees to be loyal, creative and more engaged in the organization. Employee engagement has a relationship with organizational culture, teamwork, leadership and support. The latter four factors lead to employee motivation that further leads to employee engagement in the organization which improves the productivity and performance of the employees. "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

Leadership:

[8] Leadership theories like transformational, charismatic and transactional leadership help in employees to be more engaged and perform well in their jobs and in the organization. These theories are related to the inspirational model of leadership whereby a leader inspires their employees to be committed to their work and to the organization.

Although there has been extensive research on leadership and various styles of leadership, not much research has gone on the link between effective leadership and employee engagement (Aryee, 2012). [9] Transformational leadership has been identified as the most important style that boosts engagement among employees. When leaders work with their employees to understand their needs and wants and communicates changes and helps them to manage the change well, it increases the level of engagement among employees. Transformational leadership has four main parts to it consisting of: idealized influence, intellectual stimulation, inspirational motivation and individualized consideration (Bass 1985). Idealized influence includes employees classifying and trusting their leaders; intellectual stimulation includes leaders refresh employees' creativity and adaptability in a guilt free framework. Inspirational motivation is where leaders provide challenge and meaning to the employees' work and individualized consideration is whereby leaders support employees' needs for growth and achievement. Thus, trust, guilt free environment, inspiration, autonomy, proper delegation and leader's support help employees to be more engaged with their jobs and the organization. Mentor and management behavior contribute towards employee engagement. Both relationship and task-oriented behaviors of leaders have an impact on employee engagement. Moreover, as employees start gaining more power, their engagement with the organization also increases. Thus, we can see that people in leadership position are more engaged than employees at lower position.

[13] Charismatic leadership includes getting things done or improving work by communicating strongly and effectively. Thus, a vision by the leader and strong communication to the employees leads to

engagement amongst the employees. Charismatic leadership is an optimistic and persuasive style of leadership where strong communication by the leaders motivate and encourages employees to work harder and commit to the organization. Research shows that charismatic style of leadership has a positive impact on the engagement amongst employees.

Transactional leadership encompasses on the leaders setting up tasks and goals for their employees and the latter completing them and earning a reward in exchange of completion of the same. This style of leadership is more power oriented. These leaders use rewards as well as punishment to obtain results from their employees. Thus, if an employee performs well, rewards are given to that employee but if the employee fails to perform on a given task, no reward is provided. Although it is an inspiring model of leadership, the engagement is limited to conventional methods such as rewards. Thus, the employee engagement in transactional leadership also becomes limited.

[13] Over due course of time, organizations have started realizing the value of employee engagement and now they have started prioritizing employee engagement over customer satisfaction and free cash flow as well. These were stated as the top three factors responsible for the organization's profitability by former CEO of General Electric John Welch (Welch & Welch, 2006). Employee engagement is named as the most successful key to organizational success but to utter surprise, employee engagement is named among top three challenges faced by the organization in today's global as well as challenging culture.

Over years, many researchers and academicians have tried to find correlation between organizational success as well as employee engagement. Studies have shown that there is a highly positive correlation between the both in every economic climate. It has been observed from researches conducted earlier that the top half have double the chances than that of the bottom half to deliver results.

On all the possible parameters namely absenteeism, shrinkage, safety incidents, customer metrics, productivity, profitability and so on top employees showed much better

results as compared to the bottom ones. The top-level employees who have higher engagement in the organization seem to be much more satisfied with their work and deliver better results while achieving performance goals.

For last 10 years, academics has observed that engaging employees through different activities help to motivate them for putting in more efforts, staying in late even after office hours, improved productivity as well as increased collaborative action.

[16] As we know that leaders have the capabilities to influence employees, they should use this skill efficiently to create a supportive environment backed by the psychological safety which will eventually end up in motivating employees to complete their tasks at the earliest with full concentration. The best way to improve efficiency is not just attaching variable rewards to the task but providing the best suitable environment in terms of tasks provided, team mates and providing full ownership.

[9] There are different styles of leadership which have their own pros and cons. From studies conducted, it can be concluded that Transformational Leadership positively infuses motivation and inspiration in employees to deliver better results by instating trust and faith in subordinates. For comparatively younger employees, Transactional Leadership plays a significant role as new employees feel more motivated via rewards rather than being trusted. Overall Transactional Leadership also shows a positive correlation between employee engagement and leadership style.

However, Bass and Avolio (1997) have been of the thought that maximum results can be achieved only when both the leadership styles are used optimally to design the perfect solution for employee engagement. There can not be 'one fit for all' solution therefore managers need to closely check the environment their company operates in and what kind of expectations their employees have.

Leaders are not only responsible for decision making but also for the perfect execution and implementation of those plans. So, leaders need to keep a close eye whether the employees are facing any difficulty or

everything is running smooth with them to avoid falling into a pitfall.

Age has come out as a very significant factor in defining employee engagement as employees under the age of 25 are usually on their first job and do it with full enthusiasm as is the case with people above the age of 30 who start looking for stability in their career and work towards making their workplace a better institute while employees between the age of 25 and 30 are a bit skeptical and try balancing out their aspirations and responsibilities perfectly. Higher studies not only lead to higher aspirations but also to higher expectations from employers no matter how choppy the market situation gets. It can be confidently said that age and education both have a definite impact on employee engagement.

[10] Mentoring and organizational coaching lead to workplace participation. Both leadership partnerships and task-oriented attitudes impair employee engagement. However, as workers continue to acquire more influence, so will their interaction with the company. Therefore, we can see that people in leadership positions are more involved than lower-positioned workers.

Transformational leadership gives the liberty to employees to dream bigger and step out of their comfort zones to think and innovate. In such a leadership style, it is believed that when adequate power and authority is delegated to employees they work harder and produce better results. Over time it has been witnessed that this particular practice has helped people to improve their quality of work as well as their attitude towards work.

Psychological ownership is one of the keywords that is always correlated with transformational leadership which means that the employee is given ownership to conduct a task on his own which not only provides them sense of authority to influence organization along with the sense of doing everything on their own from creating a new framework to taking decisions that can prove ground breaking for a specific organization. In other words, it is also referred to as psychological empowerment of employees.

Employee engagement is considered to be multi-dimensional according to various studies

which is not restricted just to culture of a particular organization, how employees communicate amongst each other and outside the organization, style in which leadership of a company believes, the amount of faith and trust placed in employees by various leaders.

After going through a plethora of studies conducted, we can definitely boil down the existence of employee engagement to two rock solid pillars that are attention and absorption. Although both these pillars stand quite apart from each other but both are equally important for the organization's sustain. The focus of an employee, the work hours dedicated towards the job; all these factors add up to make up for the attention of employees. Absorption on the other hand is accumulation of focus towards one's role and position in the organization, how well the person performs in a given job also defines how absorbed that particular person is.

Accountability is positively correlated with performance. When employees are made accountable for all the decisions taken by them and also for the execution of their work, the performance automatically gets better as per studies. Sense of ownership, sense of belongingness and sense of empowerment all accumulate towards the better performance of employees.

III. Research Methodology

The methodology used to come to various implications is systematic literature review with further limitations in the study. Data from various published journals graded A+, A, and B from the ABDC list were taken from the past three decades. Amongst the journals, papers were sorted out regarding employee engagement, psychological well-being, its antecedent and consequences, its determinants and practices and implications on HRM were taken. Literature was also extracted to know various types of inspirational theories and implications on engagement among employees. The scope of this paper is to discover how various leadership styles influence employee engagement including what factors employee seek in leaders to keep them more engaged to the organization. Thus, various questions were answered by a systematic literature review whereby factors such as job characteristics,

rewards, compensation, organizational climate and recognition came into picture. The consequences of these factors after employee engagement lead to job satisfaction, organizational commitment and positive employee behavior. Amongst the several causes and factors of employee engagement, leadership was picked to analyze how it plays as a significant factor leading to employee engagement. A link between employee engagement and HRM practices was defined to understand the various management practices that can be carried out by leaders to increase their engagement at the workplace. High Involvement Work Practices have a significant impact on employee engagement. Thus, managers and leaders need to continuously redefine and give meaningful work to employee to keep them more engaged to the organization. At lower levels, managers need continuous feedback from the employees and giving more autonomy to their subordinates to create meaningfulness in work. Leaders help in creating a better organizational climate and help in psychological well-being of employees, thus links between these factors with employee engagement was also established. At last, different types of leadership styles were identified which create more and less significant implications to employee engagement. Various conclusions were drawn to understand the importance of leadership styles on employee engagement and scope for further research was also revealed.

Results and analysis

- Employee engagement is a long-term process and organizations need to continuously take sufficient measures to develop it. In order to strive among its competitors, organizations now-a-days need to continuously come up with different strategies or measures so that organizational commitment of employees can increase.
- Organizations aim to have engaged employees and invest considerable amounts to build and increase employee engagement. Increasing employee engagement is a continuous and challenging activity and managers and leaders have to build deep relationships

with their subordinates to foster the engagement amongst employees.

- Literature review highlighted the important aspects related to leadership styles building engagement amongst employees.
- Leaders play a crucial role in development of engagement techniques and measures which fosters organizational commitment amongst employees.
- There are various engagement drivers linked between leaders and their employees such as support, proper communication, recognition, rewards, providing vision to employees that fulfil not only short term but long-term goals of the employees as well.
- Amongst all the styles of leadership, transformational leadership has been identified as the major and most significant style in building engagement among employees.
- Transformational leaders demonstrate behaviors that can significantly increase the level of engagement amongst employees. The reason behind this is that under transformational leadership, leaders work in continuous touch with employees and understand their needs and wants and communicate the organizational goals to them.
- Transformational leaders generate a greater involvement in the work of subordinates resulting in higher effectiveness and job satisfaction, thus increasing and improving overall employee engagement level in organization. Transformational leaders improve work engagement by allowing access to information, support, opportunities and adequate resources.

Charismatic leadership effects change in employees' behavior by making extraordinary and charming delivery of their thoughts and goals. These leaders portray a certain sense of confidence and a healthy self-esteem. They help employees feel that their opinion and beliefs matter to them as they convey it to the employees. Because charismatic leaders are skillful at motivating and inspiring employees, it is possible that leaders can encourage and increase employee commitment and loyalty. Although not that significant as compared to

transformational leadership, charismatic leadership also create some significant change in employee behavior, thereby increasing the level of engagement among them. Charismatic leadership helps in creating an environment where employees have an energetic and positive attitude. The employees are intellectually and emotionally connected to the leader's vision and thus are committed to the goals of the organization.

Transactional leadership also known as leader-follower exchange, has very low impact on employee engagement. Leaders exchange various rewards in form of salary, benefits, and appraisal for good performance with their employees. They believe creating a heavily structured environment whereby the employees have to adhere to rules and regulations. Since good performance leads to high rewards and more benefits, low or negative performance can also lead to negative reinforcement among employees which can create hostile behavior and unwelcoming environment in the workplace. Such leaders create distinction between task and responsibility so that all the employees are aware of what their job roles are and what they are supposed to deliver. Even though employees are given autonomy by employees, there is a lot of positive and negative reinforcement among employees which leads to relatively lower engagement.

IV. Discussions and Recommendations

As the results portray, transformational style of leadership has been identified as the most effective way of keeping employees engaged. This is because, the leader works with the employees and understands their needs and wants. It is not just the two factors that contribute to actively engaged employees but other factors such as identifying the required changes, supporting the employees, keeping a check on their performance and timely appraisals of the same that help in creating a meaningful work environment, thus fostering employee engagement. Leaders help and motivate employees to achieve unexpected and extraordinary results. It gives employees autonomy over their jobs and induces a positive change the attitudes of the employees. There are four major behaviors performed by transformational leaders-

- **Inspirational Motivation-** where leaders influence their employees to achieve more. They set high yet achievable goals for the employees and inspire to create commitment among employees to perform the same. The leaders must articulate their thoughts well to the employees so that they are motivated to perform the tasks and objectives set by the leader.
- **Intellectual simulation-** where the leaders motivate employees to think for themselves. These leaders are creative and are open to new ideas from their employees. They oversee their employees' mistakes and encourage them to be more innovative. They create continuous learning platforms for their employees and continuous opportunities for them.
- **Idealized influence-** where a leader acts as a role model to the employees so as to lead by example. These leaders consider the needs of their employees and take care of them by prioritizing the same. They generally have a charismatic factor in them and are very ethical.
- **Individualized consideration-** where a leader builds strong relationship with its employees. The leader acts as a strong and supportive source to its employees and takes care of the needs and wants of their employees. Leaders listen to the needs and wants of the employees and continuously supports and acts

V. Limitations

The focus of this paper is to understand and analyze link between styles of leadership and employee engagement. Extraordinary leaders continuously provide an environment where employees are committed to their jobs and are engaged. With organizations investing millions in training leaders to keep their employees engaged, there is still need to understand what organizations will do in pandemic situations like COVID-19. While companies are firing employees in such situations, not much literature has been written on how leaders try to keep their employees engaged during such times.

Companies also try to focus on combating their losses and build an environment which is task oriented, there is still need to understand what

leaders would do in such situations. Also, further research is required as to which form of leadership (i.e. transformational, transactional or charismatic) is the most suitable in these times.

VI. Conclusion

In today's time there is not only a need to motivate employees but also keep them continuously engaged. Not only leaders but

their leadership styles also have a lot of effect on the employees. The present study shows that three forms of leadership i.e. transformational, transactional and charismatic leadership have a positive impact on the engagement among employees. But the strongest relationship is between transformational leadership and employee engagement.

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SEO Vs SEM: A Comparative Study on the Effectiveness of both Techniques

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ABSTRACT

Purpose: The paper aims to establish a set of differences between SEO and SEM as strategies and understand industry perspective on their effectiveness in businesses and establish ideal case scenario for each strategy.

Methodology: This is an Exploratory Research in which a group of participants from industry participated to give their preferences of the above mentioned strategies according to their business scenario. It uses both primary and secondary research to arrive on a strategy for different business types and situation.

Findings: The study highlights the different scenarios that clearly prescribe usage of both strategies and highlights situations where it becomes ambiguous and requires more understanding of the situation at hand.

Practical Implications: The findings suggest that the managers on the various situations faced by business and gives an idea about where they should dive deep into the problem and how a mixture of both strategies can be helpful to their business.

Originality/Value: The research has two major contributions. It will clearly enlist themes which prescribe the strategy to be used. The research also elaborates the scenarios that need deeper understanding from managers before moving ahead and it bridges a knowledge gap in research.

Article Classification: Research Paper

Keywords: SEO, SEM, Content, Search, Reach

Introduction

The function of Marketing is evolving and marketers are finding innovative ways to make consumers aware about their offerings. The consumer today is much more aware and active than ever before and is consuming content at a rate faster than ever. Therefore, in this era, business houses are competing not just to lure consumers just at their stores but their virtual spaces as well. There is a virtual battle going on between brands to gain share of consumers' search results to gain the extra mind share. More and more number of companies are finding ways to get more consumers on their websites and app and are doing everything they can to make their websites well suited for their consumers.

This desire to gain extra traffic on their virtual spaces has given birth to many techniques that can help organisations achieve their goals to drive web traffic to their websites. There are different methods to achieve these goals and they have different requirements and are suited for different objectives. These objectives can be proprietary and based on the overall market and besides that so many market and consumer

related factors that can make or break that strategy and sometimes even change it.

This paper aims to establish these requirements and situations and studying these techniques in depth to understand their overall impact on the business objectives. As a part of this study, a primary research is also carried out with industry participants to understand and bring out themes about different business scenarios. These people have been interviewed to bring out themes relevant in making Digital Marketing Strategies for a business. We first study about both SEO and SEM as methods to understand more about them and gain more from existing literature. There is existing literature on the measure for each of these strategies but business situation selection had been missing from the start. This research fills that gap of situation analysis and selection of a strategy.

The research will explore the two techniques in detail:

- 1) Search Engine Optimization(SEO)
- 2) Search Engine Marketing(SEM)

To see things literally, SEO is a part of SEM Strategy which includes paid search as well. But in common parlance SEO is understood as organic listings strategy and SEM is seen as

paid listings strategy so this further will see from that lens only. Each of the techniques will be studied to determine which is well suited for different types of business situation.

Before moving into Optimization and Marketing(bidding), we will first understand what a Search Engine is and what it does. A Search Engine as the name suggests is an engine which helps the user to find most relevant and useful content to the user based on their search. There are various types of search for various purposes like Academic, Commercial, Entertainment and Geographical but today holistic Search engines have gained mass popularity. The most popular search engines are Google, Bing, Ask and MSN. A Search Engine uses a set of algorithms to find and identify different websites and matches them to relevant search keywords made by the users. It is very important to understand the algorithm of a search engine to design an optimum strategy based on content or bidding after understanding what does the search engine prefer. A search engine is a basically a common platform between content creators selling content and users finding relevant content so it has to address to both of their needs. The need of a seller is to be visible to the maximum audience which is fulfilled by the Search Engine by way of Bidding and Marketing. For a buyer or a content searcher, the need is to find relevant content which matches what they are looking for. To address this need, the search engine uses a set of algorithms to rank and list the most relevant webpages. The pursuit to be in the most relevant webpages can be termed as Search Engine Optimization.

Literature Review

Search Engine Optimization

SEO in general refers to scientific methods and processes to generate web traffic to web sites [1]. It defines structured and goal-driven techniques that would consolidate website structures, site interaction mechanisms, and languages used, and others, all of which are designed to promote the site to land itself at the top of search engine listings in light of the keyword(s) entered by the user. [2]

SEO is generally used to improve the search rankings of a webpage by organic methods.

There are various things that a search engine looks to decide the ranking of each webpage whenever a search is made. The most common of these factors are relevance of topic, word match, page description, attached backlinks and website development indices. It is normally employed by users who intend to grow their subscriber and reader base by organic methods and does not involve incurring direct costs on it. The basic aims for optimizing your webpage for Search Engine Visibility are these

1. Improved accessibility for Search engines
2. Increased relevance between site content and search engine keywords
3. Increased site credibility

There are three major routes to do attain these goals:

1. On-Site SEO: This includes making changes and optimization of factors and contents on the website like matching your content time to time with the search trends, making your URL friendly with the keywords trending in people's search, using relevant and easily interpreted text in your content, putting images matching the query and matching the content with search intent [2]. Also to further increase the relevance, one may cover the topic in discussion in depth to get a better ranking and also use short and descriptive URLs.
2. Off-Site SEO: This method includes tweaking the factors not present on your website or not directly under your control. The Search Engine, like humans, looks for validation of the content it finds on a website with other sources and websites available on the internet [3]. Therefore, it makes sense for one to use and cite backlinks to other relevant websites and get their links on our website. It builds a trust like sentiment with the Search Engine and helps in validating your content as it is endorsed by other websites with similar offerings. The algorithm of Search Engines is such that they rank those websites higher which have maximum relevant links which are

featured on their website. Another way of doing so could be creating content in collaboration with others. A search engine prefers a website where it finds guest published content as it validates the website further and makes the content reliable for the user which is its primary goal [4].

3. **Technical SEO:** While humans have their way of deciding what looks right for them or not, search engines have their own way. Search Engines prefer a directory or a properly organized website when they are looking for the search related content and they tend to give a higher rank to pages which are properly organized. Organization in this sense means designing the schema of the webpage and it is a kind of Index which tells the Search Engine about the kind of content available on that webpage [5]. It is like a table of contents in a book which briefly tells the us what kind of Information is given in the book. It makes sense for a webpage developer and SEO specialist make the schema of the website properly and update it time to time. Also, there are several other tools which can be used for making the technical aspects of a webpage better like the URL shortening, using images as links in the schema.

Beyond these broader routes there are specific ways to attain each of the three goals:

1. **Improved accessibility for Search Engines:**
 - a) **URL Structure Optimization:** Since web engines search data while crawling through URLs, it is desirable that these URLs be structured and updated from time to time to suit the trending keywords.
 - b) **Internal Redirect:** in case of change in web page URLs, or page deletions, internal redirect requests forward to alternate URLs.
 - c) **XML Sitemap:** A sitemap is a page that shows the basic structure of the website. It should be designed properly to facilitate ease to the Search Engine.
 - d) **Content Syndication:** Content Syndication enables pushing contents

of a website onto other websites, by means of extensions, links and others. It gives increased accessibility to the Search Engine as it helps in increasing traces of the website over the web.

2. **Increased relevance between site content and search engine keywords**
 - a) **Meta Tag:** The <meta> tag provides metadata such as short descriptions and keywords about the Web page, to be used by search engines. It helps in making the website more discoverable and accessible.
 - b) **Title Tag:** The title tag of a page, as the name implies, tells search engines the topic of the page. These title tags should be more descriptive as one would always like to click on a website which describes the content on the title itself and thus improves the Click Through Rate and reduces the bounce rate. This in essence increases reliability of a website.
3. **Increased site credibility:** A search uses its own algorithm to decide the credibility of a website, the higher the credibility, higher the rankings in the search results. To achieve this the following measures are:
 - a) **Redirect for Multiple domains:** Existence of duplicate pages may reduce the credibility of a website in the algorithm of a search engine. To avoid that, there should be one main domain and others should be redirect links on that domain.
 - b) **Canonical Tags on URL:** A canonical URL indicates the preferred URL for a webpage that can be accessed through multiple URLs. When multiple URLs direct to the same page, it may cause confusion for the search engine and hence might lower the rankings of that webpage in the search results. It is hence advisable to use Canonical Tags to avoid this confusion. The canonical tags look like this: (rel="canonical" link element)
 - c) **Dead Link:** These are links which used to exist in the past and did lead to some content but are now dead. A rational optimizer should time to time either remove these dead links to their website or put a redirect link there to increase the credibility of their website.

Search Engine Marketing

With almost 3/4th of the world with access to internet, companies are looking to advertise and lure customers online in different ways. One of most obvious methods, advertise to the customers when they search for something like your product. From the late 2000's, Search engines have been seeing a steep surge in revenues from search advertisements. Companies want to advertise their offerings to gain maximum traffic and ensure conversion. Search Engine Marketing involves paying an amount to the search engine to boost the ranking of the page for sponsored keywords and listings [3]. This leads to maximum visibility even without relevant content optimization. In sponsored searches, firm create text based ads for a set of keywords which matches their targeted consumer. Bid Values are assigned to each keyword and then search engines pit advertisers against each other in second-price auction-style bidding for the highest positions on search results pages. When users search for that keyword on a search engine, the relevant ad along with the advertisers' web page appears as a sponsored link on the top and the right side of the organic search results [4]. When users click on the sponsored ad, they are taken to the advertiser's website. An important parameter for the effectiveness of a sponsored search strategy is the likelihood of appearance of the website in the organic listings for that keywords.

SEM starts with the advertiser's research about the keyword and search intent that their target audience might have. For Google, keyword trends are available on Google Trends and Analytics [4]. A string of keywords can be identified and search intent can be successfully matched with relevant keywords there by the advertiser.

The second step is to decide the Ad Campaign and Ad Groups for the overall listings to cover various aspects of the communication strategies like targeting consumer based on demographics, geographic and sometimes even behavioural.

The final step is deciding a bid strategy that suits you. It depends on the overall quality of your website, targeted reach to relevant

audience and the competitiveness in your category.

First, the overall campaign starts with a keyword strategy and it includes deep research about the keywords and these search engines can show your paid listings in various situations, there can be different keyword searches than what you have subscribed for but still there may be a possibility that your ad shows up in a different search [6]. This happens because of matched searches or related searches. Basically, there are three levels of search matches:

1. **Broad Match Keywords:** This targets variations of a term. It may include synonyms, plurals or singulars and some commonly linked words as well. For example, if you are targeting users searching for mobile phone, your ad will also be visible to users searching for mobile phones, smartphones, etc.
2. **Phrase Match Keywords:** This targets the exact keywords plus with some prefixes or suffixes. For example, if you have put in an ad for mobiles, users searching for best mobile phones and mobiles phones in India can see your ad.
3. **Exact Match Keywords:** This targets words that are very closely related to the target term. This includes misspellings, singular or plural forms, stemming, abbreviations, reordered words, paraphrases, or closely related words with the same search intent of the exact match term. For example, if you have put an ad for mobile phone, users with mobile phone and mobile phone will also be targeted by your campaign.

With all of these types of matchings, there is need for exclusion as well for the searches that the advertiser doesn't want to target. For example, if one has a business of sports shoes, they may target keywords like sports, shoes and sports shoes but they would definitely want to target people looking for formal shoes so they put in a list of these negative keywords otherwise the Broad Match Keyword Function could show the ads to the user looking for formal shoes and due to dissatisfaction the bounce rate may increase which will further lead to lowering of the rankings. Therefore, putting a negative list of keywords is very important to reserve the page rankings.

After this is the targeting strategy which is very important and can make or break the campaign. In Marketing itself, Targeting is the single most important step that determines success of a marketing effort. Setting the target audience right becomes very important to reduce bounce rate, improve impressions and reduce Cost per click as the people targeted will be satisfied with the listing and it will then be listed more amongst them only [5]. Like normal marketing, there are some basic levels of targeting for SEM as well, they are as follows:

1. Location targeting: This includes targeting people or audience if a specific location because they are either more relevant for your product or your firm may have a local reach.
2. Ad Schedule Targeting: This becomes important as the advertiser can set at which time of the day or the week do they want to show their ads in search and it comes in very handy for certain types of objects like Air Conditioners and Car Repair Services.
3. Demographic Targeting: In this level, the audience demographics are targeted based on the relevance of the product or service being advertised. This is very basic and should be definitely spent time on by the advertiser.
4. Device Targeting: This basically means to target the device on which the user is searching. There are some searches that are only made on a specific device and not on the others. For example, people look for the nearest restaurant on a mobile and they look for a new air conditioner on a laptop more often. So it makes sense for these product advertisers respectively to target these devices for these type of searches.

The SEO and SEM components have been defined and now a comparison will follow of their costs and benefits:

An SEO Campaign can have various costs associated depending on the level of work required to be done on the website. There are various levels of optimization that a website may require [7]. The variables that are paramount in deciding the level of work required are:

1. Situation: The current state of the website and the resources already owned by that website.
2. Objectives: The goals that the website wants to achieve. This basically gives the amount of work that is to be done in order to achieve the desired results to attract the target audience.
3. Timeline: This plays a very big role in determining the overall costs of the SEO Campaign. Basically, it will give the resources required to travel the distance from current state to desired state. There are various service providers who can charge differently for this and that also may depend on the quality one is aiming for.

The following are the different components of costs included in an SEO campaign:

1. Rank Tracking: This is a significantly important investment if one really aims to keep a track on the progress made. This is essentially free but if the campaign is scalable then it may cost about \$500-700 a month for checking the rankings of around 500 search keywords weekly. Ideally, it's free for small businesses on Google Search Console.
2. Reporting, Dashboards and Analytics: Keeping a track on monthly/weekly results and tracking competitors on the same keywords that an advertiser is targeting is crucial and therefore requires technical capability of reporting software and dashboards. This is another cost that is time bound because it takes human resource to build and operate these dashboards effectively. There can be individuals hired for this or a separate agency can also be hired.
3. Content Engagement: In case of businesses which needs high user engagement, it also needs to generate regular and relevant content which users find resourceful and better than what is already available on the internet. Therefore, content creation and updating costs can depend on the type of website. This costs depends on the person making the content. Generally, higher skilled content makers charge exponentially high prices.
4. Technical SEO: This is a tool that gives the website a quality score on the aspect of its

index and schema and its optimization to be interpreted by search engine's crawlers. This tool significantly affects the ranking of website in search results.

5. **On Page and Off Page Optimization:** On Page optimization includes optimizing factors like web design, coding, page titles and on page copy and web search URLs. These are important for the overall visibility of the website in the search engine crawlers index [2]. Off Page SEO includes factors outside the website which play an important role for the website. These are backlinks and other links that can lead to your website. Basically having more and trustable backlinks works in favour as these work as advocates for the website and can help in improving the overall search ranking.
6. **Link Building:** Analysing what links can lead back to one's website and analysing those that lead back to competitors' websites can work in great favour for an advertiser to find additional opportunities to benefit their website search rankings. This generally takes the help of a technician who analyses and puts links on relevant and related websites [1]. The costs can again depend on the skill level of the technician employed.
7. **Keyword Research:** This is perhaps the foundation of any SEO campaign and therefore should be given the most attention as it is the beginning of the campaign and it can make or break the overall effort [3]. Keyword research requires time investment and critical thinking on the part of the advertiser as they have to understand the psyche of their target audience about how would they search about the product that they are selling. It is a time consuming and managerial task therefore it has generally high costs and is usually carried out by the owner of the website.

After this comes the parties who can be employed to carry out these tasks. There can be various alternatives which will depend on the business type, scalability and affordability of the businessperson. The general types of parties who can carry out these SEO activities are:

1. **The owner themselves:** It is probably the easiest way to reduce costs but can only be feasible when the business is local and the owner is tech savvy [1]. This has the least cost but fails when the business needs to scale up. It suits a very local business.
2. **Freelancer:** Businesses which are local but scaling in their areas usually go for this alternative as it is cost effective as well as they get a specialist for less price. Freelancers are generally lesser experienced technicians who are yet to earn their fame in the industry but they work very hard in the stage. Their probably to make mistakes is also high which is why they are paid less [8]. These are not suitable for brands which are big enough that they can't afford to make mistakes over their online identity.
3. **Consultants:** They are freelancers evolved into better professionals. They charge higher than freelancers and the quality of work is good. Businesses which are regional usually prefer them for their SEO requirements. They are usually expensive for businesses which are local and small.
4. **Agencies:** These are the first choice if corporate players as they are experienced in their work and multiple talented people who are well suited for the challenges that can come up while working for a large company for a large audience [5]. These agencies usually have packages and they are transactional in nature. They are the most expensive alternative for anyone looking to outsource the work of SEO.

For SEM, there are costs directly related to bidding and search promotion and can vary accordingly with different parameters. There are different factors that decide the overall cost to be put into the Search Engine Marketing Campaign. Firstly, we have to understand how these bids work. Basically, one pays for higher share of impressions for a search and it is called as the Pay per click campaign. One targets highest impressions of one's ad while the user is searching for the target keywords.

There is an auction by advertisers to take the higher rankings for their ads and the second highest becomes the bid cost which basically means the second highest bid is the cost of giving a lead to come to the advertisers' landing page. There are various things that can affect the bidding cost like:

- Competitiveness: The competitiveness among rival firms vying to have the largest online visibility
- Geographical targeting: The cost of buying bids for a specific geographical area
- Variety of auxiliary products or services in the same keyword search can also increase the PPC.
- Finally, presence of a large firm can also distort the overall PPC of small players.

But in an SEM campaign, there is more than just bidding. Search engines also have one other stakeholder that is the user who searches on it and expects relevant search results. To cater them, Search engines also look for the overall quality of the landing page and the content and bounce rate. Even though an advertiser has bid a higher amount for search rankings, they might end up below because of the poor quality of their page. Therefore, no matter how much the bidding is, SEO does play a role in the overall rankings.

Research Methodology

The data for this qualitative study was gathered in the months of May and June 2020 from 30 participants. The participants were from varied

backgrounds and were either business owners or Digital Marketing Managers of their respective organizations and they were selected through a Convenient Sampling process, which was conducted before the interviews. Individual Interviews were conducted as the participants had good knowledge about the subject and did not need much prompting. As this study was exploratory in nature, emphasis was placed on letting the participants' thoughts flow freely, and not restrict them to any one train of thought. Hence, all the interviews were more of a conversation. The sessions were also informally conducted on the telephone due to the environmental constraints put forward by the COVID Scenario. The explanatory nature of the interviews did not confirm any existing hypothesis, but identified some key themes for discussion. The telephonic conversations were recorded and transcribed by the interviewer for further analysis.

Results and Analysis

To analyse the interviews of the participants, open coding method was employed and no predetermined categories were assigned for the data. The participants' voices were kept as they were, but some minor changes of grammar were made to provide more contextual clarity. This was done while ensuring that the actual meaning of the conversation was not lost. Finally, while reporting the findings, pseudonyms were used for the participants to maintain anonymity of participants.

Facilitators to SEO								
	User Experience	Long Term Benefits	Organic Search Result	Competition	Focus on Cost	Focus on Content	Medium to Large Scale in Revenue	High Customer Education
Pt 1	√	□	□	√	□	√	√	√
Pt2	√	√	√	□	□	√		
Pt 3		√	√	√	√	√	√	√
Pt 4	√	□		□			□	√
Pt 5	√	□	√	√	√	√	□	√
Pt 6	√	√	√			√	□	
Pt 7		□	□	□		√	√	
Pt 8		□	□	√			□	√

Pt 9	√	<input type="checkbox"/>	√	<input type="checkbox"/>	√	√	<input type="checkbox"/>	√
Pt 10	√	√		√		√	<input type="checkbox"/>	
Pt 11	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>			√	<input type="checkbox"/>
Pt 12	√	<input type="checkbox"/>	√				<input type="checkbox"/>	√
Pt 13		√	√	√		√	<input type="checkbox"/>	√
Pt 14	√	√			√			
Pt 15	√	<input type="checkbox"/>		√		√	<input type="checkbox"/>	
Pt 16		√			<input type="checkbox"/>	√	√	√
Pt 17		<input type="checkbox"/>	√	<input type="checkbox"/>	√		<input type="checkbox"/>	√
Pt 18	√			√				√
Pt 19		√				√		
Pt 20			√	√		√	√	√
Pt 21	√				√			
Pt 22	√	√	√			√		√
Pt 23		√		√		√		
Pt 24			√					√
Pt 25	√	√	√	√	√	√	√	√
Pt 26		√						
Pt 27	√		√				√	√
Pt 28	√			√	√	√		
Pt 29		√				√		√
Pt 30	√		√	√			√	√

Facilitators to SEM								
	Quick Customer Acquisition	Competition	Focus on Leads	Dynamic Market	Low Customer Education	Focus on Visibility	Limited Geographic Reach	
Pt 1	√	<input type="checkbox"/>	√	√	√	√	√	<input type="checkbox"/>
Pt 2	√	√	√	<input type="checkbox"/>		√	√	
Pt 3			√	√				

Pt 4	✓	□	✓		✓	✓	□
Pt 5	✓	✓	✓		✓	□	✓
Pt 6	✓			□	✓	✓	✓
Pt 7	✓	✓	✓	✓		✓	✓
Pt 8	□	□	□	□			
Pt 9	✓	✓	✓		✓	✓	□
Pt 10							
Pt 11	✓	✓	✓	□	✓	✓	✓
Pt 12	✓	✓	✓	✓	✓	✓	✓
Pt 13	✓	✓		✓			□
Pt 14			✓	□		✓	✓
Pt 15		□	✓	□		✓	
Pt 16	✓	✓		□			✓
Pt 17	✓	□	✓	□	✓	✓	
Pt 18	✓	✓			✓		✓
Pt 19			✓			✓	✓
Pt 20							✓
Pt 21	✓		✓			✓	✓
Pt 22	✓	✓		✓	✓	✓	
Pt 23	✓		✓				
Pt 24						✓	✓
Pt 25	✓	✓	✓	✓	✓	✓	✓
Pt 26							
Pt 27	✓		✓	✓			
Pt 28		✓	✓		✓	✓	
Pt 29	✓			✓			✓
Pt 30	✓	✓	✓			✓	✓

Findings

Several varied and complex themes were identified through the discussion with participants. These were broadly classified into two groups: “Facilitators for SEO” and Facilitators for SEM”. Many of the themes were recurring for different participants. Each theme has been portrayed below to gather more clarity and understanding.

- User Experience: Participants seemed to find it a very crucial outcome of their digital marketing efforts through SEO and they want this to be a broad outcome of all the SEO efforts put by the firm. One of the participants reported, “We try our best to make the user experience better by our optimization practices

as it is most important for our customer to feel better.”

- Long Term Benefits: This was another mild theme that Participants focused on. SEO is a long term driven activity as it is organic and works for longer duration usually. The content is the main reason behind it being a long term driven activity and there the benefits are also spread in a longer duration. According to a participant, “Why should I even care about SEO if it cannot help me in the long run.”
- Organic Search Result: This is a key element of SEO as it brings real result on the search and the advertiser or business owner does not want to force the searcher to click on the sponsored link. Moreover, the searchers tend to click

on the links which are organic and not sponsored. According to one participant, “I don’t want my audience to click on links which are desperate, I want them to click on webpages that they think can be the best for their search.”

- Level of Competition: This was very discussed theme among the participants as their decisions are shaped by the level of competition in the market they are operating. Usually, SEO is preferred where there is low competition and high product complexity. SEM is preferred where there is high competition and low product complexity.
- Focus On Cost: Participants discussed about this a lot because their decision depends a lot on the costs involved. SEO generally is a long term engagement and involves high costs but gives better returns as well. SEM on the other hand is a low cost activity but short term as well. They preferred SEM for small and dynamic businesses but SEO for strategic products and sometimes a mix of both. A participant reported, “Cost is a big factor and I definitely want to optimize it therefore we do proper analysis before taking any decision and it totally depends upon the situation.”
- Focus on Content: This was a major theme for SEO as its advocates have a huge focus on content quality and they try to make it the best in the competition. Content creation happens on various levels by building back links, continuous upgrading and collaborating with visitors to create content. In the words of a participant, “Content is paramount for attracting good and relevant audience and it makes them stick as well.”
- Revenue Level: This is a mild factor as it is preferred by some participants but not all. But those who prefer it have strong dependence on it and they feel that SEO should be for high revenue companies and SEM for low to medium revenue companies. One participant said, “Our revenue and profits should support what we want for our customers and it cannot go in a different manner.”
- Customer Education: This was high dependence factor as the final strategy depends a lot on this because customer education directs how much the customer is actually willing to explore the web and in case of high education, customers tend to not click on sponsored links. Low customer education however attracts the SEM strategy. To quote a participant, “We have to know how much the customer is educated and we can’t really use SEM in case of high product education.”
- Customer Acquisition: The time required for Customer Acquisition plays a huge role and usually SEM is employed by advertisers who look at quick acquisition of Customers as it is an aggressive strategy which targets on direct conversions. One of the participants reported, “It’s an important part of business to acquire customers and especially for repeat purchasers so we usually prefer SEM for customer acquisition in such product categories.”
- Focus on leads: This is a mildly important factor as it is important for some specific industries and service categories. SEM generally the options of Call to Action and proves to be a better tool than SEO. It also ensures timely service of customers and generally compares better to SEO. Also, this is the same with organisations who have seasonal services or business. One participant reported, “It is important to generate leads in my seasonal business and SEM comes handy for generating leads.”
- Market Type: This is an important factor for firms with decent market

competition. There can be Static and Dynamic Markets and the strategy does depend on them. For dynamic markets, the communication changes frequently and SEO can become as it includes changing content and construct frequently. Therefore, in such markets, the SEM strategy comes handy. One participant reported, "My market is very dynamic and the service changes frequently and with it changes the communication, so SEM is best for us."

- **Focus On Visibility:** This can be a key issue for some advertisers if their services are shortlived or seasonal because frequent changing of content can be problematic. Using SEO is not a viable strategy in these cases and they tend to go for SEM to increase visibility to the target audience. Visibility is important and seasonal businesses tend to spend their budgets on these. One participant reported, "I can't really go for SEO because I need high visibility as my market is seasonal and dynamic."
- **Geographic Reach:** The geographic footprint of a business has a huge impact on the SEO and SEM strategy. Usually, businesses with local reach go for SEM and businesses with wider geographical reach go for SEO. Local markets usually are competitive and that is why the SEM strategy. A participant reported, "Local searches are highly competitive so we have to resort to SEM strategy."

The themes identified have been common among the participants and were mentioned several times by them during the interviews. As the businesses could be of different types, they are to be employed with changes made to suit the business and industry as these strategies are generic and don't focus on an industry in particular.

One theme that was particularly observed was the mixture of both the strategies used simultaneously to have the best results. While

content is important for a business, they can't afford to lose on the visibility and vice versa as well. Therefore, the hybrid strategy has been gaining a lot of popularity among the industry.

Conclusion

The interviews conducted with the participants suggest towards some clear trends in which a person can select which strategy to implement easily. For example, in case of Geographic Reach and Customer Education Level, it is easy to make decisions which strategy to choose. But in other cases like Content Validity, User Experience, Business and Market Type and Costs involved, the advertiser has to dive deep into the situation and further assess which strategy should be used. There cannot always be a clear answer to this but one can always come up with a combined strategy to implement. These strategies are not essentially mutually exclusive and can be carried out simultaneously as well.

Another thing that can be concluded is the two strategies are complimentary to each other and while in some situations a strategy can work alone, usually it's the combination of both strategies that does the job and achieves the desired results by a firm. SEO is the primary step for any organization in its online marketing strategy and should be executed carefully while keeping in mind different variables that will affect the final result desired by the business like more visits, call to action, customer walk in or queries. The SEO plays the key role in getting the website the required quality score which is measured by how useful the search engines find the overall content on the website in comparison with what they expect from their search. SEO is a continuous project and not just one time and it can bring a lot of benefits if done religiously. The SEO industry popularity has been growing at a great pace even in developing countries because of the enormous potential it unlocks.

Limitations

First of all, the participants were selected through convenient sampling method which could lead to some bias in the study but still we have tried to make it as objective as possible. The participants majorly came from Tier 1 cities because these strategies are in much use

in these cities. While Tier 2 and 3 cities have small cases of these strategies, they are still in the nascent stages and could not be taken for this research. Also, the interviews were totally telephonic due to the situation posed by the current COVID 19 Pandemic. This actually created problem in meeting these people in person. Meeting them in person could have led to better conversations and could have given extra clues about their preferences in these strategies.

The participants were mostly marketing or Digital Marketing Managers in most of the cases but in some cases as the businesses were

small, we had to take interviews of the business owners who were not as actively involved but knew about these processes. This might have led to some skewness in results but in all these responses have been more than satisfactory.

The industries chosen were FMCG, Beverages, Apparel and Entertainment again because of the convenient sampling method employed. Other industries like Healthcare, Sports, etc. were completely ignored for the purpose of this research.

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A study on Determination of Emotions which Influence Consumer Behaviour due to Cause-Based Marketing

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ABSTRACT

Purpose: Purpose – This paper tries to explore the various emotions that can be elicited by brands through cause-based marketing among their customers to drive consumer behavior. Advertisement being a key determinant in cause-based marketing, we will try to explore what emotions should such advertisements convey in order to resonate with customers.

Design/Methodology/Approach – This paper will try to explore the dominant emotions to be evoked by cause-based marketing by inviting responses from a sample population. They would respond about how the various emotions evoked in them with respect to a cause will make them inclined to respond positively to the cause. Their answers will be quantified and factor analysis will be done. This will help us know the predominant emotions which elicit positive response from the population.

Findings – The findings of this paper will help us quantify the propensity to react to an emotional stimuli by customers of a brand using cause-based marketing techniques.

Practical implications – As brands try to associate themselves with various social causes, not only to fulfil their commitment towards corporate social responsibility but also to foster a positive image in the minds of the customers. The findings of this paper will, thus, help determine which emotions should brands and organizations try to induce by various cause-based marketing efforts in order to get a positive response from their customers.

Originality/value – The study is original in nature and its findings will help us to know which emotions brands should tap into with appropriate messaging using cause-based marketing to evoke a desired response in their customers.

Keywords: Cause-based marketing, prosocial behavior, emotional response, positive emotions, negative emotions

Introduction

An important part in marketing communication is about invoking emotional response. As much as the fact that features and quality of a product is of significance to customers, the attitude that they develop towards a particular product or service can also play an important role. Cause-based marketing in this regards pushes the button much further. It makes the whole process an emotional gameplay whereby engagement with a brand can make customers feel differently about the brand while consuming its products or services.

Cause-based marketing is the process whereby brands align themselves with a particular contemporary cause or various causes. Such support for a cause can be done in collaboration with other for-profit or non-profit organizations or can be undertaken solely as part of the objectives of the brands. Such efforts are then marketed to its customers. Customers by associating with the brand can thus support that cause. Such associations can

be direct or indirect. In indirect association customers while buying or using the products and services of the brand is providing a financial support to the brand which in turn means supporting the cause purported by the brand. In direct support, customers are urged by brands to act in a certain way which among other things can also include donating money for a particular cause. The donated money is not a part of the price of the product. Such behavior of directly supporting a cause is termed a prosocial behavior. Direct and indirect support to a cause by cause-based marketing can be considered part of consumer behavior. Prosocial organizations have different moral objectives. Some seek to promote welfare but others seek to promote justice and equality. Whether customers align with a cause directly or indirectly, there has to be an emotional trigger. For example in case of welfare objective, evoking emotion of compassion may work. On the other hand for objectives of justice and equality, evoking

gratitude will help customers align with the cause [1]. Evoking emotions in customers can be studied under consumer behavior.

Consumer behavior is considered by many to be purely based on emotions which can be interpreted in a variety of ways with respect to the product in question. It is rather expected that consumers during the decision making process of buying a product will make use of the information and facts that distinguish the specific product from the rest according to their needs [2]. However, it has been observed that consumers depend on their emotions to make purchase decisions as much as on rationalism of their choices. With many companies concentrating their brands on the issue of customer satisfaction, it is an obvious fact that most of them are obliged to employ the use of cause-based marketing in order to inspire positive emotions in their customers as a means of ensuring higher sales. Brands have used emotional messaging strategically to be successful in the market [3]. The reason for such success is that customers in additions to functional benefits also try to cater to manage their emotional needs through their choice of purchases [4].

Cause-based marketing through an emotional appeal can be defined as the concept of marketing where emotions are used to trigger attention from the consumers and enabling remembrance of the product as well as purchase and use of the same [5]. With the different factors leading one to the point of purchasing a product, there are various emotions that transpire within the mind of the customer. Some customers end up having a sense of uniqueness and pride, others become excited and some others may portray a sense of confidence and responsibility. Emotions do not by any means dictate what the physical body is undergoing with regards to the product serving the needs of the customer. But it is a state of the mind; it feeds the conscience with the decision or opinion derived from using or purchasing the product. This has led to the increased research on the role of cause-based marketing in defining the emotions that a product can evoke in a customer based on how it was sold or presented as an option worth buying through advertisement. Some of the evoked emotions can be based on morality as

well [6]. Content centered on morality can encourage prosocial behavior on part of the recipient [7]. Since, recipients have their own values of morality, emotions arousing morality can influence preference in customers. It can then make the customer prioritize a social concern or cause to associate with [8]. It makes a person do a good deed and comply with his sense of morality [9]. This sense of morality can stimulate positive emotions like compassion, gratitude and love, which in turn will make a person engage in an activity [10, 11]. On the other hand, negative emotions like shame, guilt, embarrassment etc. can also lead a person to undertake or refrain from an activity [12]. One of the reasons for displaying a particular behavior in response to moral content is believe of some people that doing good enables someone to expect good things to happen to them. This is basically believing in the concept of exchange [13, 14]. Another reason, for displaying a particular behavior in response to moral content is adherence to social norms. People being part of the society can develop the believe that some actions are to be taken for the greater good of society. It ought to be done to comply with their culture or community [15, 16].

Business brands that deal with cause based products have invested heavily in social media channels that can reach as many people as possible. They are not only reaching out to them but also ensuring they get their loyalty. This has led to the growth of advertisement industry which puts out the information regarding a product through the various social media platforms so that people can associate themselves primarily with the business brand and in turn associate with a cause and, secondarily, associate with the product features.

Cause-based marketing has undergone many changes over time with different channels of information emerging on a daily basis due to the power of innovation and technology. This has been propagated by the dire need for information. In the 21st century, people being tech savvy and information hungry, different media streams have risen on the internet with social media sites being common place for networking. Platforms such as Facebook and Instagram have become a channel though

which people share and communicate without any form of limitations. This has also revolutionized the concept of emotional appeal to the consumers with many advertising departments forced to employ more creative and aggressive means to manipulate the emotions of consumers.

To know more about which emotions motivate customers to engage with a brand in response to cause-based marketing initiatives of a brand, quality data is required. And to this end, social media has emerged as a powerful platform to collect and analyze huge amounts of data. People can develop the urge to engage in more relationships in the online space where celebrity status quo is considered as an advantage in being able to maintain many followers. Through this, individuals can achieve a sense of gratification and entertainment since their need to be affiliated to certain people or groups of people has been met. Studies has indicated how the use of social media for networking has been useful in providing emotional support through the maintenance of relationships.

Due to the high competitive nature of the world's market structure, information has turned to be a leading edge in the game of profit making. With such facts in mind, it is important to note that the use of online social networks has experienced an exuberant growth over the years due to more penetration of the internet. This has also led to the vulnerability of information systems. Security of data is not only important for litigation process but also for survival of organizations in today's world. In light to this facts, classification of data becomes an important tool in ensuring data security. Data classification is the process of organizing information in categories for easier protection and retrieval. Information integrity and its availability are some of the factors used in classification system. The major data classifications in the market include context based classification, content based classification and user based classification: Context based classification involves inspection and interpretation of files while searching for sensitive data. Content based classification focuses on application and location as triggers for sensitive information. User based classification is dependent on how

end users manually select documents on a system portal. Some organization keep it as simple as just confidential and public information, while others use the following types of classification: sensitive, confidential, private, proprietary and public data in the order of their sensitivity from the highest to the lowest [17]. Transparency of companies to the public over time has turned into a culture that cannot be overlooked in this day and age. The social media tools like ratings and reviews of companies by their employees and customers come a long way in helping provide useful information to the public as well as providing feedback to the company in question.

Literature review

One of the major ways great brands are built by companies is by offering great value in the goods or services they produce. Brand is not all about image and appearance as commonly considered. The best way to build a brand is to ensure that quality of goods and services is not compromised. Production and delivery of quality goods and services is one thing and ensuring that the consumers are well aware of the quality or the value of the product or service they are purchasing is another issue all together. Apart from the factor of quality, the ability to communicate value to the customer is vital in building a great brand. Cause-based marketing is all about communicating value to the consumers through the use of psychological means to ensure that the value is not only factual based but also based on impression to the customers' instincts [2]. With this in mind, cause-based marketing is highly dependent on the data collected regarding the market through research and making discoveries regarding how their marketing communications are receive by the consumers.

It is evident that advertisements appealing to the rationale has been in used over time. And with the concept of emotional appeal being introduced, debates have risen over which of the two methods is effective in reaching new customers and maintaining their loyalty for the longest period of time possible. During the 1980s, studies have shown that the use of rational appeals was able to give a better impression of advertisements when compared to emotional appeals [18]. Looking at

commercial reports during the time, rational appeals were able to effectively persuade people with various marketing techniques. Emotional appeals were considered as a manipulative scheme that was used to blind consumers from seeing the real value in a product or service. This could have been due to the lack of technological advancements during the time to propagate good visuals through advertisements. With other scholars arguing that emotional appeal was commonly used in TV commercials, the debate still continues till today with the field of advertisement undergoing a lot of changes [19].

Psychological circumstances at the time information about a product is being relayed to a consumer is an important factor that determines how appealing the advertisement will be to the emotions of the individual. For cause-based marketing to be effective, then, the advertisement being showcased has to have the ability to trigger a desired emotional response. Once an emotion is aroused, the recipient is ready to receive a message elaboration from the brand. Also, the recipient is more attentive to the message being received [20]. Message elaboration is when after receiving a message, seeking a desired response by the brand, the recipient shows some openness in doing what was asked in the message. This needs some effort from the recipient to understand the message and act in accordance of what was requested through the message. The amount of attention paid and the readiness to receive a message elaboration is dependent on the type of emotion conveyed through the message by the brand. Broadly, the type of emotion can be divided as positive or negative [21]. Positive emotions can be excitement, happiness, sense of humor etc. Negative emotions can be fear, worry, irritation, anger etc. When aroused with a negative emotion, people seek to get rid of that feeling and make themselves feel better. And to do that, people whose negative emotions have been aroused are more likely to be attentive to the message being conveyed by the brand [22]. This is because the recipient is looking for a way to get rid of the negative feeling and return to their baseline emotion [23]. Hence, brands can use negative messaging if they want people to be attentive and follow through with their message. This

will be done by the customer to overcome their discomfort [24]. On the other hand, many researches have shown that only negative message or only positive message might not elicit the desired response from the recipient [25, 26] It is suggested that a conjugation of negative and positive emotion evoking messaging be used to make the recipient pay more attention to the message and thereby respond favorably as desired by the brand to engage with the message [21, 27] With respect to conjugation of various emotions, a message where recipient is first introduced to a negative emotion and then follow it with a positive emotion, is bound to have more persuasive outcome [28]. Out of the various combination of conjugation possible between a positive and a negative emotion sequence such as negative - positive, positive - negative, negative - negative and positive - positive, the sequence wherein a negative emotion arousal is following by a positive emotion arousal results in greater impact on the recipient for message elaboration [6]. This means that the concept of emotional appeal should have the ability to override the pre-existing psychological condition of a consumer and able to turn his emotions from a negative to a positive one. Emotional responses can be difficult to predict and control with most businesses doing whatever they can to appeal to the emotions of the consumer and leaving the rest of the job to the fate of luck due to the lack of control over the pre-existing conditions of the consumer. Research that has been done in the field of measuring emotional response of people to messaging done by brands can be classified into three subsection: Measurement of the factor that corresponds to emotional responses. Theoretical frameworks that determine how emotional response and the attitude that arises as result of advertisement relate with one another [2]. Research that provides some model that tries to predict how different people are most likely to respond to advertisements. Measurement of emotional responses can be done through physiological, symbolic and self-report metrics. Physiological measurements determine how strong an emotional impulse is to the extent of affecting the body and thereafter leading to the making of a certain decision directly propagated by the emotion in

question. Symbolic metrics deal with verification of emotions that emerge from the conscious or subconscious part of the mind while self-report focuses on the effects that an advertisement has on a person's thought triggering some level of emotional response.

Looking into theoretical frameworks that define the relationship between advertisement and emotional response, it is evident that the attitude towards a product or service can either be positive or negative after a consumer has been exposed to advertisement regarding the same [18]. As much as advertisement of a product is geared towards creating positive emotional response, research has shown that different emotional responses are certain since not all emotional appeals are taken positively. Advertisements make use of common stimuli that trigger emotional responses; the choice of words, music accompaniments, type of pictures and colors used. Depending on how these features relate to the consumers' self-relevance, they can lead to a positive or negative emotional response. Positive emotional response is associated with inspiration of consumers' sense of relevance through nurturing while negative emotional response is caused by threatening the aspect of self-relevance through attacking [18].

In cause-based marketing, emotions can be used as a strategic initiative for making a brand successful. This is because customers will choose to engage with the brand to address their emotions. This is why when customers select a product of a brand due to the cause(s) it chooses to address. The features of the product can often be a secondary consideration [3, 4]. Experiments have been conducted wherein the image of a poor child have resulted in the likelihood of people considering the brand and supporting its cause [29]. Negative emotions increase the propensity of people to associate with a cause [30]. This is because negative emotions not only creates a feeling of remorse or anger in the minds of the recipient but also create a positive effect by making ones resolve stronger to do something about it [31]. But there are other reasoning as well which says that some causes might also trigger a moral response from the recipient. Because of some accepted norms of the society or some personal reasons of morality, some individuals may be

more open to associate with a cause-based marketing campaign [1]. Moral emotions can provide the motivation to do good for someone in need [9].

It is important to note the role of moral values of the customers receiving a cause-based marketing message. In such cause-based marketing, moral emotions can be evoked in customers. This in turn encourages or strengthens customers' intention to engage with a cause or purchase a product supporting a cause. This intention can mainly be considered to encourage a direct or an indirect form of financial support to the brand or cause. Engaging in a direct support of the cause means contributing to a charity, either in terms of money or labor. Such a prosocial behavior can be stimulated in a customer by cause-based marketing campaigns [32]. Relevant advertisements can be showcased by brands to its customers to participate in charity activities [33]. In such advertisements, repeated messaging and a consistent support for a cause by a brand can produce successful results. This is because, donation intentions are influenced by prior donation experiences of the donor [34, 35, 36]. Compared to direct financial support in form of charity, in indirect support, purchase of a cause related product is involved. And a portion of its price is used for charity or supporting a cause. Thus, apart from emotional consideration, an indirect support to a cause will also involve considering the product utility or functional benefits sought from the purchased product [37]. Presence of product buying motivation either in terms of functional need satisfaction or brand association is an important consideration in cause-based marketing of products [38]. When purchasing such a product in retail setting, the decision of the buyer is displayed in front of others and hence visible to be judged by others. This may lead to adhering to some social norms thereby making social conformity and affiliation also play a substantial role in the purchase decision. But in an online purchase setting, the influence of displaying social conformity while making a purchase decision may disappear [39]. Both direct support and cause-related product support involves evoking an emotional response to trigger an action on part of the recipient. Triggering a negative emotion has

shown to strengthen purchase decision of a cause related product [40].

With the help of cause-based marketing, request for making donations for a particular cause can be made to consumers. The price of the product or service might be inclusive of donation amount. Or a separate donation amount which is over and above the price of the product or service may be requested from the consumer. Generally, consumers are willing to pay more for a product linked to donation [41]. For inviting donations, emotions can be elicited from people by showing images. If such images display the positive effect as a result of making the donation, then prompt response can be expected from purchaser. While on the other hand, evoking a negative emotion, by showing the plight of someone, for example, tend to increase the amount of donation. It is, also, suggested that success of a donation campaign might depend on the strength of emotions triggered rather than its nature. Meaning stronger emotions may elicit greater amount of donation [29].

Cause-based marketing soliciting a desired response from people works in a two-step process. The first step involves an initial contact point with a messaging to trigger an emotional response and draw the attention of the recipients. This is followed by the second step wherein a strong motivation is created in the recipients to express themselves in a certain way as desired by the message creator. An enabling environment is created and a desired action is communicated [42, 43]. Since, a strong motivation for willingness to act by the consumer is to be created, it is observed that evoking positive emotions alone fails to garner the desired response. This is because only triggering positive emotions fail to generate a feeling of sympathy or empathy which is very much needed if a strong motivation to act in a certain way by the customer has to be created. Only evoking positive emotions might also create a sense of jealousy towards the subject of cause-based marketing in some extreme cases [44]. Since creating empathy in minds of the customers for a cause is important, evoking negative emotions can make them inclined towards associating with the purported cause of the brand [45]. The way negative emotions work is by making people empathetic towards

the plight of a target and in turn motivating the person to take an action so as to do something in their capacity for the benefit of the cause. If people can resonate better with the messaging of the cause-based marketing, it is bound to deliver positive response from them. Hence, people should be communicated with a messaging that is a depiction of the reality as it exist in the world. Creating a sense of uneasiness is a good way to depict reality as most people consider the world to be a mixed bag of opportunities. To this end, delivering a cause-based content in a way that makes people aware of a particular problem or despair situation and at the same time also suggest a way that an individual's contribution can make things better is a good strategy. Through this process a person is evoked with a negative emotion causing uneasiness and at the same time provided a way so as to alleviate the situation by his contribution or effort, thereby providing some relief to that person's emotions [46]. Rather than examining the impact of positive or negative emotions in general, studying the effects of discrete emotions like happiness vs excitement or sadness vs anger can help us devise better strategy for cause-based marketing [47]. Among the various discrete negative emotions, the intense ones like furiousness, frustrations etc. can tend to upend the desired action sought from the recipient. Likewise, intense positive emotions contributing to over zealotness can lead to unwarranted consequences [45]. Hence, brands should make a note to properly consider which discrete emotions is to be evoked. Depending on this, suitable cause-based marketing campaign or content is to be designed.

Methodology

The aim of this research paper is to investigate the impact of various human emotions in cause-based marketing. In the course of this investigation, the paper particularly looks into how advertisements can appeal emotionally to customers of corporate brands so that they make contributions to various causes supported by the brands. The paper will determine the emotions which brands can attempt to evoke in their customers by using cause -based marketing to ensure they not only sales their

products and services but also successfully request their customers to support a cause directly or indirectly.

Methods of data collection

The research makes use of both primary and secondary sources of data and information since the subject has been well documented in current literature and is a matter that continuously undergoes various changes from time to time. Through the use of secondary research some of the common emotions related to social marketing, emotional marketing and cause -based marketing have been documented [29, 2]. These emotions were considered to be important factors which appeal to customers and urges them to undertake a particular action when confronted with such emotions through advertisements. Next, in order to do primary research through factor analysis, a questionnaire comprising of questions centered on how customers feel when subjected to attempts of cause -based marketing through advertisements was prepared. Primary source of data involved circulating the questionnaire and filling of online forms which was useful in determining the effectiveness of advertisement stimuli on the development of negative or positive emotional responses. The questions used in the questionnaires made use of the Likert scale to determine the extent of impressions made by advertisements.

Sampling method

Random sampling was used to ensure participants were from various geographies, demography and with different behavioral attributes. The number of respondents was 215, out of which 160 were male and 55 were female.

Data collection method

For primary data collection the questionnaire was floated on various social networking platforms like Facebook, LinkedIn, and WhatsApp. The questionnaire comprised of 22 questions which were directly related to research questions. There were some other questions related to individual details of the participants. The research took on a cross sectional study where data was gathered at a specific point in time. All the questions were qualitative in nature. A 7-point Likert scale

was used to determine the answers given by the respective respondents.

Tools Used

In the investigation of how and which emotions affect attempts of cause-based marketing, the data which was collected went through an analysis using the method of factor analysis. It was useful in understanding the relationship among a number of variables by placing them under the scrutiny of common underlying factors. This helped in reducing the complexity of the study through reduction of the variables under study to the ones which are very significant to the subject of emotional appeal of cause -based marketing.

The questions related to primary research are as follows:

Perception of negative emotions

Highly disagree (1)/highly agree (7)

a1 I get **worried** when I see others in pain
a2 I **fear** for the well-being of the vulnerable

a3 I would **regret** if I could not help those in need

a4 I get **anxious** if I cannot help someone in need

a5 I am **saddened** if I miss an opportunity to help someone in need

a6 I feel **bleak** when I know how others are suffering at the present moment

Perception of extremely positive emotions

Highly disagree (1)/highly agree (7)

b1 I am **enthusiastic** to help out others in need

b2 Helping the needy makes me **excited**

b3 I will **eagerly** participate in any activity for helping the needy

b4 I will be **proud** of myself for helping anyone in need

b5 I **desire** to be an active participant in social upliftment of the needy

Perception of positive emotions

Highly disagree (1)/highly agree (7)

c1 I feel a sense of **joy** when helping others

c2 I would be **delighted** to have an opportunity to help the needy

c3 I find **comfort** in knowing that I have actively helped someone in need

c4 Helping the needy should arouse a sense of **satisfaction** in me

c5 It will be a **pleasure** to receive an invitation for any activity to help the needy
 Perception of extremely negative emotions
 Highly disagree (1)/highly agree (7)

d1 It is a **shame** if people overlook the opportunity to help the needy

d2 I feel **disgusted** when people blindly ignore the request for help

d3 I feel **frustrated** that there are so many issues to help the needy, yet so little is done

d4 I am **irritated** when people are oblivious to sufferings of others

d5 I will be **furious** to know if someone with the capacity to help the needy ignores it

d6 I have **contempt** for people who cannot sympathize with the needy

Results

In factor analysis, KMO and Bartlett’s Test determines the significance and veracity of the data.

With a satisfactory factor of above 0.5, the KMO and Bartlett’s Test, Table 1, provides a go ahead to proceed with the factor analysis since it indicates that the sampling adequacy is 0.901 (90%). In addition, the Sig. value of our data is 0.000, indicating that our data is adequately significant to carry factor analysis.

Table 1: KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.901
Bartlett's Test of Sphericity	Approx. Chi-Square	3456.776
	df	231
	Sig.	.000

Next, we see under the Extraction column of the Communalities chart in Table 2, that most of the questions asked in the circulated questionnaire for primary research were having extraction values above 0.6. It means that atleast 60% of variance can be explained using data set for all the components involved. We can also see that questions d1, d4, a1 and d6 have extraction values between 0.5 and 0.6. And for d3 it is slightly less than 0.5. Since these questions are important part of the questionnaire and have acceptable extraction values, they have been considered.

Next, we see that in the table named Total Variance Explained, Table 3, that 4 components have Eigen values greater than 1. This means that if only those factor

components are selected which have Eigen values greater than 1, then there will be 4 factors after loading the data. And observing the values under the Cumulative Variance column (Cumulative %) in the Total Variance table, we find that by using only these 4 factors we can deduce 67.528 % of variance in the data set, which is quite good.

Table 2: Communalities Chart

	Communalities	
	Initial	Extraction
d1	1.000	.533
d2	1.000	.702
d3	1.000	.467
d4	1.000	.560
d5	1.000	.641
b1	1.000	.671
b2	1.000	.731
b3	1.000	.769
b4	1.000	.661
b5	1.000	.734
a1	1.000	.547
a2	1.000	.699
a3	1.000	.725
a4	1.000	.723
a5	1.000	.748
a6	1.000	.819
c1	1.000	.622
c2	1.000	.835
c3	1.000	.857
c4	1.000	.646
c5	1.000	.634
d6	1.000	.532

Extraction Method: Principal Component Analysis.

Table 3: Total Variance Explained

Component	Initial Eigenvalues			Total Variance Explained			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.665	43.931	43.931	9.665	43.931	43.931	5.169	23.565	23.565
2	2.706	12.302	56.233	2.706	12.302	56.233	3.777	17.166	40.752
3	1.374	6.245	62.477	1.374	6.245	62.477	2.980	13.544	54.295
4	1.111	5.051	67.528	1.111	5.051	67.528	2.911	13.233	67.528
5	.937	4.257	71.785						
6	.742	3.373	75.159						
7	.696	3.163	78.321						
8	.658	2.991	81.313						
9	.603	2.741	84.053						
10	.501	2.275	86.328						
11	.455	2.069	88.398						
12	.415	1.885	90.283						
13	.367	1.666	91.949						
14	.328	1.489	93.439						
15	.279	1.269	94.708						
16	.244	1.109	95.817						
17	.218	.993	96.810						
18	.193	.877	97.687						
19	.164	.757	98.444						
20	.146	.666	99.110						
21	.109	.495	99.605						
22	.068	.315	100.000						

Extraction Method: Principal Component Analysis.

Now we understand the Rotated Component Matrix, Table 4, and can deduce the following results:

Table 4 indicates the loading of the 22 components on 4 factors. The factor loading represents the correlation coefficient between the components and the factors. The factor loading values measures how closely the components under a factor are related.

Identified factors

From table 4, we can see that components a1, a2, a3, a4, a5 and a6 are significantly loaded on factor 1; components b1, b2, b3, b4 and b5 are significantly loaded on factor 2; components c1, c2, c3, c4 and c5 are significantly loaded on factor 3; components d1; d2; d3; d4; d5 and d6 are significantly loaded on factor 4.

Table 4: Rotated Component Matrix

Rotated Component Matrix ^a				
	Component			
	1	2	3	4
a6	.848			
a3	.826			
a5	.802			
a4	.799			
a2	.742			
a1	.673			
c3		.892		
c2		.889		
c1		.764		
c4		.742		
c5		.595	.402	
b2			.796	
b3			.711	
b4			.670	
b1	.453		.552	
b5	.516		.547	
d2				.790
d4				.635
d3				.632
d1				.567
d5	.457			.519
d6				.462

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 a. Rotation converged in 6 iterations.

Factor 1: Components a1, a2, a3, a4, a5 and a6 represent the emotions worry, fear, regret, anxiety, sadness and bleakness respectively. These emotions trigger a negative response in the body. These feelings, generally, do not lead to extreme reactions but a morose feeling on a personal level. Hence, factor 1 is termed as ‘sorrow’.

Factor 2: Components b1, b2, b3, b4 and b5 represent the emotions enthusiasm, excitement, eagerness, pride and desire respectively. These emotions can be associated with an overtly expressed positive feeling. Hence, factor 2 is termed as ‘zealousness’.

Factor 3: Components c1, c2, c3, c4 and c5 represent the emotions joy, delight, comfort, satisfaction and pleasure respectively. These emotions give way to feeling good about oneself without the need to overtly expressing them bodily. Hence, factor 3 is termed as ‘happiness’.

Factor 4: Components d1; d2; d3; d4; d5 and d6 represent the emotions shame, disgust, frustration, irritation, furiousness and contempt respectively. These emotions can induce intense negative feeling. Hence, factor 4 is termed as ‘anger’.

The four identified factors have been summarized in Table 5

Table 5: Identified Factors

Factor 1 : Sorrow	Factor 2: Zealousness	Factor 3: Happiness	Factor 4: Anger
Worry	Enthusiasm	Joy	Shame
Fear	Excitement	Delight	Disgust
Regret	Eagerness	Comfort	Frustration
Anxiety	Pride	Satisfaction	Irritation
Sadness	Desire	Pleasure	Furiousness
Bleakness			Contempt

Conclusion and discussion

The major emotions that were considered in the study have been clubbed as happiness, zealousness, sorrow and anger. These emotions play an important part in emotional marketing as well, wherein purchase decisions is governed by emotions more and less by logic. Nowadays, these emotional appeal is majorly propagated by social media channels which is responsible for the creation of an image in the minds of the consumers. Advertisements have found their way into various social media platforms besides their presence on main stream media such as the newspapers and televisions. With social media being deemed as an increasingly dominant source of entertainment, main stream media runs the risk of losing relevance.

Thus, understanding that cause-based marketing depends on the same emotions as in emotional marketing, we can follow the same line of thought that emotions have a major role in appealing to customers for cause-based marketing. Sorrow and happiness are two important emotions which brands can use to reach out to their customers for cause-based marketing. Moreover, we can also say that sorrow is the pre dominated emotion which is to be utilized by brands to appeal to its customers. Extreme and overt set of emotions characterizes by anger and zealousness may not replicate the same desired response expected from customers. And, since, nowadays social media gives us a range of media platforms by which we can reach out to customers in ways

not possible by traditional channels of media, we should make full use of it for cause-based marketing as well. The more engagements we can generate with customers, the more emotions we can trigger at the touch points.

In summary, the following conclusions have been derived

- A range of emotions impact customer engagements with cause-based marketing; among which negative emotions characterized by sorrow and positive emotions characterized by happiness are the most influential emotions to drive consumer behavior.
- A combination of various emotions elicited by cause-based marketing may evoke the necessary action from customers. Hence, in addition, to traditional mediums of communication, special focus should be on using various social media platforms to disseminate the cause-based marketing campaigns. This is primarily because social media provides more opportunities to engage with customers and thus increasing the probability of eliciting desired customer emotions followed by adequate response.

Limitations of the research

The research was conducted to know the main emotions which can influence cause-based marketing. But its findings have been limited by scope of financial resources available and the level of interaction possible with the respondents. The research was conducted on respondents based pan India. We know that response to emotions depends a lot on culture besides other factors. India being a multi-cultured country, the emotions and the subsequent response can vary depending on people belonging to different regions of the country. Hence, the findings are limited in pinpointing the effects of emotions on cause-based marketing based on cultural orientation.

Further, the questions were asked in the form of a questionnaire which respondents filled out without any opportunity to directly observe the respondents. Hence, a better understanding of customers' decision making process at time of actual purchase has been limited.

Scope for future research

In order to further the findings of this research paper, various modern tools like neuroscience, dial testing etc. can be performed. Besides consideration of cultural orientation of the people, we can also explore how they would react to various products depending upon their involvement in the purchase decision. We can understand how customers' emotional reaction will differ if the cause-based marketing is done by a B2C brand/product vis-à-vis done by a B2B brand/product. Also, the response by a person to an emotional appeal might change over a period of time. A consumer who is aware with a cause supported by a brand will react differently to a cause-based marketing emotional appeal than a customer who is made aware of the same issue for the very first time. Thus, a longitudinal study of response of people to the same emotional appeal can be done in order to better understand how organizations might evolve their campaigns over time. An interesting thing to observe will also be the fact that with the emergence of new communication platforms, particularly in the social media space, customers' openness to perceive an emotional appeal via various channels of communication will change. We can endeavor to understand such effects as well.

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Impact of COVID-19 on FMCG industry in India: A consumer behaviour study**Samitinjaya Rath¹, Gauri Joshi²**^{1,2} Symbiosis Centre for Management and Human Resource Development, SCMHRD, Symbiosis International (Deemed University), SIU, Hinjewadi, Pune, Maharashtra, IndiaEmail: ¹ samitinjaya_rath@scmhrd.edu, ² gauri_joshi@scmhrd.edu**ABSTRACT**

Purpose – This study attempts to qualitatively and quantitatively assess the change in consumer behavior with regards to FMCG products in India post the implementation of lockdown in India owing to the COVID-19 pandemic. The study further aims to understand the rationale for the consumer behavior and identify patterns, if any based on demographic segmentation.

Design/Methodology/Approach – The research is to be conducted through an online questionnaire to understand changes related to beliefs, purchasing power, attitudes and opinions when it came to spending on FMCG products. The sample size for the same is approximately 100 and the consensus opinion derived from the respondents would qualify as the lessons/conclusions from this research.

Findings – Demand for critical FMCG products have only increased during the pandemic. Non-essential FMCG products have taken a beating. Most FMCG companies have increased their online spends and have taken to online channels as a major source of sales.

Practical implications – The study can help fill the knowledge gap that exists regarding the growth of FMCG space in India post the implementation of lockdown. The research will also analyze the consumer behavior patterns and the rationale for the same, post March, 2020.

Originality/value – The study will help marketing agencies to make informed decisions regarding their marketing spends to address the consumer behavior changes and the shift in buying channels. It will also give insights into the channels they can take up to reach the consumers in a pandemic-hit world.

Keywords: FMCG, Consumer behaviour, Pandemic, Online shopping

INTRODUCTION

The coronavirus pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) impacted the lives and economies of countries across the world. The pandemic has affected 198 countries and while countries are taking various measures to protect their citizens through self-isolation, wearing of masks, and quick development of vaccines, a downturn in economic activity has led to the world being on the verge of a global recession. The pandemic has led to many behavioural changes that could be ever-lasting. While drug manufacturing companies like Pfizer, Moderna are working on a cure with the financial support of governments around the world, the vaccine is still some time away and the efficacy uncertain.

The impact felt has been across sectors. Tourism and the hospitality industry have been severely impacted and many countries have restricted international flights until the end of the year 2020. The entertainment industry has taken a hit and no screening of movies in theatres had been possible. Recently, some

countries have allowed the opening of theatres with reduced seating capacity. Schools in many locales have pivoted to 100 percent online learning and digital classrooms. Banks have transitioned to remote sales and service teams and launched digital outreaches. There has been a sharp impact on manufacturing and automotive due to lockdowns, supply chain disruption and demand slowdown. Remote shopping has led to increased spends on building digital capabilities as well as introducing AR/VR capabilities to showcase lifestyle products.

The impact was also felt in India, leading to loss of jobs and contraction of economy by nearly 24% in Q1, FY21. Barring the agriculture sector, which grew by 3.4% in the said quarter, other sectors like mining, manufacturing, construction, trade, transport, communication saw huge contractions, by as high as 50.3%.

Fast Moving Consumer Goods are defined as non-expensive products which do not require a lot of effort while shopping. These are vastly different from long-term durable products, like

refrigerators, televisions which are long-term purchases after a fixed number of years. FMCG goods are bought in small quantity and they exhaust themselves after a short duration [1]. The broad FMCG segments are as follows:

- **Household Care:** This includes products that are meant for taking care of the house like floor cleaners, glass/wood cleaners, detergents for clothes, utensil cleaners, toilet cleaners, mosquito repellents like Good Knight, air fresheners like Odomos, besides furniture polishes.
- **Personal Care:** It includes products designed to take care of personal hygiene like hair care (Head n Shoulders), skin care (Lakme), oral care (Colgate), cosmetics, deodorants (Fogg), sanitary tissues, shoe care products, etc.
- **Packaged Foods:** This category includes soft drinks (Pepsi), juices, bottled water, cereals, biscuits, breads, cakes, tea, coffee, packaged snacks, chocolates, dairy products, wheat flour, branded rice, dairy products, sugar, etc.
- **Spirits and Tobacco:** Alcoholised products which help people unwind and celebrate occasions.

The FMCG sector is the fourth largest sector in India, with a market size of nearly 1.1 trillion US\$. It has 3 main segments: Food and Beverages (19%), healthcare (31%) and Household and Personal Care (50%). The urban sector contributes about 55% of the overall revenue to the FMCG sector in India. However, over the last few years, it has been seen that the rural sector has grown at a faster pace as compared to the urban sector, when it comes to the consumption demand of FMCG products. Experts believe that the rise of rural consumption will be the major driving force behind the growth of the FMCG sector in India in the years to come. To deepen their presence in the rural markets, companies have come up with customized offerings in the rural areas. For example, some companies have come up with smaller SKUs, like making a 5 INR product available in the rural areas, while continuing to sell a 10 INR product in the urban areas. This is keeping in mind the lower

incomes and lower discretionary spending power of people in rural India.

The Indian FMCG sector has relatively low entry and exit barriers. Increased capital requirement prevents the entry of new entrants. There is also a very real threat of substitutes in the industry as according to the theory of economies, these products are classed as essentials and the demand for such kind of products is always elastic [2]. As India gets urbanized, the upper middle class is accumulating a lot from the western world. The customer is now willing to experiment with western ideas and products and this has led to the growth of foreign MNCs in India. [3].

Consumer behaviour is a very interesting topic for marketers. The subject helps understand the psyche of consumers, how and why they choose certain products, what is the criteria they employ to choose from a certain set of alternatives, what they perceived of a brand, and how they are influenced by brand activities and promotions, how customers are influenced by their environment, relatives, neighbours, colleagues, etc, in making a purchase decision, as well as the social and psychological factors influencing the purchase decision[4].

The growth of the FMCG sector had been slowing down since mid-2018. While the growth rate was 16.2% in Q2, FY 2019, the growth rate came down to 6.6% by Q3, FY 2020. However, owing to COVID-19, companies have ventured into newer product categories like personal hygiene (sanitizers, handwashes, etc). Critical FMCG products have grown at unprecedented rates, while non-critical items like cosmetics have seen a decline.

Many companies have put in efforts to attempt direct distribution during the pandemic. Dabur, for example, has partnered with food delivery applications like Swiggy. The focus is on direct to customer distribution as the companies believe that this model is likely to gain acceptance from customers. Tata Consumer Products tied up with Domino's Pizza and Zomato under this model. However, companies also highlighted that they were not permanently moving away from traditional channels of sales. Flipkart stated that the most searched belongs to the personal care products like trimmers, electronic goods like mobiles,

laptops, and fans air conditioners to beat the heat. Snapdeal claimed that they have received a huge proportion of 75% of the total orders from these orange and green zones in the country [5]. There has also been a rise in digital payments as people curtailed the use of cash, a potential vector for the spread of the Coronavirus. BHIM UPI, PhonePe, PayTM were some of the companies which benefited because of this change.

At the beginning of the lockdown, the government did not classify FMCG products as “essential”, which restricted the flow of FMCG products across the country and affected their availability at retail stores. This led to the sudden emergence of local brands that substituted the popular FMCG brands in the country. This led to revenue loss for these major brands. The factories/plants of these companies were also running at one-third capacity leading to stockout of accumulated inventory. However, these changes were short-lived as the government, after three weeks of the lockdown, allowed the manufacture and transport of FMCG products, with reasonable safety precautions in place. Many FMCG companies, while not expressing openly, were saddened that their products were not classified as “essential” at the beginning of the lockdown.

There were supply chain disruptions in India owing to over dependence on China. India being locked in a tense border stand-off with China, led to higher material costs for Indian manufacturers and this led to decrease in profits. This also meant companies resorted to lesser capex expenditures. However, the disruptions were temporary as the border standoff cooled and the Chinese manufacturing picked up again.

Consumers, on the other hand, resorted to buying local brands, as well as using online retailers like Flipkart, Amazon and BigBasket for their FMCG consumption demands. They also started using Zomato and Swiggy delivery services to meet their weekly/monthly grocery needs. This also led to Flipkart and Zomato increasing their delivery staff to meet the increasing demands. Initiatives like ‘No-contact’ delivery have been appreciated by consumers.

Products such as floor cleaners, toilet cleaners, sanitizers, soaps, handwashes, masks, wipes, kitchen cleaners, have seen a surge in demand. Similarly, the demand for food staples, instant noodles, biscuits, floor, cooking oils, frozen foods, instant mixes have not taken a beating. Products that help in boosting natural immunity like chavanprash have also seen a significant demand from customers. However, non-essential FMCG products like deodorants, fragrances, skincare and other cosmetics, have seen a slump in demand.

Hence, in this context, it becomes important to understand the consumer buying behaviour in the FMCG space post COVID-19 and the implementation of lockdown in various parts of India - and the world - to curb the spread of the pandemic.

Therefore, the following are the objectives of the research:

1. To study the difference in consumer spending on FMCG products before and after the pandemic
2. To understand the FMCG categories which have gained greater adoption post the imposition of lockdown
3. To understand preferred channels of shopping post imposition of lockdown
4. To understand the popular FMCG brands which were always able to maintain a healthy offline shelf presence despite the uncertain times

Literature Review

Lockdown in India was implemented on 22nd March, 2020. Experts believe that the three-week lockdown was insufficient for a country like India. Various epidemiological studies suggested that long-term lockdown with temporary lifting of the same would be more favourable, as this would help the public infrastructure to deal with the crisis while still maintaining sufficient economic activity. Researchers at the time suggested that the situation in India looked dangerous and that the affected people would reach millions within a short period of time [6]. John Hopkins University kept providing updates regarding the number of COVID-affected and COVID deaths on a real time basis, based on the daily/bi-weekly briefs released by government agencies across the world. Hence, the Indian

Government, on a war footing, decide to do isolation, contact tracing of infected and close family. The lockdown was implemented as a means to acquire team to control the outbreak and prepare health care systems to cope with the upcoming demand. If not handled properly, the crippling health infrastructure of India could have collapsed [7]. India spends only 1.5% of its total GDP on public health infrastructure, the systems were grossly under-prepared to meet the demands of a health crisis of this magnitude. This meant millions of people, especially the labour class were unable to earn a living owing to government restrictions on working in public spaces. This led to widespread migration of urban poor back to their villages to fend for their livelihood. The urban poor had hope that once in their villages, they would be able to have two square meals a day thanks to their families in the villages. This led to chaotic scenes of millions of people walking thousands of miles to reach their native place without the availability of required public transport. It also made it difficult for villagers to come to towns to sell their vegetables, fruits, or home-made products to earn daily wages, fearing police brutality [8]. The pandemic and resulting lockdown rarely affected self-sufficient villages where there is less over-crowding, the houses are well ventilated and the daily manual labour is in open fields.

All these factors contributed to a change in the composition of the consumption basket. An increased focus has been placed on health and hygiene products. Meanwhile, people have been postponing their purchases decisions in many categories [9]. Experts believe that brands that manage the crisis well should increase in stature and value. There has also been a growth in digital channels for most companies, including FMCG companies. Newspaper reports highlight the growth in orders from digital retailers like Flipkart and Amazon. At the same time, the number of food orders from food delivery applications like Zomato and Swiggy had taken a beating in the immediate aftermath of the implementation of the lockdown. However, post 3-4 months of the lockdown, once the Unlock processes began and the food delivery applications advertised heavily regarding no COVID-19 cases owing

to the food supplied or the contact with delivery representatives, there has been a steady growth in the number of food deliveries, almost back up to normal levels. There has been an increase in internet usage, digital gaming, live streams and video applications.

There have been several disruptions to the Indian retail segment owing to the drop of sales: ballooning of inventory, higher discounting to excess inventory, cash crunch or liquidity issues, BOPIS (Buy Online and Pick up In the Store) being encouraged, and multi-brand retailers becoming omni channel [10]. Experts believe that the whenever there is suppressed demand, the situation tends to reverse back very quickly when the controlling factor that has lead to the suppressed demand, is removed. Hence, there was a belief, that once the lockdown is lifted, demand will come back to normal quickly. The presence of online channels saved the country from the drastic consequences when the traditional channels were closed down with the imposition of lockdown. This helped in countenancing some of the losses for the FMCG industry [11].

Many FMCG companies have stepped up the accelerator when it comes to creating awareness about the pandemic. Companies resorted to both BTL and ATL mediums like television, newspaper advertisements, hoardings in public places to build awareness about their products and brands. Brands were not only trying to gain relevance, but also informing their customers by creating a precautionary narrative so that their customers could be aware and not have misconceptions regarding the coronavirus [12].

There is not much literature that identifies the consumer behaviour post the implementation of the lockdown and the effects the lockdown has had on FMCG consumption. This research paper attempts to fulfil that gap.

Research Methodology

The research paper aims to understand the shift, if any, in consumer buying behaviour and the impact on FMCG consumption of individuals and families. It also aims to understand the brands that have responded well to the situation and ensured availability and accessibility according to the consumer. To understand this, a survey questionnaire was

designed that tries to answer the major objective questions of this study. The study tries to understand the change in consumer spending, the availability of discretionary spends and the availability of FMCG channels for buying of FMCG products. The respondents would note down their observations in a manner which makes it easy to get a pre-pandemic and post-pandemic view. Whether or not there has been a significant change can be confirmed with a help of a paired t-test. The significance value of 0.05 has been taken for the purposes of the study.

Sampling Method:

Stratified random sampling is used for the purposes of this research. The research will be carried out with the help of approximately 100 respondents, who are mostly business students, homemakers and tradesmen, in the ratio of approximately 70, 20, 10 respectively. Business students have a pulse on the demand and supply of products in market. They are also generally affluent enough to be urban consumers of FMCG products, which constitutes about 55% of the total market for FMCG products. Homemakers are the decision makers in every household, for FMCG products. Tradesmen are employed in the purchase and selling of FMCG goods, and hence, understand demand and supply fluctuations.

Data Collection Method:

The survey questionnaire was floated on professional networks like LinkedIn and B-school portals. While a few questions focussed on getting demographic details to understand any difference in responses based on demographics, the majority of the questions were focussed on understanding the difference between a pre-pandemic view and a post-pandemic view. The tradesmen category includes wholesalers, shopkeepers, salesmen and other staff working at sales outlets. Interviews were conducted with some respondents to get a more holistic picture of the situation. Social distancing limited the number of face to face interviews that could be conducted.

Questionnaire:

1. Name:
2. Age:
3. Profession:

This survey is to understand changes in consumer buying behaviour post the emergence of COVID-19 and the subsequent lockdown imposed across India. The survey will take 5-10 mins of your time. The information collected through the survey will only be used for academic/research purposes. No information shared will be sold/distributed without prior consent and confidentiality will be ensured at all times. Please feel free to be descriptive in answers which are not subjective in nature. The survey results will be shared with the respondents, on request.

4. Do you know what an FMCG product is?
 - Yes
 - No
 - Can't say
5. Which of the following FMCG products did you consume prior to the lockdown? (select all that apply)
 - Ready-made meals: Readily-available meals which are easy to cook
 - Drinks: Energy drinks, juices and bottled water
 - Delicacies which are backed: Cookies, and bagels
 - Processed foods: Muesli, Cereals, products made of cheese,
 - Fresh fruits, vegetables, frozen peas, nuts, almonds, raisins, and frozen peas
 - Medicines that do not require a prescription: Pain relivers, medicines that help remove headache, back pains, etc
 - Sanitization products: soaps, handwashes, sanitisers, wipes, disinfectants
 - Cleaning products: Glass cleaner, baking soda
 - Stationary: Pens, pencils, notebooks, markers
 - Toiletries and cosmetics: Oral care, Hair care products
6. Which of the following FMCG products did you consume post the imposition of the lockdown? (select all that apply)

- Ready-made meals: Readily-available meals which are easy to cook
 - Drinks: Energy drinks, juices and bottled water
 - Delicacies which are baked: Cookies, and bagels
 - Processed foods: Muesli, Cereals, products made of cheese,
 - Fresh fruits, vegetables, frozen peas, nuts, almonds, raisins, and frozen peas
 - Medicines that do not require a prescription: Pain relievers, medicines that help remove headache, back pains, etc
 - Sanitization products: soaps, handwashes, sanitisers, wipes, disinfectants
 - Cleaning products: Glass cleaner, baking soda
 - Stationary: Pens, pencils, notebooks, markers
 - Toiletries and cosmetics: Oral care, Hair care products
7. What would be an approximate amount that you would spend on FMCG products, on a monthly basis, PRIOR to the imposition of lockdown in March, 2020?
 8. What would be an approximate amount that you would spend on FMCG products, on a monthly basis, POST the imposition of lockdown in March, 2020?
 9. Which popular FMCG brands have you seen on the shelves POST the lockdown?
 - HUL
 - ITC
 - Nestle
 - Britannia
 - Godrej
 - Dabur
 - Emami
 - Marico
 - Patanjali
 - Colgate
 - P&G
 - Amul
 - Johnson & Johnson
 - Nirma
 10. Which channels did you use to purchase FMCG products PRIOR to the lockdown? (Select all that apply)
 - Local Kirana Store
 - Modern Trade (Malls)
 - Online Retail
(Flipkart/Amazon)
 11. Which channels did you use to purchase FMCG products POST the implementation of the lockdown? (Select all that apply)
 - Local Kirana Store
 - Modern Trade (Malls)
 - Online Retail
(Flipkart/Amazon)
 12. How often did you purchase FMCG products PRIOR to the lockdown?
 - Several times a week
 - Bi-weekly/Weekly
 - Fortnightly
 - Monthly
 13. How often did you purchase FMCG products POST the implementation of the lockdown?
 - Several times a week
 - Bi-weekly/Weekly
 - Fortnightly
 - Monthly
 14. Did you get the requisite quantity of FMCG products POST the implementation of the lockdown?
 - Always
 - Never
 - Sometimes
 - Can't say
 15. Were the offline retailers you visited stocking the appropriate quantity of FMCG products when you visited them?
 - Yes
 - No
 - Don't know
 - Did not visit any retailer
 16. Have you started shopping online more because of the pandemic?
 - Yes
 - No
 - Shopping online as much as before the pandemic
 - Can't say
 17. Did government/private company efforts to make FMCG products reach

your home through mobile vans make your life easier?

- Yes
- No
- Didn't use

18. What are the advantages of online shopping in your view? (Select all that apply)

- Ease of ordering
- Ease of delivery
- Speed of delivery
- Saves time of visiting an offline retailer
- More choices of products
- Cheaper price
- Offers/cashbacks/discounts

19. Any other trends/changes that you have noticed in FMCG product consumption/availability in the last 8 months?

RESULTS

After conducting the survey, we decided to do paired sample t-test for questions that involved a pre-lockdown and post-lockdown view to understand the changes brought about by the intervention (the imposition of lockdown).

For the question relating to the change in spending on FMCG products post the imposition of lockdown, we created a null hypothesis as follows:

H0- There is no significant difference in consumer FMCG spending between before and after the implementation of lockdown

H1- There is a significant difference in consumer FMCG spending between before and after the implementation of lockdown

After applying a paired t-test, we get the results as follows:

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	6594.29	98	3501.472	353.702
	5864.08	98	3608.152	364.478

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1	98	.939	.000

Paired Samples Test

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pair 1	730.204	1241.081	125.368	481.393	979.025	5.824	97	.000

Under the table Paired Sample Correlation, we see that there is significant correlation among the before and after datum and its Significance value (sig.) is also less than 0.05 which means that we can comfortably say that they both are highly correlated.

Coming under Paired Samples Test we see that Sig (2-Tailed) is 0.000 which is less than 0.05 confidence, which means that we can comfortably reject the null hypotheses (H0) and can select the alternate hypotheses (H1).

This means that, there is a significant difference in consumer FMCG spending between before and after the implementation of lockdown. The mean before the implementation of lockdown for a sample of 98 respondents, was 6594.29 INR, while the same after the implementation of lockdown is 5864.08 INR.

Other notable observations from the survey:

1. There has been a significant increase in the purchase of sanitization products, like handwash and sanitizers. While 65 respondents out of 98 used to purchase this category prior to the lockdown, there is now universal adoption with 98 respondents out of 98 purchasing one or more products in this category.
2. The most popular brands that made themselves available on the shelves are

- ITC, Nestle, AMUL and Britannia. P&G and HUL fared the worst. This could also be due to lesser brand recall of P&G and HUL among Indian customers as compared to household brand names like AMUL, Nestle and Britannia.
3. There has been a 16.2% increase in adoption of online shopping as compared to a pre-pandemic era, based on the sample of 98 respondents. Out of 98 respondents, 73 respondents shopped at their local kirana stores, 53 respondents shopped at modern trade centres like malls and hypermarkets, while 74 respondents shopped online, before the imposition of lockdown. After the imposition of lockdown, the figures were 79, 24 and 86, respectively. Most respondents were already online shoppers, owing to being in an affluent class of postgraduate business students. However, the frequency and ticket size of orders has gone up for this group of respondents. The same does not hold true for traders/shopkeepers.
 4. There has been a 120.8% decline in preference for shopping at malls, primarily to the government-introduced lockdown measures implemented at public places, including malls/hyper malls/supermarkets, and the adoption of online shopping.
 5. Only 44% respondents noted that they were 'Always' able to get the requisite quantity of FMCG products post the implementation of the lockdown, which means that the required quantity was not available in the immediate aftermath of the lockdown. 42% respondents said they could 'sometimes' get the required quantity while 14% said they 'never' got the required quantity.
 6. 77.6% respondents said they had seen an increase in their own personal online shopping post the implementation of lockdown. The increase was either in the frequency of orders or the ticket size(s) of orders. Only 9.2% respondents said that there had not been

any increase, while 11.2% said that they are shopping online as much as before.

7. 79% respondents said that the government initiatives to make delivery of FMCG products through mobile vans made their life easier/helpful. Only 7 out of 98 respondents said the same was not helpful to them. Most respondents appreciated the government's efforts in the immediate aftermath of lockdown that helped them meet daily dietary needs.
8. Most respondents were aware of the advantages of online shopping and listed the same as follows: Ease of ordering, Ease of delivery, Speed of delivery, saves time of visiting offline retailer, more choices of products, Cheaper price, Offers /cashbacks /discounts.

CONCLUSION

From the above research, it is clear that COVID-19 has introduced certain long-term consumer behavioural changes, especially in the FMCG space. While consumers have taken to newer product categories, they have also cut down on FMCG spending reflected by the results of the paired t-test. The mean spending on FMCG consumption is down as compared to pre-pandemic levels. Industry had cut-downs in manpower to meet the requirements of the consumers in the immediate aftermath of the pandemic. The situation has improved since, and companies are now continuing with increased levels of product keeping safety precautions in mind.

Not all brands were accessible to the consumers when they went for purchases on the shelf. The most prominent brands that they could still find on the shelves included Britannia, ITC, Nestle and AMUL. There was a significant increase in sale of sanitizers and hand washes, to keep people safe from the coronavirus. Newer and smaller brands stocked up on sanitizers to tap this sudden big market that opened up. Consumers have taken to online shopping for all kinds of product categories and this is a trend that is likely to continue. Consumers are now more aware about the advantages of online shopping and

will likely prefer it to visiting malls / hyper markets, which increases the risk of being infected with the virus. FMCG being one of the growth drivers of the economy, has done well to be less affected as compared to other sectors, but that was inevitable, since FMCG consumption fulfils the primary dietary requirements of billions of people.

Consumers were not able to stock enough quantity of products they wished to purchase owing to supply side crunches as well as panic buying leading to inflated demand. The situation stabilized by the end of March. Companies which were facing labour shortages owing to heavy migration to India's villages, have now been able to bring back some of the labour to meet the factory requirements. Consumers also appreciated the government's efforts to bring FMCG products to their doorstep at the time of strict social distancing and implementation of containment strategies.

LIMITATIONS

While every attempt was made to touch upon every aspect of consumer behaviour, there are bound to be certain aspects that could not be covered. The sample size, while adequate, could have been higher to give an even better reflection of the situation on the ground. The sample could have included people from more walks of time besides the chosen segments: B-school students, homemakers and traders. Secondly, the information was collected through survey questionnaires and limited set of interviews. If the situation allowed, more one on one interviews could have been conducted to understand the consumer psyche in a more detailed manner. The perspective of tradesmen / shopkeepers / salesmen was limited as conducting interviews with them in a physical setting taking all precautions for COVID-19 was difficult.

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The Necessity of IT Solutions for Citizens' Engagement in Monitoring Municipal Services

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ABSTRACT

Services provided by municipalities around the globe are of great importance in every citizen's daily life as a result of the emergence of the citizen-centered concept in modern governance. The dominance of this administrative model necessitates local authorities to deliver those services with acceptable quality that meets a minimum of predefined governmental standards to obtain citizens' satisfaction. In this research paper, we aim to review citizens' opinions on the necessity of utilizing an IT solution to perform as a monitoring tool. Simultaneously, we will develop a web-based mobile application that enables citizens to implement the monitoring process.

Our proposed software application will serve as a median between citizens, service providers, and authorities to monitor the quality of delivered municipal services. Implementing our application will solve many flaws in currently applied methods by authorities to monitor the quality of provided services by assigning a dedicated committee of official personnel to carry out monitoring tasks.

Keywords: *Monitoring e-services, digital government, e-government, and citizens' engagement*

1. Introduction

Municipal services are becoming more vital for citizens due to their significant affections on various sectors of humans' life. Therefore, governments dedicate considerable financial resources to municipalities for services' provision and the assurance of its continuity and quality. Furthermore, municipalities assign the responsibility of monitoring the service deliverance process to a specialized supervising committee that evaluates service quality and ensures project continuity.

In the current monitoring process, the supervising committee monitors and evaluates performed tasks to oblige the operating party to commit to the project's scope and contract terms, yet the citizens do not engage enough in the process despite the importance of its outcomes. Instead, supervising committee collects and analyzes citizens' feedback on service quality, if the feedback process is approved in contract, then interact accordingly with concerned entities. A mission of such nature requires significant technological, financial and human resources to guarantee

service's availability and continuity due to time and distance-related complications.

As a matter of fact, different municipalities present numerous services that can be distinguished according to the development of sciences, deployment of technologies, availability of required funding, and merits of implementation personnel. Nevertheless, the vast majority of municipalities in the world including Iraqi municipalities are delivering few basic services to fulfill the living standards for their citizens. Drinking water provision, urban waste collection, and sanitation projects exist in almost every town and city as an obligation of embracing citizen-oriented approach [1] by the governments due to the indispensable effects of those services on citizens' different aspects of life.

Thus, monitoring these influential services by the most affected entities, citizens in precise, emphasizes the concepts of transparency and accountability in projects managed by public administration to provide municipal services [2].

In this context, many developing countries attempt to solve the community's recently

rising impatience related to basic services delivery [3]. In this study we will investigate the necessity of such a monitoring tool then we will design a web-based mobile application for civilians to monitor the provided municipal services.

2 Literature Review

According to articles 46 and 50 of currently applied Municipalities' Administration Law No. (165) of 1964 issued by the Iraqi Presidency, a municipal council is responsible for approving, performing, and monitoring major services such as drinking water provision, urban waste collection, and sanitation.

Municipal consciousness is a vital concept because it comprises citizens' understanding of social and political matters and their insights about government activities and services. The concept of public awareness, in general, incorporates psychological and behavioral scopes. The two studies [1][2] interpreted awareness as a state of mind in which people show their emotional state, insights, and sentiments that reproduce a level of understanding for the nearby atmosphere or specific situational circumstances. Moreover, researchers in [3] defined awareness as an insight based on reasoning method and capability to be aware of touching happenings and substances.

Conversely, [4] [5] have dealt with awareness as an influential feature for citizens' perceptions and social and political movements. In addition, [6] described the awareness as conduct that produced as a response to happening events. Events stimulate feelings and perceptions of individuals that lead to a state of awareness and consciousness. Several researchers focus on the effect of social-economic factors and the educational context of persons on the level of communal awareness [7] [8]. For instance, Yang [9] highlights the connection between the consciousness of persons and their social assignment and public contribution. Mohanti [10] sights municipal consciousness as the information of citizens of the nearby social circumstances, and the functional elements of the local system. Steinem [11] describes awareness as energy for social modification

through the knowledge of social and political difficulties and the growth of patterns for expression. Yet, the grade of awareness differs from one person to another, predominantly regarding public services somewhere not all people are aware of the room of municipal purposes and amenities. Subsequently, there is a variation between civic, political awareness, and social awareness.

Municipal awareness is a portion of an incessant communication process between the civic authorities and organized civil society. This awareness is separated in terms of the grouping of all the communal organizations, captivating the form and position of social cohorts by social work, education, public engagement, and the standards of basic rights. Regarding political awareness, it comprises a group of values, attitudes, and political values which permit the people to vigorously contribute in cooperative action. This research aims to be a movement for change and development [11]. The literature places of interest the vitality of citizen participation in performance measurement by their contribution to decision making and their feed of public services [12][13]. Incidentally, numerous researchers advocate the use of citizen studies to assess the quality of local government performance and services [14][15]. The key explanation for the practice of citizen survey is that the procedure of citizen's feedback of the quality of civic services may notify about public importance and concerns. Several Academics have connected citizens' fulfillment with a democratic performance of political systems to the trust in government and political organizations [16][17]. Though Margit [18] claims that the majority of papers were dedicated to examine and define the factors neighboring citizens' attitudes and views, and fewer have been dedicated to gauging the performance and amenities of local authorities.

3 Methodology

Our study comprises two dependent levels which were sequentially performed by firstly conducting a questionnaire to a group of citizens then developing a web-based mobile application that responds to results found from the survey regarding the process of monitoring municipality services.

3.1 Final Questionnaire

The aims of our study are to investigate the necessity of an IT solution for citizens' engagement in the monitoring process at first. Then, design a web-based software application with the ability to fulfill citizens' requirements for effectual monitoring of provided services.

The first aim was accomplished by publishing a list of indispensable questions about IT solutions for service monitoring to a group of random citizens using both online surveys and personal interviews. Depending on the analysis of questionnaire responses, the second aim was achieved by designing a web-based mobile application that grants citizens the desired level of participation in monitoring provided services.

The published questionnaire was arranged in four parts. The first part included four personal questions about the age, gender, academic achievement, and address of surveyed citizens. In the second part, we asked two questions regarding citizens' opinions on the importance of monitoring services and their preferred organizations for operating those services. Our questions in the third part focused on citizens' knowledge and interaction with currently applied monitoring procedures and tools alongside peoples' propositions for improving services' quality and empowering citizens' participation in the process. Finally, surveyed persons were asked four questions about their evaluation for four municipal services plus their suggested services that require better attention.

3.2. Proposed Software Solution

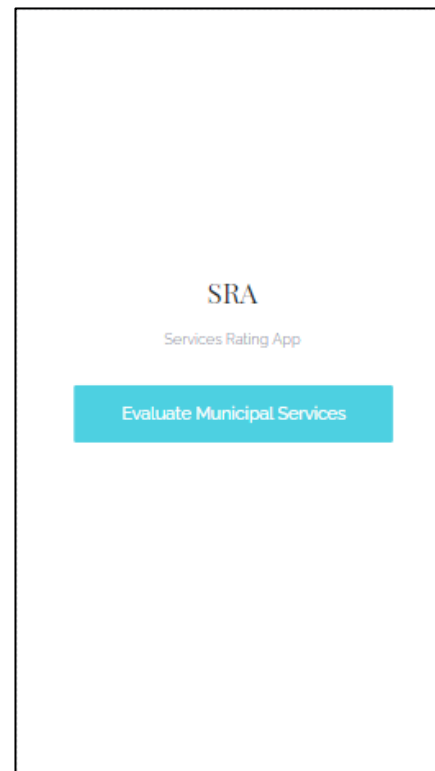
The designed software application is a web-based mobile app to make our solution platform-cross. This platform-independent feature guarantees a wider deployment of the mobile app in all used operating systems which, in turn, ensures the participation of utmost willing citizens.

The mobile application is designed with many important features such as sending pictures, coordinates, and service insufficiency reports. The proposed application is divided into two main sections for sorting the information about feedback sender and feedback description as shown in figure 1. Section one is dedicated to collecting information about the feedback

sender including name, contact information, recording number, email, location.

Section two is especially used to collect report details concerning service types, feedback types, photos of feedback type, and automatic detection of reporters' coordinates. For more reliability, the reporter is required to open the camera and submit a direct photo to support the report's case.

These features and functions serve the purpose of monitoring by documenting needed information about insufficient services' details and the reporters' information. Then, reports can be submitted and sent to responsible authorized officials to act in accordance with agreed administrative and legal procedures for the sake of obtaining citizens' satisfaction.



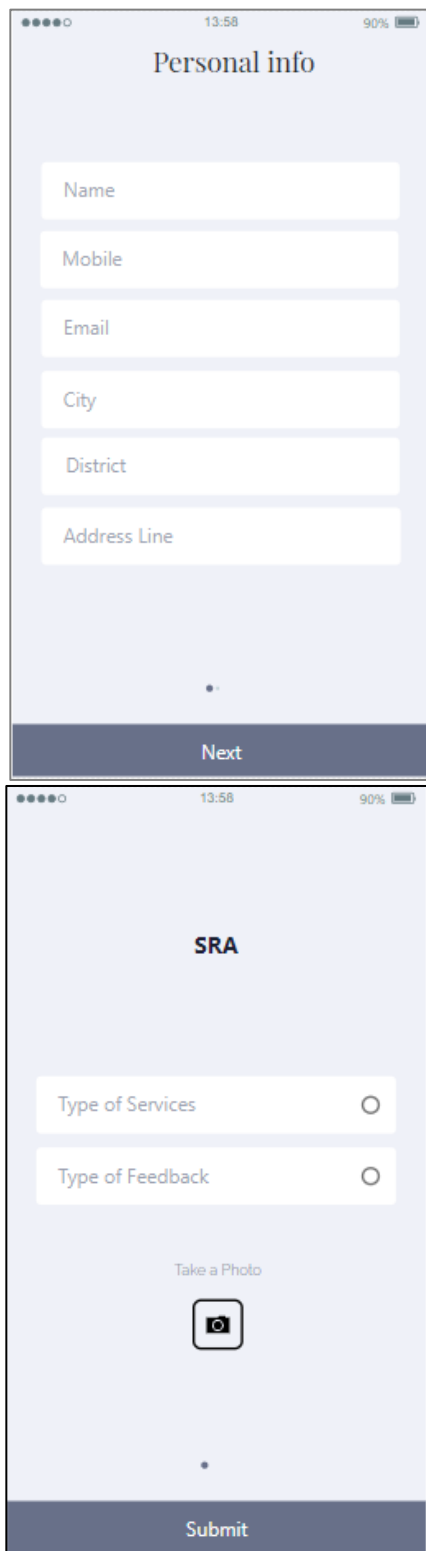


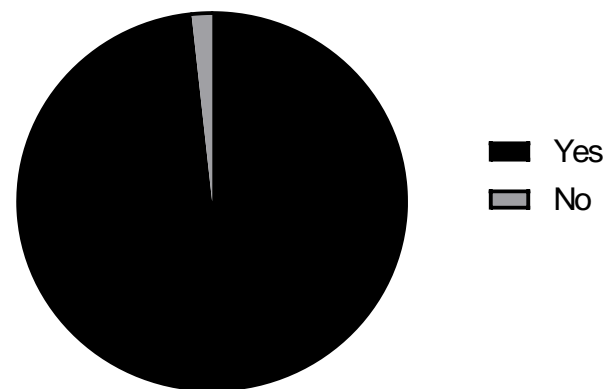
Figure 1: SRA Apps
4 Results

The structure of the questionnaire addressed several questions and it was distributed and emailed to different groups, students, teachers as well as ordinary people. The questionnaire covered key questions regarding participating citizens in monitoring and assessing the public services provided by municipalities by the

KRG and the reasons behind the lack of having such services.

The total participants were 645 and have been distributed to different groups of citizens in KRG. 78.6% of the participants were aged between 15-30 years old and 18.6% were aged between 30-40 years old while the rest were older than 45 years old.

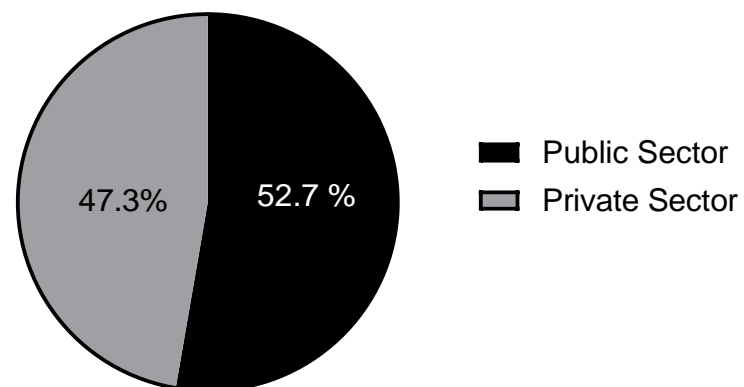
As can be noticed in figure 2 an overwhelming majority of the participants indicated that it is enormously important to monitor the public services in which, %98.3. Whereas, only %1.7 of the respondents stated that there no need to monitor public services.



Total=100

Figure 2: The importance of monitoring public services

Moreover, another question was asked to identify the importance of the private sector in providing and monitoring public services. Figure 3 shows the result of the question by the participants.



Total=100

Figure 3: Private sector vs public sector important involvements

As shown in figure 3, %52.7 of the participants stated that the public sector shall be mainly responsible for providing the public services and also provide the relevant application to monitor the service by the citizen. However, around half of the respondents indicated that the involvement of the private sector can be crucial to improve public services. The reason behind, the closeness belongs to the lack of quality of the services provided by the public sector and citizens have no application to monitor the services.

A high number of the participants by 82.5% mentioned that they do not know whether the government has provided many tools, methods, and applications to take the opinion or take feedback from citizens about public services. On the other hand, %17.5 of the respondents stated that they are aware of few methods and/or tools to provide or send relevant feedback to the governments, which can be through social media pages, Viber, and WhatsApp. Figure 4 shows the survey results.

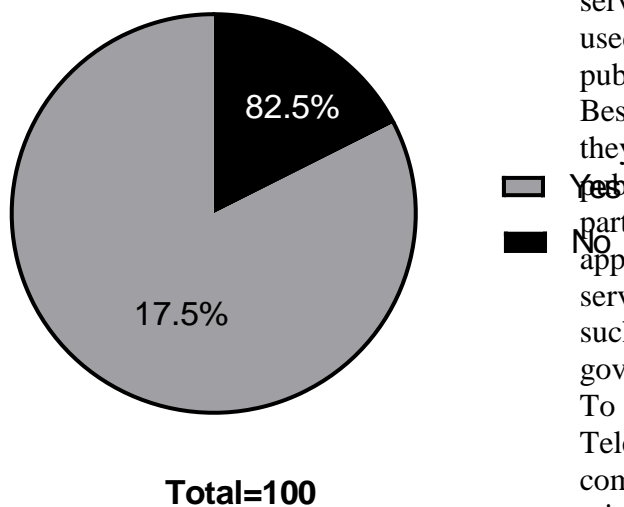


Figure 4: Awareness of the feedback and assessment methods, tools, and applications

To know the existence of mobile applications, websites, or social media channels, we have asked the participants whether they use or they have used any of the above channels to monitor or evaluate the public services. As the result, %73.3 of the participants stated that they have never used any channels to evaluates or send feedback regarding the public services provided in the public sector. At the same time, %26.7 of the citizens clarified that they have used several channels and/or methods to give

their opinion, feedback, or evaluate the public services.

Figure 5 demonstrates the methods, channels, and mediums normally used by the citizen to evaluate the public services.

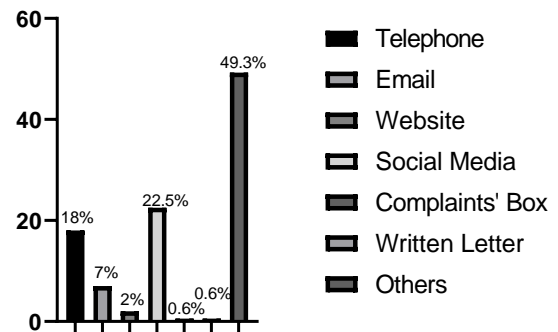


Figure 5: methods, channels, and mediums used by citizen

As can be observed in figure 5, the majority stated that they normally use social media pages and accounts to provide their evaluations regarding public services.

The telephone was ranked as the second most famous method by citizens to evaluate the services. Furthermore, %7 of the respondents used email service to evaluate or monitor the public services provided by the governments. Besides, only %2 of the citizen indicated that they used the related website to evaluate the public services. Last but not least, none of the participants mentioned the use of mobile applications to monitor or evaluate the public services which indicates the lack of having such an option neglected by the relevant governmental departments.

To discover the importance of using Telephone, email, website, social media, complaint box, or written letter, a question was raised to all participants as shown in figure 6.

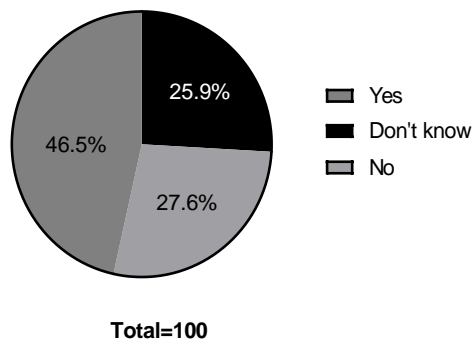


Figure 6: The importance of various mediums of evaluating public services

As demonstrated in figure 6, %46.5 of the citizen stated the importance of having various mediums to evaluate the public services by either public or private sector. Moreover, the %27.6 indicated that various mediums might not be extremely efficient to evaluate the services. However, %25.9 answered this question with “I do not know”, which indicated that there are citizens who do not care about monitoring or evaluating the public services or might refer to the disappointments of citizens. Lastly, one of the aims of the study was to discover the importance of having mobile applications to evaluate public services, %59.2 specified that it is remarkably important to have mobile apps to evaluate public services. Although, %16.6 the said that there is no necessity to having mobile applications. Lastly, the remaining answered with “I do not know”.

5 Discussion

The outcomes of the qualitative and quantitative study are promising. It widely accepted that having certain mobile applications to monitor or assess public services become crucial to any society. Furthermore, nowadays the participation of the private sector has become common around the world, however, the results of this study prove otherwise. The possible reason behind this contradiction refers to fear expensiveness when these public services are provided by the private sector. Moreover, until now, the private sector has not been successful to gain the trust of the citizen by providing relevant mediums to evaluate and monitor such services. Another outcome of this study’s shows that the majority of the participants were not aware of

having any medium to monitor or assess related services, which could be because of lack of information technology literacy, lack of awareness by relevant parties, the dominance of social media pages and carelessness of the citizen when it comes to monitoring or assessing the services.

On the other hand, few findings were surprising. Firstly, %16.6 of the participants stated that having mobile apps is not necessary, which might reflect the fact that the majority of citizens lost trust in the governments. Secondly, %25.9 of the respondent clarified that various mediums for monitoring or assessing the public services. Lastly, around half of the participants stated that they have not yet used any methods, channels, or internet to monitor or assess the publics' services. One can say, the possible explanation behind this luckiness could be referred to the inappropriate administration by the government, lack of IT methods, lack of mobile apps, and poor IT literacy.

Lastly, an interesting finding of this study shows the importance of providing various tools as well as applications. Therefore, we urge the relevant government department as well as the related private sector to provide up-to-date tools and technologies to citizens so that they can assess or monitor any public services they use.

6 Conclusion

The monitoring web-based application we designed proved that basic flaws in currently practiced monitoring procedures can be reduced to a minimum limit. The application successfully systemized the monitoring process between citizens, service providers, and supervising authorities.

Citizens’ demand for utilizing a monitoring tool was fulfilled via this application leading to solving complaints availability and delivery inappropriate time. At the same time, service providers have effective access to citizens’ evaluations for their activities supported with real-time proofs. More importantly, difficulties related to distance and projects wide areas can be reduced by a considerable percentage in case citizens participate in the duty of monitoring and reliable evaluation.

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BRAND COMPARISON ON THE INCREASING PRICES OF FLAGSHIP SMARTPHONES FROM CONSUMER POINT OF VIEW

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ABSTRACT

Purpose: To study the factors behind the increase of flagship smartphone prices of two leading smartphone brands and understand its impact from a consumer point of view. *Proposed Design/Methodology:* This is an exploratory study that is conducted to find out the relevant factors that influence flagship smartphone prices, which in turn affects the relationship between the customer and the brand.

Findings: The findings of the study indicate that Qualcomm has increased prices of the Snapdragon chipsets for flagship smartphones over the past 5 years resulting in a smartphone price hike.

Originality: This study identifies whether consumers are ready to pay a higher price on flagship smartphones for the benefits derived.

Article Classification: Research Paper.

Keywords: smartphone, flagship, Apple, OnePlus, Samsung, smartphone price, flagship smartphone, Qualcomm

I. Introduction

Smartphones are an integral part of human life today. It is one of the largest and fastest growing sectors in the communications industry. As of now, smartphones are concentrated on moving technologically. They help in performing and completing most tasks in a convenient, fast and smooth manner for its users. The author suggests that over the years there has been an advancement in technology that has made things more and more convenient for smartphone users. Today most of the tasks that were once possible only on the computer are at our fingertips with evolution of technology over the years. These technological advancements, on one hand have made things easier for its users but the price of smartphones, especially the flagship high-end smartphones have increased considerably over the years. Now, the first question that lies ahead of us is what are high-end flagship devices.

Smartphones today are more costly than any time in recent memory. Most smartphone brands have also created communities on social media platforms like Instagram, Twitter & Facebook to influence customers. The high end flagship devices not only have higher price tags attached to it but usually come with a premium design, strong aluminum/metal finish,

a camera which could be compared to the best DSLRs and include the best and top-of-the-line specifications prevailing in the market during that time period thus making differentiating it from the mid-tier or the low-tier category. What we have also witnessed in the past 3 years coming to 2020 is that such devices also come in with a built-in IP certification ensuring waterproof guarantee from smartphone manufacturers and wireless charging. High end flagship devices could also include devices that are futuristic compared to current market offerings with a different build or spec, say a foldable screen smartphone. These devices are exceptions to the normal offerings in the flagship devices as they may not offer the best specifications but come with a different kind of a build than usual separating it from the other devices available in the market.

The author suggests that high-end flagship gadgets from smartphone makers like Apple, Samsung, OnePlus, Google, and other top producers would now be able to cost several dollars more than they did only a few years back. There are various reasons to why smartphone costs have been soaring in the course of recent years. Some of them could be the increase in the price of Qualcomm manufactured Snapdragon chipsets, rise in the demand for high end specifications including

high camera performance and better processor. The author suggests that there is also an increase in the demand for flagship smartphones that include premium features like wireless charging and an IP certification to prove that the smartphone is water and dust resistant. The luxury effect has also played a huge role in the increase of smartphone prices. This research paper intends to discuss all such reasons and explain the factors behind the price hike in flagship smartphones from major smartphone makers in the market.

II. Literature Review

Suman Khadka (2014) - Smartphone is a significant item and price increase has involved the worry among the individuals. Different brands in the market sell more than 1 billion Smartphones in each year. Organizations, for the most part, make their own one of a kind Smartphone embracing different versatile working frameworks. Today, top Smartphone working frameworks are iPhone OS from Apple, Android OS from Google, and WP OS from Microsoft. All the Smartphone makers present their scope of item portfolio in the market with costs going from Rs. 5000 to as high as Rs. 2,00,000. Notwithstanding the accessibility of Smartphone going from low cost to significant expense, buyers are continuously inspired by the top of the line Smartphone gadget presented by producers as a lead gadget. Oxford word reference has characterized Flagship gadgets as the best or most significant thing claimed or delivered by a specific association. Deals and prominence of the lead gadget assume a significant job for any smartphone organization to decide the market position, brand position, client steadfastness and just as a market achievement.

Anil Lama (2014) - Majority of the Smartphone brands who are centred around assembling top of the line smartphones are confronting the circumstance where their piece of the pie has declined astoundingly while, planned smartphone makers are picking up the piece of the pie with monstrous measure of deals. There is high rivalry in the smartphone showcase, thus the value advancement is one of the most significant elements for the smartphone makers since it can either produce income for the organization by huge deals or

influence the brand picture by declining in piece of the pie. The study results indicated that members have various viewpoints while buying smartphone like value, highlights, brand, and structure. Every one of these variables has its own significance, however this overview indicated that the vast majority of the members considered cost and brand as a significant factor.

Besides, the Price drop has been a significant concern, yet it doesn't influence the brand picture fundamentally. Currently, the smartphone advertise is by all accounts changing into an alternate measurement. The smartphone producing organizations like Apple, OnePlus, and Samsung and others who are on the hand-off to create very good quality, high-end flagship smartphones are undermined in light of the fact that, the consumer wants more. On the one hand, planned Smartphone organizations like Huawei Technologies and Lenovo bunch constrained are picking up the piece of the pie, however then again, the very good quality production organizations like Apple, OnePlus & Samsung are quickly confronting the destruction of cost and piece of the overall industry. The normal cost of Smartphone has declined to \$375 from \$450 since the start of 2012 as indicated by the estimation of International Data Corporation (IDC).

Quanqing Yu (2019) - Practically 2.4 billion individuals utilized cell phones in 2017, and the quantity of cell phone clients is required to increment to more than 33% of the worldwide populace before the finish of 2020. Buyers are so dependent on their cell phones that it is assessed that 61% have utilized their cell phone in the washroom (restroom/latrine) and 9% have dropped a telephone in a latrine. As indicated by the International Data Corporation (IDC), in 2016, contact with water was the second biggest reason for harmed cell phones on the planet, beat uniquely by broke screens from mechanical effects (e.g., dropping the telephone). In this manner, other than longer battery life and a shatterproof screen, water obstruction has become a key cell phone highlight sought after by cell phone clients

Dr. S Saravana Kumar (2020) - Consumers conscience is satisfied according to their needs and desires, so they choose the product from

which they get maximum value and satisfaction. For any business Marketing plays a vital part and advertising being the most important part of marketing. The researchers focused on brand awareness of the American semiconductor and telecommunications equipment company Qualcomm Snapdragon, which designs processors and wireless telecommunications.

Mohanbir Sawhney (2018) - In early 2016, after the success of its first two smartphones, the OnePlus One and OnePlus 2, China-based startup smartphone maker OnePlus was deciding how to build on its early success and grow into a global contender in the highly competitive smartphone market. Technology enthusiasts and geeks had flocked to purchase the first two generations of its smartphones and expectations were high for the company's next product. The company's founders, Pete Lau and Carl Pei, faced the challenge of broadening the appeal of OnePlus to address the mainstream market without alienating its core customer base.

Nazir Ahmad Suhail (2019) - Smartphones have become a vital piece of training framework in creating nations. The utilization of cell phones in the learning process improves understudies' learning involvement in various ways. Cell Phone advances sway on the learning process incorporates convenience, joint effort, and inspiration. The transportability Nature of cell phones empowers students to convey the innovation anyplace inside or outside the grounds, home, and field excursions to acquire or recover course data to improve a wide assortment of learning settings. Understudies' cooperation through web-based social networking systems, for example, Twitter and Facebook got to on cell phones help them to share their insight and data by shaping gatherings, which could bring about effective community-oriented learning. At last, understudies at organizations of higher learning utilize cell phones as learning apparatus and give off an impression of being progressively inspired and occupied with the learning process as it likewise expands bunch interest in exercises done during learning in class.

Rahul Kumar Singh (2016) – The smartphone industry has seen a quick development and has

made gigantic hops since its commencement and especially in these 5 years we have seen our smartphones getting more brilliant and more jazzy than its initial days when the idea of having a cell phone was completely misconstrued by the majority. New and all the more energizing highlights have been made conceivable in the telephones which has now ignored the very idea of conveying a PC which was itself an upheaval for individuals as now they don't have to convey a 2-3-kilogram item when they can do something very similar in a 171 grams' item and which is more versatile than a PC. Presently this new advancement which is currently sort of heart pulsate for individuals yet there are sure necessities which purchaser needs to be satisfied and this is the place the smartphone makers need to take a gander at with the goal that they can lead the market. More or less, cell phone industry has a market structure of oligopoly. Cell phone additionally have a few variables of interest that we ought not neglect like the simplicity of utilizing factor, accessibility of utilizations and the showcase of the cell phones, also different factors, for example, pattern, age gathering, recompense, etc. Besides, we can infer that smartphone have versatile interest.

Dominic Appiah (2019) - The smartphone is increasingly redefining our identities, and reshaping our perspectives about shopping, socialising, teaching and learning. With current developments and shift towards luxury smartphones, the expectation of luxury smartphone manufacturers is ultimately to consolidate customer loyalty through improved user experiences. Nevertheless, luxury is considered as an experience that adds value to consumer- brand-relationships and emphasizes that luxury brands enable consumers to derive, to some extent, intangible benefits beyond their functional utility. Loyalty to a luxury smartphone brand occurs as a consequence of positive attitudes which motivate consumers to repeatedly demand a particular brand, or a limited number of brands within a suitably defined period of time. The management of these luxury smartphones is a key marketing function. A strong and healthy brand is instrumental in creating sustainable perspectives. An evaluation of both behavioural and attitudinal loyalty is carried

out to establish the latter as more of a sustainable choice.

The author suggests that all the other research papers have focused on studying the improving technology of wireless communications, convenience provided by modern smartphones, drop in average smartphone prices in the world or even the build of luxury smartphones.

This research paper, however, aims to study all the factors related to the price increase of a flagship high end smartphone and provide an in-depth analysis.

III. Research Methodology

The paper talks mainly about increase in the price of flagship smartphones which lets in insightful knowledge and evidences to be meaningfully put together. The author has used both the primary and secondary sources, secondary sources being the widely used parameter.

The Research Methodology used is an Empirical Research wherein the author experimented with the data research analysis regarding the increase in the price of flagship smartphones which were actually used to write this paper. Empirical research is a kind of research that is based on observation and measurement phenomena as directly experienced by the researcher.

The author has come up with certain conclusions following which he realised that these analyses were capable of being used in a manner which can be observed keenly and experimented with throughout this research paper. The research strategies include the nature and source of the data that has been gathered to meet the objectives of the study. Based on the nature, the data has been more of a quantitative analysis. The work on a bare note commits only to a certain stratum of the society i.e., the young generation. Involvement of strata beyond this does not affect much of the companies. Usage of the Smartphones is limited only to this stratum thus the philosophy of the research becomes much more accurate.

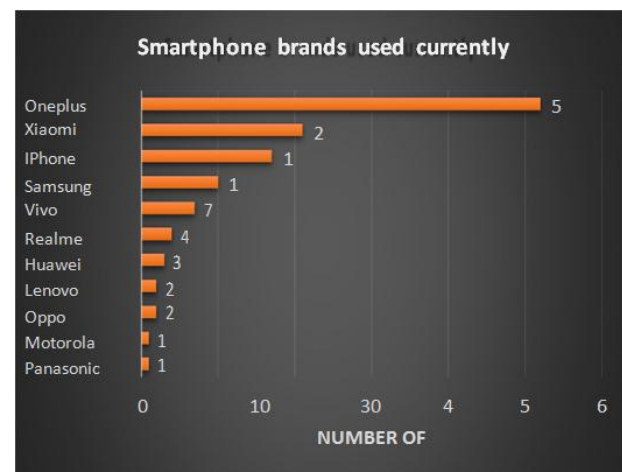
The time frame used here was until a certain number was accumulated where the author could categorize the known smart phone leaders in India. Total number of responses received for the sample size were a 120. Since nature of the research is a data based, the

author opted for the quantitative strategy, bound by interpretivist approach. The key research tools were questionnaire, supplemented by reviews with two groups of participants students and working professionals. The participants were carefully targeted and thoroughly analysed through stratified sampling technique. The results were analysed manually, due to the small sample of participants.

IV. Results and Analysis

1. Which smartphone brand are you using currently?

In India, as per the author's suggestions, consumers have as many as 18 flagship smartphone brands to choose from in order to make a purchase decision while buying a flagship smartphone. Despite the stiff competition amongst smartphone makers in the market only a few smartphone brands stand out in delivering true value for their flagships and gain purchase preference, customer loyalty & volume sales. This is also to be taken into account that research was conducted in a sample size where all responders were smartphone users.



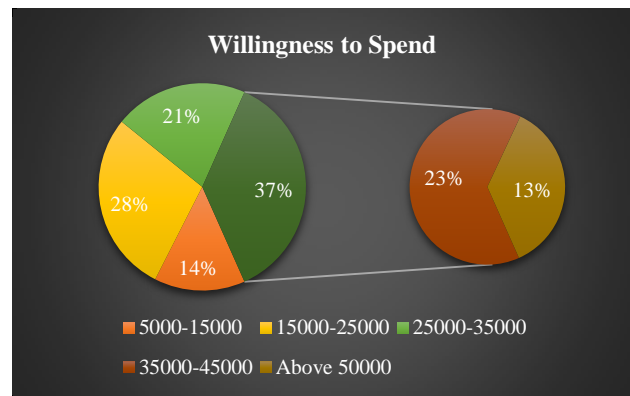
Out of 120 responses, it was observed that over 43% of the responders were using smartphones from the sub-brand of BBK Electronics, OnePlus and it had gained a huge response amongst other smartphone makers in the market. The smartphones used by this category varied from OnePlus 5T to the latest edition OnePlus 8 Pro where the latter is the company's latest flagship smartphone whereas OnePlus 5T was launched by the smartphone brand in November, 2017 and consumers have

found no issues while using them thus far. Amongst the other preferred smartphone brands by the responders were Xiaomi & Apple contributing to over 17% and over 14% respectively. On one hand

Xiaomi is a MIUI based Android smartphone platform whereas Apple is known for making IOS category smartphone devices, known as iPhone. Amongst the responders, Xiaomi devices such as Redmi K20 Pro, Redmi K20, Mi 9 Pro, Mi Note 8 Pro were used by most responders whereas for Apple iPhone the product category varied from their flagship device iPhone 8 Plus, launched in September 2017 to iPhone 11 Pro Max. Other users were observed using flagship grade devices from Samsung and as per the author only a considerably small sample size were using other brands like Vivo, Realme, Honor, Lenovo, Oppo, Motorola & Panasonic. However, like OnePlus which is the preferred brand by the responders, Vivo & Oppo are also sub-brands of BBK Electronics but haven't gained the same popularity in terms of purchase decisions by the responders, as per the author.

2. How much are you willing to spend on a smartphone?

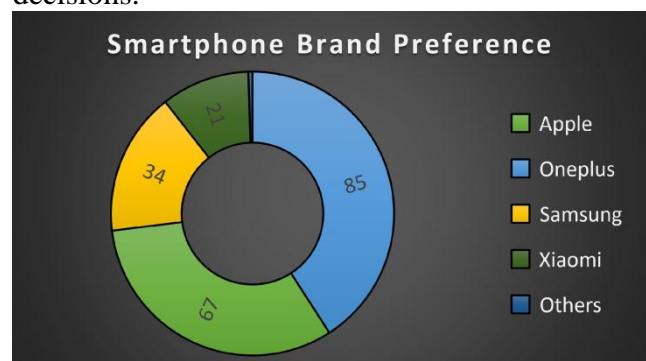
As per the author, purchasing a flagship smartphone in the year 2020 from recognised brands like OnePlus, Apple, Samsung requires a hefty budget and a purchase decision. As mentioned earlier, flagship smartphones are expensive and different consumers have different budgets for their smartphone purchasing decisions that allows them to look for their ideal smartphone by their preferred brand. The author suggests that flagship smartphones by different smartphone makers in between Rs. 35000 in the lower range to as high as Rs. 1,20,000 or above and it entirely depends on consumer preference on which brand they want to choose and what specifications they require on their flagship smartphone device.



Out of the 120 responses received it was observed that about 37% responders were ready to pay a sum above Rs. 35000 to purchase a flagship smartphone device and 35% (appx.) of such consumers were ready to pay a sum above Rs. 50000 in order to purchase their desired flagship smartphone. 21% of the responders however were ready to pay a sum between Rs. 25000- Rs. 35000. However, the research also tells us that 28% responders believed that their desired specifications on the smartphone could be fulfilled by a smartphone priced between Rs. 15000- Rs. 25000 to which the author suggests that whilst it is getting expensive to buy a high-end smartphone each year, it is also getting less expensive for consumers to buy a good smartphone each year.

3. Which flagship smartphone brand do you prefer? (Select Max. 2)

As mentioned by the author earlier there are as many as 18 flagship smartphone makers in India currently but only a few brands as per the author have been able to gain the customers loyalty in terms of purchase/re-purchase decisions.



In the research conducted, 85 of the 120 responders mentioned OnePlus as their preferred brand for purchasing a flagship

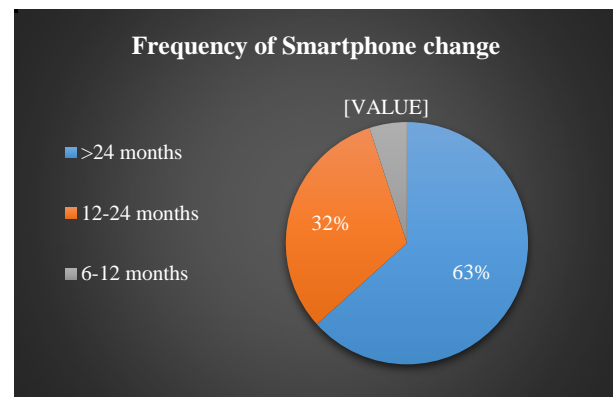
smartphone which corresponds to 41% (appx.) of the total responses. The author suggests that since the launch of its flagship smartphone OnePlus 3T in 2016 the company has acquired a major stake in the Indian smartphone market making it a clear preference amongst the Indian consumers for its seamless OS platform which is termed clean and smooth by its users. Other than Oneplus, the second most preferred brand in the research was Apple with its iPhone being preferred by over 32% (appx.) of the total responses. The author suggests that iPhone's IOS platform is more user-friendly compared to any other android platforms. Despite not changing the look and feel with minor enhancements in touch and software, Apple has gained a loyal customer base who do not feel the need to switch to any other platform/device. Apple is also known for providing a bloatware free smartphone for its users where even pre-installed applications can be uninstalled at the preference of the user. It provides ecosystem networking to ensure smooth and transparent workflow with other Apple devices like Macs, Apple Watch and AirPods. However, as per the author the Apple iPhones are largely preferred by its consumers for building relationships with its user providing the best technical assistance and support than any other platform in the smartphone market.

While Oneplus & Apple are termed to be the brand in focus, as per the author, amongst other smartphone makers. Brands like Samsung & Xiaomi were preferred by 16% (appx.) and 11% (appx.) of the total responses. According to the author, Samsung provides the best smartphone displays in the market which differentiates it from other brands like OnePlus & Xiaomi. On the other hand, as per the author these are early days for Xiaomi in the flagship range after having built a consumer base and gained customer loyalty in low & mid-range smartphones.

4. How frequently do you change your smartphone?

The smartphone market is getting technologically advanced and evolving in an extremely rapid pace. The author suggests that today we come across smartphones that are better than its predecessors in terms of specifications offered, camera and build quality

with a time difference of less than 4-5 months between their respective launches. This suggests that a consumer needs to be clear about his requirements from the flagship device and make purchase decisions accordingly keeping the frequency of change as an important point while finalising the purchase as not every consumer would want to upgrade their hardware every 4 months or before.

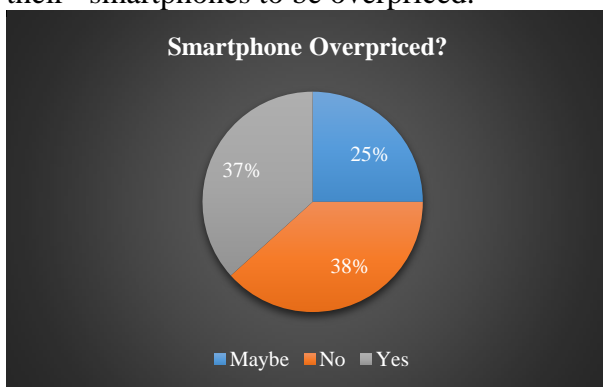


The responders were asked about frequency of changing their smartphones on how long would they prefer to use their current smartphone and when do they make a purchase decision on upgrading their device. It is observed that 63% of the responders believed in upgrading their device after the passage of a minimum of 24 months or more. They believed that 2 years is an ideal time frame for the devices to show wear and tear in their build quality while specifications offered, even in these evolving times, would serve their purpose of using the device during that time frame. Also, it is observed that since the cost of flagship smartphones get higher, the responders believed in using the device for a longer tenure. 32% of 120 responders believed in upgrading their smartphone in between 1-2 years' time frame while only a small ratio (5% approximately) of responders believed in upgrading their smartphone in between 6-12 months.

5. Do you feel your smartphone is overpriced?

Flagship smartphones are getting more and more expensive to purchase each year. To take a small example the highest end smartphone by the brand OnePlus, Oneplus 3T in 2016 costed Rs. 34,999 in India while its

latest launch Oneplus 8 Pro, the high-end model in May 2020 costs Rs. 59,999 in India. This is a 71% (appx.) price increase in a time period of 4 years. Not just Oneplus but other brands like Apple have considerably increased the price of their high-end devices, making it find a place in the premium category segment. However, the author suggests that both the above-mentioned smartphones by their respective brands are completely different in terms of the specifications offered, build quality, camera performance & more. To know more from a consumer point of view, the question was asked if the consumers regard their smartphones to be overpriced.

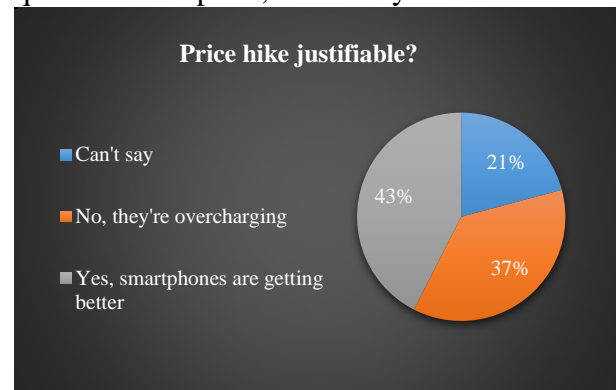


Out of the 120 responses received, 38% responders believed that it wasn't really overpriced in comparison to all other costs the company needs to live up to. Such responders were of the view that despite increased pricing in the flagship smartphone category, the perceived value derived from the product has always been greater. However, 37% responders also believed that their smartphones were getting overpriced when comparing the price of the smartphones and value derived from it. The remaining 25% responders were unsure of the same. The author suggests they were aware of the rising supply costs, inflation and technological advancements however it wasn't possible for them to find out the true value of their flagship device.

6. Do you find the price hike on smartphones justifiable?

We have learnt thus far that the price of flagship smartphones has increased considerably over the years although the question that lies ahead is, if the price hike on such high-end smartphones is justifiable. The smartphone brands need to take care of various parameters before finalising the price of

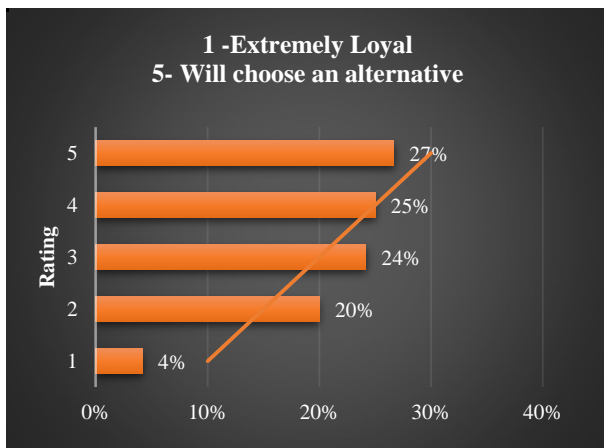
smartphones such as the selling costs, production costs, inflation, rise in price of Qualcomm chipsets, the luxury effect and more.



52 out of the 120 responses received were found to align with the price hike of smartphone brands. Such responders believed that smartphones over the years are getting better and the additional amount charged by its consumers is to deliver better value and good after sales service. We have learnt that 63% consumers in the sample have believed in upgrading their device after a minimum period of 24 months and hence after sales service becomes a major factor while choosing a flagship device. However, 44 responders believed their smartphone brands were overcharging them and such a huge price increase isn't justifiable for an average consumer. The remaining 24 responders were unsure if the price hike in flagship category devices is justifiable.

7. On a scale of 1-5, how loyal are you towards your flagship smartphone brand for repurchase?

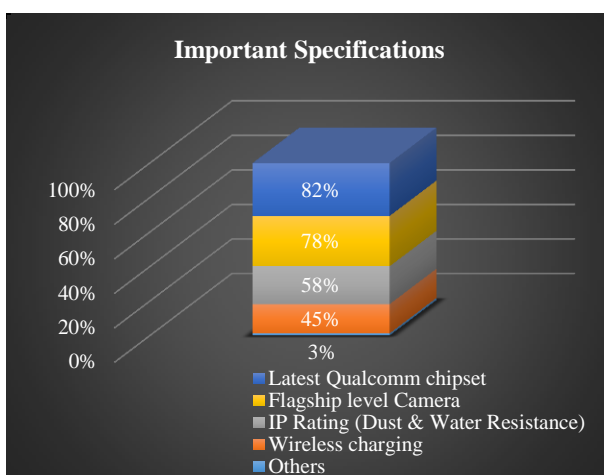
As mentioned earlier there are as many as 18 brands that offer high-end flagship smartphones in India. Although, 17 of such brands offer Android platforms while it's only Apple that offers the iOS platform. The author suggests with a plethora of options to choose from there is tough competition between Android flagships to offer the best value on purchase.



52% (appx.) of the 120 responders in the sample were ready to choose a different brand in case they do not find their ideal high-end smartphone at their desired price. While only 24% (appx.) believed they would stick to the same brand despite price increase or any other factors as they are a part of an ecosystem of the brand’s devices (such as laptops, truly wireless earbuds, advanced AI assistant platforms etc) and it wouldn’t be possible for them to cut themselves out from the brand because of just one device.

8. Important specifications you need on your flagship smartphone?

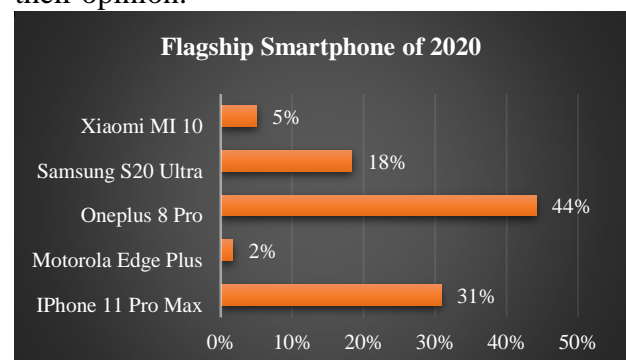
A flagship smartphone doesn’t only mean a device with premium build and quality in the high-end category but its also includes certain top-notch specifications that other mid-range and low-range devices do not offer. These specifications could be the IP68 certification to ensure the device is dust and water resistance, wireless charging to ensure convenience, highest camera quality and latest Qualcomm chipset to ensure smooth and faster performance for its consumers.



The responders were asked to select the specifications they desired on their ideal flagship phone. 99 out of 120 responders wanted the Latest Qualcomm Chipset on their smartphone. It is the most desirable feature amongst the flagship smartphone users along with a Flagship level camera that was opted in 94 responses. The author suggests that it is to be taken into account that Qualcomm, the company that manufactures the Snapdragon chipset which is inserted in most of the smartphones today have been increasing prices of their chipsets with the rising demand which has played a huge role in the high-end flagship smartphones getting expensive. Other than the high-performance chipsets and flagship grade camera, features like IP Rating and Wireless charging were selected by 70 & 54 responders respectively. IP Rating is an added premium feature to the smartphone which makes them resistant to dust and water and damage can be borne by the brand, if any. Wireless charging on a smartphone ensures that the device can be free from wires and all the wirelessly chargeable devices can be charged on a charging pad. These premium features on flagship devices differ them from the mid-range devices and as per the author users have been ready to spend extra for such features.

9. In your opinion. which smartphone amongst the options is the flagship smartphone of the year 2020?

In India, till the end of the month of May 2020, we have witnessed launch of high-end premium flagship devices from major smartphone brands including Apple, OnePlus, Samsung, Xiaomi & Motorola. The responders were asked to choose the flagship smartphone (amongst the brands mentioned) of 2020 in their opinion.



44% responders opted for the Oneplus 8 Pro while 31% of the responders out of the total of 120 responses opted for the iPhone 11 Pro Max. It was observed by the author that only these two devices in the flagship category offer all the premium features for the high price charged by its consumers. Samsung's flagship device, Samsung S20 Ultra was opted by only 18% responders despite offering a similar camera performance to Oneplus 8 Pro & Apple iPhone 11 Pro Max although in India, it doesn't offer the highest end Qualcomm Snapdragon chipset and rather ships the Samsung made Exynos processor in their devices. Xiaomi Mi 10 was the only flagship device that lagged behind its competitors in terms of camera quality and performance (as per responders) hence gaining preference of only 5% responders. Motorola Edge Plus had the lowest preference in the sample with just 2% responders opting for it. It is observed by the responders that despite being Rs 20,000 (appx.) more expensive by the Oneplus 8 Pro, it still doesn't match its performance and camera quality. Also, it offers just 18W fast wired charging as compared to 30W by its competitor, Oneplus.

The author suggests, consumers today look for value in their purchase along with the luxury effect in terms of the build quality.

V. Discussions

The price of flagship smartphones is going up fast and we are observing that each year smartphone brands are increasing the prices of their flagship devices by a huge percentage in order to maintain their brand image in the premium segment category. The question though lies ahead of us is how can brands get away with charging such a huge amount each year for their flagship devices and still sell them in abundance each year. We observed during the study that majority of the consumers are ready to pay a sum over Rs. 50,000 to purchase such flagship devices. Smartphone brands like Apple, Samsung & OnePlus have charged their customers a sum over Rs. 85,000 in India. Even a brand like OnePlus, a sub-brand of BBK Electronics in China who has maintained its image in the world smartphone market as a budget friendly flagship charge as high as \$1099 for their

budget phones and still manage to be on the top of the selling charts in major countries.

The author suggests while there are numerous reasons for brands to charge such a high price for their flagship smartphones, majority of the customers have agreed to pay the high sum for the quality they have derived from the product. While most customers have believed that the brand has been overcharging them for their loyalty towards the product and their inability to shift between smartphone brands, a majority also have expressed their views on deriving the benefits out of it like the smartphones have just got better over the years resulting in such a high price increase. The author has studied various factors for the price increase:

Snapdragon Chipsets: Qualcomm is a brand which manufactures the Snapdragon chipset that is inserted in majority of the smartphones in order to power them. Qualcomm chipsets are inserted in smartphones to provide the high-end performance benefits to consumers involving high speed and higher processing capabilities. The author suggests that Qualcomm chips are preferred by the customers and is the most important factor for them while opting to purchase a new flagship smartphone. Over the years, Qualcomm has built a reputation in the smartphone market for its smooth performance capabilities that has forced major smartphone manufacturers to buy their chipsets for inserting them in their smartphones. With increasing demand amongst smartphone users, Qualcomm has increased the price of its Snapdragon chips and in such a monopolistic market scenario, the smartphone brands have no option but to agree to the price quoted by them. In 2019, Qualcomm also asked smartphone brands to purchase their 5G modem to be inserted in the flagship smartphones as an add-on with the Snapdragon chipsets which raised prices further as whether or not the smartphone makers want 5G on their flagship device, they are paying for it and have to charge their consumers too for the same reason. The author suggests that companies like Samsung have tried inserting their own Exynos chips to provide better costs to consumers although sales have gone down due to the non-inclusion of Qualcomm chips in major smartphone markets like India and UK.

Guidelines by Qualcomm: We just learnt on how Qualcomm has increased the price of their Snapdragon chipsets resulting in a price increase of the flagship devices. In order to purchase these devices, the smartphone manufacturer also needs to follow a set of guidelines. The author suggests that Qualcomm has asked its buyers to have a large amount of space inside it which means such flagship devices who are meant to deliver high-end performance need to be big in terms of size as per such guidelines. Also, we have to take into account that smartphone makers cannot just make the phone taller and keep the screen size small in the modern era of smartphones, as their consumers would only prefer smartphones that delivers a full display and minimalistic bezels on their devices. This also means that not just the smartphones but the screen inserted in them should be taller as well powering a high definition setup. It is also important to note that such tall screens in flagship devices are also a selling point for brands where consumers prefer high end smooth displays for their flagship devices. The author suggests that when a smartphone brand powers its tall display with a high definition screen, not only does it increase costs it also has an affect to the battery life which is why they need to insert a bigger battery to power such a high-end display resulting in overall costs increase for the screen display and battery on such flagship devices.

Upgradation in technology: The technology offered in the smartphones today is getting better. The author suggests that although technology offered will get better each year is a common sense but the segment who still feels their smartphone brand is overcharging them is probably missing this point. For instance, if a smartphone brand released the exact same phone as their flagship model with minor improvements to previous editions, the consumers could expect prices to stay constant or have a marginal increase. Although the author suggests that this is not something that is happening, it is not that we see minor upgradations in flagship devices in terms of specifications, performance and camera quality offered instead its completely the opposite in present scenarios. Each and every year consumers are getting designs that push the boundaries further also more intelligent AI

cameras, much more advanced technology in terms of the performance offered. Flagship devices in 2020 have approximately 3 times the surface area to when they started and this along with new technology offered needs to be scaled accordingly.

Selling costs: The entire process of selling a flagship smartphone can cost a lot of money to the smartphone makers which obviously also gets added to the price of the smartphone and with such increased competition amongst the smartphone brands the selling costs tend to jump higher. The author suggests that although there is an element of currency conversion differences when smartphones are imported from foreign countries but it mostly adds up to two major factors, Sales taxes & Operational costs. In India, GST on smartphones have been recently hiked from 12% to 18% also resulting in price increase of all smartphones from all brands. Operational Costs include costs of running a store for such smartphones manufactured, hiring employees and this varies massively between countries. To give a small example the latest flagship of OnePlus, the OnePlus 8 pro costs as high as \$999 in U.S. and \$1120 in U.K. but the price in India is can range up to \$799 for the best variant. According to OnePlus India, this is also because OnePlus has an assembling unit in India and this helps them keep reduced prices for countries like India and yet make profit. This goes on to show how much of a difference the selling costs can make to the price of a smartphone

Production Costs: Every aspect of the chain of the production of a smartphone is expensive and it is getting more and more expensive. To prove this the author suggests to look at a small example. The price of Samsung's 2020 flagship smartphone, Samsung Galaxy S20 Ultra is Rs. 97999 in India but it's bill of components will be approximately Rs. 43,000 (based on past years) so it is easy for a consumer to look at this data and think that Samsung is making an approximate profit of Rs. 54999 per device but as per the author this is not depicting the true picture. The author suggests that after we look at the above-mentioned points and take out the sales tax which could be an approximate of Rs. 17639, yet the approximate profit is considerably high

but we need to take into account that sales tax component cost is one of many other costs.

- **Manufacturing Costs** – Cost of the machines, factories & production lines which are either rented/bought.
- **Employee Costs** – Cost of hiring and maintaining employees who work for assembling such devices and solving problems over the phones for their customers.
- **Failed Chip Costs** – As chipsets become more and more minute and sophisticated the probability of failure for such chipsets are higher. Based on 7nm fabrication process about 30% of them fail and need to be checked or potentially recycled.
- **Research & Development Costs** - Flagship smartphones are expected to look and feel premium in terms of build and quality. Hence smartphone makers need to invest, try and test devices and eventually scrap quite a few of them in order to deliver the best premium finish on a smartphone
- **Advertising Costs** – Smartphone makers feel the need to invest heavily on advertising their flagship devices with rising competition amongst brands. This includes all costs related to advertising the product
- **Retailer Costs** – Cost of selling the smartphone on various retail platforms. The author suggests that most smartphone companies in the market (except Apple who has full control over the parts on its devices) have seen profits falling and not rising although the volumes have increased considerably.

The Luxury Effect: The author suggests that flagship smartphones by such brands like Apple, OnePlus & Samsung come with a premium price tag and target users who can spend that huge sum of money for a smartphone. This adds luxury tag to the smartphone which makes consumers pay the premium price for the high-end flagship smartphones.

VI. Conclusions And Recommendations

Over the years the high-end flagship smartphones have got expensive and the author suggests that they are bound to get more and

more expensive with the prospects of curved smartphones displays and foldable flagship devices set to prosper in the near future. Also, the consumers, as per the research have wanted those high-end specifications on their flagship devices like latest Qualcomm chipset for fast and smooth performance, flagship grade camera, IP certification for dust and water resistance, wireless charging, ecosystem compatibility and more, making the smartphone brands to add such premium features on flagship devices and charge higher. However, it is observed that whilst it is getting expensive to buy a high-end smartphone each year, it is also getting less expensive for consumers to buy a good smartphone each year. In the United States of America, the average smartphone price has fallen considerably from \$336.8 in 2010 to as low as \$214.7 in 2019 as phones get better customers do not need to buy the highest end flagship devices and can purchase an affordable alternative. The author suggests that while high end flagship devices on one end are pricing higher to maintain their premium category segment, the low-end affordable budget smartphones are generating the major sales for the smartphone brands as technology is getting better.

VII. Limitations

1. The sample collected for the research included responses individuals who used smartphones.
2. Information could be limited.
3. Topic is too broad.
4. Tax rate mentioned in the research paper could vary differently for different countries.
5. Responses were collected from students and working professionals only.
6. Only two smartphone platforms were considered for the research purpose, IOS and Android.

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A REVIEW ON GENERATIVE ADVERSARIAL NETS AND ITS TYPES

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ABSTRACT

Generative adversarial networks (GANs) are an astonishing novel contribution in machine learning and are a hot research topic recently. Since its creation in 2014, the GANs have been extensively studied and a large number of algorithms have been proposed.

As of December 2020, there are more than 5000 GAN related papers available on arXiv. However, connections among different GAN variants are not commonly studied.

In this paper we attempt to explain some of these types namely the original GAN, Conditional Coordinate GAN, StyleGAN2 and Logic-Guided GAN. We plan to provide a review on these GANs methods from the perspectives of theory and algorithm and their connected mathematics.

Keywords: Generative adversarial networks(GAN), GAN, COCO-GAN, StyleGAN2, Logic-Guided GAN, GAN Performance

Introduction

Generative Adversarial Networks (GANs), proposed only a short while ago, already have got an extensive footprint on generating data of diverse genre like texts, images, audios, and videos. Even though GANs can generate a diverse genre of data, images are the most studied part of the of this technology.

GANs are "generative models", their main goal is to create a new dataset that mimics the given training data. For example, faces in figure 1 were generated by a successor of GAN called StyleGAN2 using FFHQ dataset which contains photographs of real people, having said that none of the generated images belong to any real person.



Fig.1 StyleGAN2 Generated Images.

Since its publication in 2014 [1] there are numerous types on GANs addressing various applications have been made. These GANs follow the same architecture published in original GAN with some modification to them. Few such GANs are COCO-GAN: which is used to generate part of an image that can be

used to reconstruct corrupted images, StyleGAN2: the most advanced and detail oriented GAN till now and Logic-guided GANs: that can use limited data for training.

Generative Adversarial Nets

The GAN model consists of not one but two distinct models that are trained simultaneously. The first model is known as generative model **G** which aims to produce intended output by generating new data distribution. The second model called discriminative model **D** whose only task is to identify faux data (i.e. the output of the generator) from real data (i.e. data from the training set).

"Generative" within the name "Generative Adversarial Network" signifies a category of statistical models that contradicts with discriminative model. Hence, the aim of generator here is to make an effort to deceive the discriminator and the discriminator tries to stay on top of the generator. This adversarial model allows GANs to generate real-life images of human faces which is not an easy task to do.

A. Adversarial Framework

The generative model are usually assumed to be equivalent to a team of counterfeiters, attempting to provide counterfeit currency and use it without being noticed, while the

discriminative model can be believed to be the police, trying to discover the counterfeit currency.

Adversary or opposition in this game propels both teams to strengthen their techniques until the counterfeits are hard to make out from the original data. When the training begins, the generator produces undeniably faux data, and therefore the discriminator rapidly learns to distinguish that the generated data is faux.

As training advances, the generator approaches to fabricating perfect output that may deceive the discriminator: Eventually, if generator training progresses well, the discriminator slowly loses the ability to differentiate between real and faux data and it starts to label faux data as real, and its accuracy decreases.

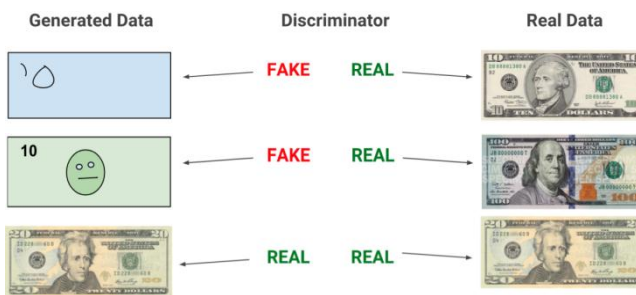


Fig.2 Adversarial Framework [14].

B. GAN Architecture

In GAN architecture as seen in figure 3 [14] the generator takes input from random noise and generates faux data sample. The discriminator takes this faux data sample and data sample from real images and outputs which is faux.

Putting labels on the architecture we get the following: Z is random noise, θ_g is Generator function, $G(z)$ is the sample generated from random noise, X is sample randomly selected from real data, θ_d is discriminator function, $Y = 0 \& 1$ are labels that are automatically generated and given to discriminator that then uses it for training. Discriminator loss is given as $D(x)$, Generator loss is given as $D(x) + (1 - D(G(z)))$

Note that despite of presence of labels the GAN models are un-supervised models. No human input is needed.

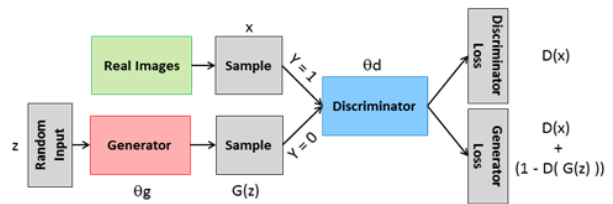


Fig.3 GAN Architecture

C. Minimax Loss

In the paper that proposed GANs[1], the discriminator tries to maximize the following function (figure 4) while the generator tries to minimize it:

$$\min_G \max_D V(D, G) = \underbrace{\mathbb{E}_{x \sim p_{data}(x)} [\log D(x)]}_{\text{[Real Data Samples]}} + \underbrace{\mathbb{E}_{z \sim p_z(z)} [\log(1 - D(G(z)))]}_{\text{[Generated Data Samples]}}$$

Fig.4 Minimax Loss Equation with labelled real and generated data samples.

Here, x =Sample of real data, $P_{data}(x)$ =Distribution of real data, D =Discriminator, $D(x)$ =Discriminator Network, z =Noise, $P_z(z)$ =Distribution of noise data, G =Generator, $G(z)$ =Generator Network.

This equation can be divided into two parts: The first part is discriminator loss calculated from real data samples and the second part is half of generator loss calculated from noise. The other half being discriminator loss.

The in above figure 4 the discriminator need to correctly classify “real” data i.e. $D(x)$ should be 1 or near to 1 and correctly classify generated data as fake i.e. $D(G(z))$ should be 0 or near to 0.

On the contrary, the role of generator is to fool the discriminator i.e. the generator wants $D(G(z))$ be classified as 1 or near to 1.

D. Learning Phases

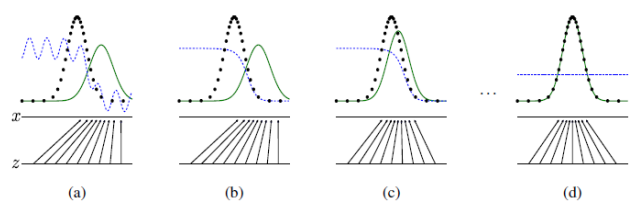


Fig.5 Different learning phases a GAN goes through [1].

The training of GANs are done by simultaneously improving discriminative model (D, Blue dotted line in fig. 5) and generative model (G, Green solid line in fig. 5). The horizontal line labeled x denotes data samples i.e. mixture of real data and faux data.

the lower horizontal line z denotes presence of noise. The arrows pointing upwards shows in what way the $x=G(z)$ implies non-uniform distribution on data samples.

(a) At first when discriminator is not trained it finds it hard to classify real from fake (fig. 5(a)).

(b) Then in the second figure (fig. 5(b)) the discriminator is properly train and can clearly classify real from fake. As can be seen from the smooth blue line.

(c) In the third figure (fig. 5(c)) the Generator starts to learn and gets closer to generating good fake images. The discriminator is now having hard time to discriminate between real and fake at cross sections of real and fake data distribution.

(d) In the last figure (fig. 5(d)) the generator has perfected generating fake images as the green line overlaps the black dotted line. The discriminator cannot tell the difference between real and fake and guesses the output as 50-50.

E. Algorithm

The algorithm is divided into two parts as noted in figure 6 [1]. The first part is followed by the discriminator and the second part is followed by the generator.

First the discriminator trains on random noise to quickly learn to identify real samples from fake. Since, the gradient slope of the discriminator is very shallow in the beginning, we train discriminator k number of times before training Generator 1 time. Here, k is a hyperparameter that is used to adjust the number of steps (i.e. continue the training) in discriminator and k can be changed by the programmer at the time of writing the code.

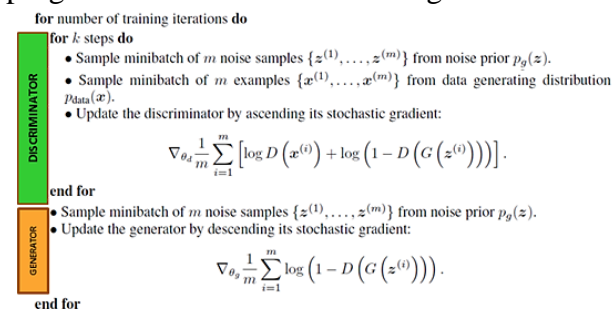


Fig.6 GAN Algorithm with labelled discriminator and generator functions.

The reason discriminator is run for k steps is to avoid “Helvetica scenario”[1] in which

discriminator cannot keep up with ability to properly distinguish fake from real early on as generator learns too fast resulting in bad image quality.

F. Results of GAN

Figure 7 shows output from different datasets. The figure 7(a) is from MNIST(Modified National Institute of Standards and Technology) dataset, The figure 7(b) is from TFD (TensorFlow Data) dataset, The figure 7(c) is from CIFAR-10 fully connected (Canadian Institute For Advanced Research) dataset The figure7(d) is from CIFAR-10 (convolutional discriminator and “deconvolutional” generator)

The figures in figure 7 show images through various stages in training. The leftmost images is when the training is close to start and the rightmost image (with yellow border) is the final output.

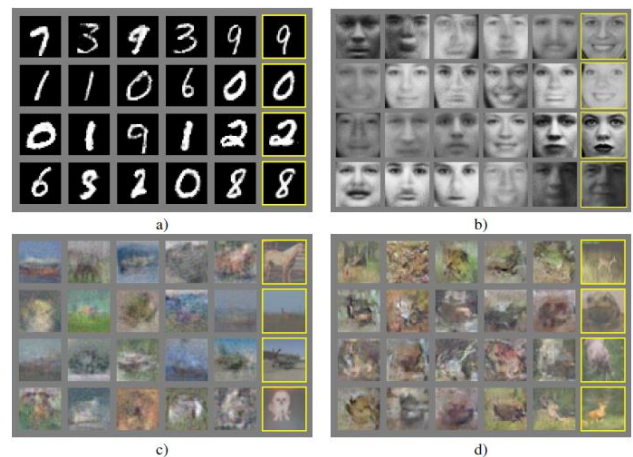


Fig.7 GAN generated images through various stages in training [1].

Measuring GAN Performance

Since GAN is an unsupervised learning technique, it is very hard to evaluate it. There is no standard way to measure GAN, and since GAN is a popular technique with more than 32 papers being published related to GANs everyday in 2018 [5].

We need GAN measurement to: (a) Compare various types of GANs, (b) Measure their effectiveness mathematically, (c) Improve them. (By creating new types of GANs and having better score than previous technique) There are many GAN evaluation techniques available but we will be concentrating on only 3 types in this report: (a) Inception Score, (b)

Fréchet Inception Distance and (c) Perceptual Path Length

A. Inception Score (IS)

Tim Salimans, et al. proposed the inception in 2016 [13].The inception score uses a pre-trained deep learning AI model to differentiate the generated images and label them into different classes. The pre-trained model they use is the Inception v3 model.

The use of inception v3 model in its back-end got inception score its name. Inception model is trained on Image-net dataset.

IS uses two criteria in measuring the performance of GAN: a) Image Quality: Do the images resemble a certain entity? b)Image Diversity: Do each class contain a broad selection of entities generated?

The largest values of inception score or "IS" is the quantity of classes backed by the categorizing model (i.e. Inception v3 model which supports the 1,000 classes), so largest value here is 1,000 and the smallest value is 1.0.

To get image quality we use conditional probability. Its formula is given as entropy = -sum(pi * log(pi)). Where pi is class label conditional probability. The instinct here is that a small probabilities have more information than large probabilities.

We use marginal probability to attain our interests in a broad selection of images. It can be said that we intend to find the divergence between marginal distributions MD and conditional distributions CD in Kullback–Leibler or "KL" divergence. Its formula is given as KL(CD || MD). More precisely, here we intend to find the average for all generated images using KL divergence.

B. Fréchet Inception Distance (FID)

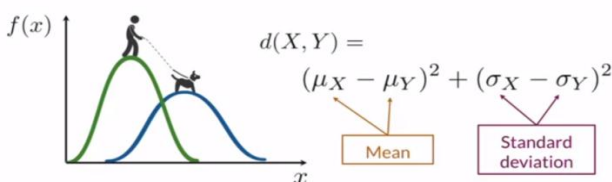


Fig.8 Fréchet Distance visualization and its Formula [16].

Martin Heusel et.al. [8] first proposed FID score into the GANs in 2018. The dog walker is a classic example used to illustrate Fréchet distance, where the dog is on one curve and the

walker is on the other. Each can go at their own speeds, but neither of them can go backwards. So to calculate the Fréchet distance between these curves, you need to figure out the minimum leash length needed to walk the curves from beginning to end. That is, what is the least amount of leash you can give your dog without ever having to give them more slack during the walk. It is by far the most popular GAN evaluation technique.

There's a simple formula to calculate the Fréchet distance between two single dimensional, normal distributions.

Let's look at both of the distributions means, which is represented by μ here, as well as their standard deviations represented by σ . So one distribution is X and one is Y. So you can imagine X and Y where X is the dog walker and Y is for the dog. The mean gives you a sense of their center and the standard deviation gives you a sense of their spread.

Notationally, you can take the difference between the means and the difference between their standard deviations, and then square each of these differences to penalize values further away from each other and also as a notion of L2 distance in some way.

Univariate Normal Fréchet Distance :

$$(\mu_x - \mu_y)^2 + (\sigma_x - \sigma_y)^2 \tag{1}$$

Multivariate Normal Fréchet Distance :

$$\|\mu_x - \mu_y\|^2 + \text{Tr}(\Sigma_x + \Sigma_y - 2\sqrt{\Sigma_x \Sigma_y}) \tag{2}$$

You can also expand the formula for the difference between those standard deviations in the univariate case, so if you expand this square here, you will get this term and you can see that you end up with something that is very similar to the multivariate formula, where Tr refers to the trace of a matrix, which is just the sum of its diagonal elements. The sigma refers to co-variance of a matrix.

The disadvantages of FID are that it uses pre-trained Inception model, which as previously mentioned may not capture all features. It needs a large sample size. Larger the sample size lower the FID Score. It is also slow at runtime.

C. Perceptual Path Length(PPL)

Perceptual Path Length (ppl) indicates that in a given shortest path how smoothly an image changes between point A and point B. With

high PPL scores, “new features” may appear in-between or the images between 2 latent vectors may be completely different.

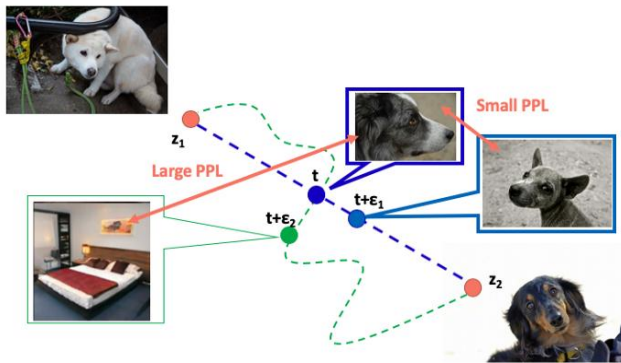


Fig.9 Perceptual Path Length [17]

In the above figure 9, \$z_1\$ and \$z_2\$ are two distinct images that are created from “seed value” called latent vectors. \$T\$ is any value between \$z_1\$ and \$z_2\$ i.e. \$U(1,0)\$. \$\epsilon\$ is a very small subdivision. Suppose we have two latent vectors \$z_1\$ and \$z_2\$. \$z_1\$ produces white colored dog and \$z_2\$ produces black colored dog. Imagine only color of the dog is being changed, taking a data in the middle of these two latent vectors, we should get an image of a grey dog. Here, the blue path in figure 9 that changes only color of the dog is the “perceptually” shortest distance.

On the contrary, the green path alters the structure and features of the object to something like a bedroom is a “perceptually” long distance with large ppl score as many features in the image \$t + \epsilon_2\$ that was not present in the original images \$z_1\$ and \$z_2\$ has appeared. For instance here the shape of the dog has been completely altered into a shape of the bed. This change in structure and features is measured by Perceptual Path Length(PPL).

$$l_z = \mathbb{E} \left[\frac{1}{\epsilon^2} d(G(\text{slerp}(z_1, z_2; t)), G(\text{slerp}(z_1, z_2; t + \epsilon))) \right] \quad (3)$$

$$l_w = \mathbb{E} \left[\frac{1}{\epsilon^2} d(g(\text{lerp}(f(z_1), f(z_2); t)), g(\text{lerp}(f(z_1), f(z_2); t + \epsilon))) \right] \quad (4)$$

Equation (3) and (4) defines formula for perceptual path length [7]. In the formula \$z_1\$ and \$z_2\$ are the two latent vectors of different images. The distance amid the generated images is the mean obtained by mixing the two latent variables at ratio \$t\$.

A natural definition for the perceptual path length would be "the limit of this sum under

infinitely fine subdivision", but in practice, we approximate it using a small subdivision epsilon = \$10^{-4}\$ [7]. Where, "\$z_1\$ and \$z_2 \sim P(z)\$", "\$t \sim U(1,0)\$", "\$G\$ is the generator" and "\$d(.,.)\$ evaluates the perceptual distance". Slerp stands for spherical interpolation interpolates our normalized input latent space. StyleGAN uses linear interpolation (lerp) because normalization is not done in vector \$W\$.

Conditional COordinate GAN (COCO-GAN)

Conventional GANs uses latent distribution (generally a Gaussian unit) to train a generator to immitate real data distributions.

The authors introduced coordinate systems to generate high-quality images from parts. The idea behind COCO-GAN is to generate the whole image from smaller chunks.

Chieh Hubert Lin et.al. [2] and their framework named Conditional COordinate GAN (COCO-GAN), aims at learning a coordinate manifold after a latent vector is sampled, the generator conditions on each spatial coordinate and generates patches at each corresponding spatial position.

While in parallel, the discriminator learns to identify whether the adjacent patches are continuous and homogeneous.

The generator can produce full visually sound images despite the fact that during training the generator is never given an opportunity to generate a whole image.

A. COCO-GAN Architecture

The architecture of COCO-GAN is given in figure 10. Like the original GAN, COCO-GAN consists of 2 models (a generator model \$G\$ and a discriminator model \$D\$), but adding to standard GAN it also has two coordinate systems, a fine-grained micro-coordinate system for generator and a coarse-grained macro-coordinate system for discriminator. All the image are divided into 3 sizes: full images (real: \$x\$, generated: \$s\$), micro-patches (generated: \$s''\$) and macro-patches (real: \$x'\$, generated: \$s'\$).

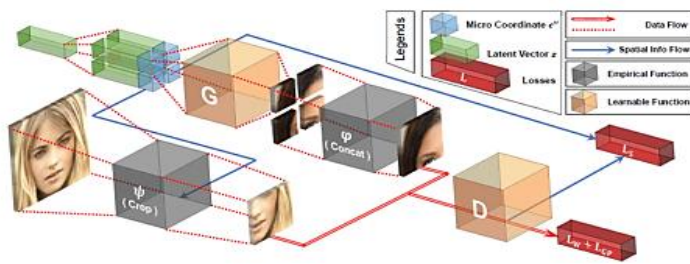
The goal of generator is to generate realistic, seamless and believable images by assembling smaller parts of an larger image. This can be stated in formula as \$s''=G(z, c''\$), where \$z\$ is the latent vector (or seed value), \$c''\$ is a micro-

coordinate system used by the generator and shown in fig 10. Both of these values are used to generate s'' (or generated micro-patches). This s'' is assembled using a merging function ϕ . Setting ϕ as merging function without overlapping is in practice sufficient for COCO-GAN to synthesize high quality images. Similar to micro-patches and ϕ , to generate parts of images from full images for discriminator, the authors used cropping transformation ψ . ψ is used to crop of a macro-

patch x' from real image x , which is used as a data sample for training discriminator.

B. Spatial coordinate system

This system creates a spatial coordinate system to keep track of locations, where the images are being generated and, if, they are at right location. The authors started with designing 2 spatial coordinate systems, for generator G they created micro-coordinate system (fig. 11) and for discriminator D they created macro-coordinate system ($c'_{(i,j)}$).



WGANLoss:
 $L_W = \mathbb{E}_{x, c'} [D(\psi(x, c'))] - \mathbb{E}_{z, C''} [D(\phi(G(z, C'')))]$

Gradient penalty loss
 $L_{GP} = \mathbb{E}_{\hat{s}'} [(\|\nabla_{s'} D(\hat{s}')\|_2 - 1)^2]$,
 $\hat{s}' = \epsilon s' + (1 - \epsilon) x'$

Spatial consistency loss
 $L_S = \mathbb{E}_{c'} [\|c' - A(x')\|_2]$

\hat{s}' : Interpolated macro patch
 s' : Generated macro patch
 x' : Real macro patch
 c' : Macro coordinate (from macro patch, (x,y))
 C'' : Micro coordinate (Matrix)

Fig.10 COCO-GAN Architecture along with it's losses[2]

C'' is the matrix of micro-coordinates used in Generator.

$$C''_{(i,j)} = [c''_{(i:i+N, j:j+M)}]$$

Fig.11 Spatial coordinate C'' equation short form [2]

$$C''_{(i,j)} = \begin{bmatrix} c''_{(i,j)} & c''_{(i,j+1)} & \dots & c''_{(i,j+M-1)} \\ c''_{(i+1,j)} & c''_{(i+1,j+1)} & \dots & c''_{(i+1,j+M-1)} \\ \vdots & \vdots & \ddots & \vdots \\ c''_{(i+N-1,j)} & c''_{(i+N-1,j+1)} & \dots & c''_{(i+N-1,j+M-1)} \end{bmatrix}$$

Fig.12 Spatial coordinate C'' equation expanded form [2]

C. Testing Phase

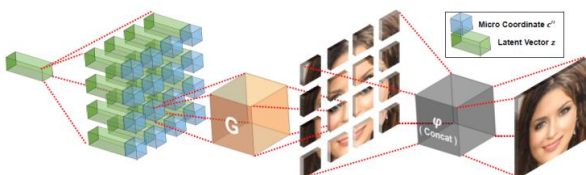


Fig.13 During the testing phase in COCO-GAN, the generator G creates micropatches of whole images (not macro-patches) that are later concatenated into full image [2].

The testing phase is similar to training phase without the discriminator and the losses. Similarly to training phase the latent vector is duplicated onto multiple coordinates known as c'' . The generator generates images independently for each coordinate and a concatenation function is applied to join the whole image.

D. COCO-GAN Losses

COCO-GAN is kind of special GAN as it uses 3 different Losses in its architecture

The patch Wasserstein loss L_W is a macropatch-level Wasserstein distance loss similar to Wasserstein-GAN loss that is used in WGANs [11]. It forces the discriminator to distinguish between the real macro-patches x' (i.e. $D(\Psi(x, c'))$) and fake macro-patches s' (i.e. $D(\phi[G(z, C'')])$), and encourages the generator to confuse the discriminator with seemingly realistic micro-patches s'' .

The authors also apply Gradient Penalty to the macro patches discrimination: where $\hat{s}' = \epsilon s' + (1 - \epsilon) x'$ is calculated between randomly paired s' and x' with a random number $\epsilon \in [0, 1]$

Finally, the spatial consistency loss L_S is similar to ACGAN loss. The discriminator contains auxiliary prediction head A . A aims to

estimate the macro-coordinate of a given macro-patch with $A(x')$. A slight difference is that both c'' and c' have relatively more continuous values than that of ACGAN which has a more discrete setting[18]. As a result, they applied a distance measurement loss for LS, which is an L2-loss. It aims to train G to generate corresponding micro patches by $G(z, c'')$ with respect to the given spatial condition c'' .

E. Experiments:

1) Quality of Generation by Parts:

As seen in figure 14(a) the size of the image is 128 px x 128 px. S16 denotes the size of micro patch (That is used by generator). Here Micro-patch is of 16px x 16 px. Finally N and M denotes the length and breadth of macro patch that is derived from micro-patch size. Here N and M are equal but they can be different sized (like N4 and M5) and they cannot exceed the initial image. N4 and M4 denotes they are 4 times the size of micro-patch i.e. 16x4=64. The same can be calculated for figures 14(b) and 14(c)

To verify that COCO-GAN can learn to generate the full image without the access to the full image, the authors first conduct a basic in which the macro patch edge length (CelebA: 64 x 64, LSUN: 128 x 128) is 1/2 of the full image and the micro patch edge length (CelebA: 32 32, LSUN: 64 64) is 1/2 of the macro patch.

To further clarify that COCO-GAN can learn from varying micro-patch size from same macro-patch size, the authors swept through the resolution of micro-patch from 16x16 (N16,M16,S4), 8x8 (N8,M8,S8) and 4x4 (N4,M4,S16) and, respectively. The results shown in Figure 14 suggest that even with extremely small 4x4pixels micro-patch, COCO-GAN can effectively learn coordinate information.



(a) CelebA (N4,M4,S16) (full image: 128x128, FID: 9.99).

Full Image Size: 128 x 128 pixels
 Macro Patch Size: 64 x 64 pixels
 Micro Patch Size: 16 x 16 pixels



(b) CelebA (N8,M8,S8) (full image: 128x128, FID: 15.99).



(c) CelebA (N16,M16,S4) (full image: 128x128, FID: 23.90).

(N4, M4, S16):

S16 = Micro Patch Size (i.e. 16x16pixels)

N4 & M4 = Macro Patch is 4x4 micro Patch

Fig.14 Various images generated from COCO-GAN. The first row of every figure (a,b and c) is the full image. The second row contains macro-patches generated by the discriminator D. Lastly, the third row contains the micro-patches generated by generator G. The first five columns from left in each row is connect with each other [2].

Dataset	CelebA 64x64	CelebA 128x128	LSUN Bedroom 64x64	LSUN Bedroom 256x256	CelebA-HQ 1024x1024
DCGAN [26] + TTUR [13]	12.5	-	57.5	-	-
WGAN-GP [12] + TTUR [13]	-	-	9.5	-	-
IntroVAE [14]	-	-	-	8.84	-
PGGAN [15]	-	7.30	-	8.34	<u>7.48</u>
Proj. D [22] (our backbone)	-	19.55	-	-	-
Ours (N2,M2,S32)	<u>4.00</u>	<u>5.74</u>	<u>5.20</u>	<u>5.99*</u>	<u>9.49*</u>

Fig.15 FID scores of various GAN types (vertical) with various databases (horizontal) compared with COCO-GAN [2]. This figure indicates COCO-GAN is competitive with other state-of-the-art GANs.

The authors reported Fréchet Inception Distance (FID) in figure 15 comparing with other state-of-the-art GANs. From observing fig 15 we can say that the COCO-GAN, without additional hyper-parameter tuning is competitive with other latest GANs

2) Latent Space Continuity

To demonstrate the space continuity more precisely, the authors performed the interpolation experiment in two directions: “full images interpolation” and “coordinates interpolation”.



Fig.16 Some examples of full-image interpolation progressing from one latent vector to another using COCO-GAN [2].

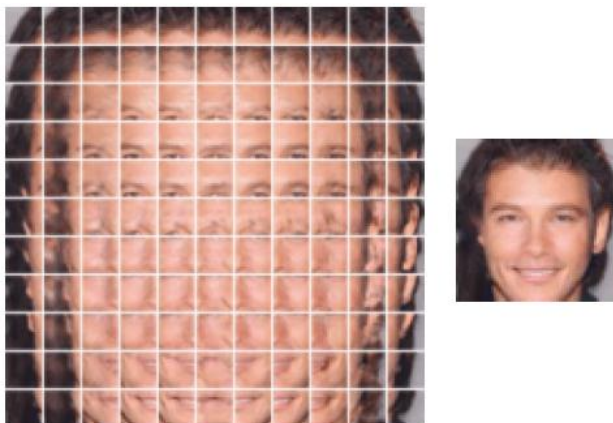


Fig.17 Figure on the left shows coordinates interpolation done in COCO-GAN and figure on the right shows the original reference image [2].

Full-Images Interpolation:

Since all the micro-patches are generated with different spatial coordinates, all of those patches must change synchronously while staying consistent with their neighboring patch to make a smooth full-image interpolation. Nonetheless, as shown in Figure 16, COCO-GAN can interpolate smoothly and synchronously without producing unnatural artifacts.

Coordinates Interpolation:

Another latent space continuity experiment was done between spatial coordinate condition called inter-class interpolation between fixed latent vectors. The authors linearly-interpolate spatial coordinates between [-1, 1] with a fixed latent vector z. The results in Figure 17 shows that, the spatial coordinates interpolation is overall continuous even thou discrete spatial coordinate set is used.

In Figure 17, COCO-GAN does not know the strategy to handle glabella. Glabella being position between two eyebrows which it learns to create by directly deforming the shape of the eye to switch from one eye to another instead of making a new part which should be the case. This phenomenon raises an interesting insight that even if the model may learn to create high-quality human believable images, it can still produce them from wrong methods or from wrong relationships behind the scene.

3) Beyond-Boundary Generation



Fig.18 “Beyond-Boundary Generation” generation example. Objects in the red box are sample images and objects outside the red box are COCO-GAN generated images[2].

COCO-GAN allows a novel type of image generation, i.e. generating images that have more pixels and features than any training sample. A verification can be made by looking at the generated image's size in the post-training phase as seen in figure 18. In this figure, dataset used for training is "LSUN Bedroom 256x256". As its name suggests, all

the images in this dataset is 256x256 pixels but all the images generated by this GAN has an image resolution of 384x384 pixels. By the process called extrapolating, COCO-GAN can generate additional contents of the images, in this case each side was extended by one micro-patch of 64 pixels.

This is an awe-inspiring finding as existing GANs have their output shape (their size) set once the training is done, they cannot generate images with bigger resolution than the one they were trained on. For example if the existing GANs were trained on a dataset with 256x256 pixel resolution, it can only generate images with 256x256 pixels.

StyleGAN2

StyleGAN is famous for its unconventional Generative Adversarial Network architecture such as the use of Adaptive Instance normalization, a mapping network from the Latent vector z into W and the progressive growing [6] of going from a 4x4 image up to 8x8 up so on up to powers of 2 up to a high resolution generated image.

StyleGANv2 has restructured the use of Adaptive Normalization. Get away from the progressive growing to get rid of artifacts introduced in StyleGANv1 [7] like water droplet effects and then fixed position of eyes and noses like that with respect to generating these images

The Authors also introduced a Perceptual Path Length Normalization term in the loss function to improve on their already impressive Latent space interpolation ability.

Latent Space interpolation describes the changes in the generated image when changing the Latent vector z . So when you have small change in latent vector z you can have small semantic perceptual changes in the generated image

The authors also introduced a deep defeat detection algorithm to project a generated image back to latent space to try to see if you contributed the generated image or the fake image to the network that created it or the dataset that created it.

A. Problems with StyleGAN

StyleGAN v1 [7] was famous for its unconventional Generative Adversarial Network architecture such as the use of (1) Adaptive Instance normalization, (2) a mapping network from the Latent vector z into W and (3) the progressive growing of going from a 4x4 image up to 8x8 up so on up to powers of 2 up to a high resolution generated image.

1) Droplet Artifact

StyleGAN displayed water droplets-like artifact that were present both in normal image and its feature map as seen in figure 19. Redesigning the generator component called normalization removed the artifact as seen in figure 23.



Fig.19 Water droplets effect caused by normalization in StyleGAN [3].

2) Phase Artifact

Progressive Growing seems to have an intense location bias for features like eyes and teeth. Features quickly move to next place after staying significantly long time in one place. The authors proposed an alternate design that retains merits of progressive growing without the limitations.



Fig.20 Phase artifacts caused due to progressive growing. In this figure, the blue line stays in place to indicate that even if the camera angle is rotated the teeth stay at the same place [3].

B. Removing normalization artifacts

The problem was recognized to AdaIN (Adaptive Instance) operation that eliminates any information that originated within the image features. This happened because in

AdaIN operation every feature map normalizes the mean and variance separately.

Adaptive Instance in divided into two parts: normalization and modulation [12] as seen in figure 22.

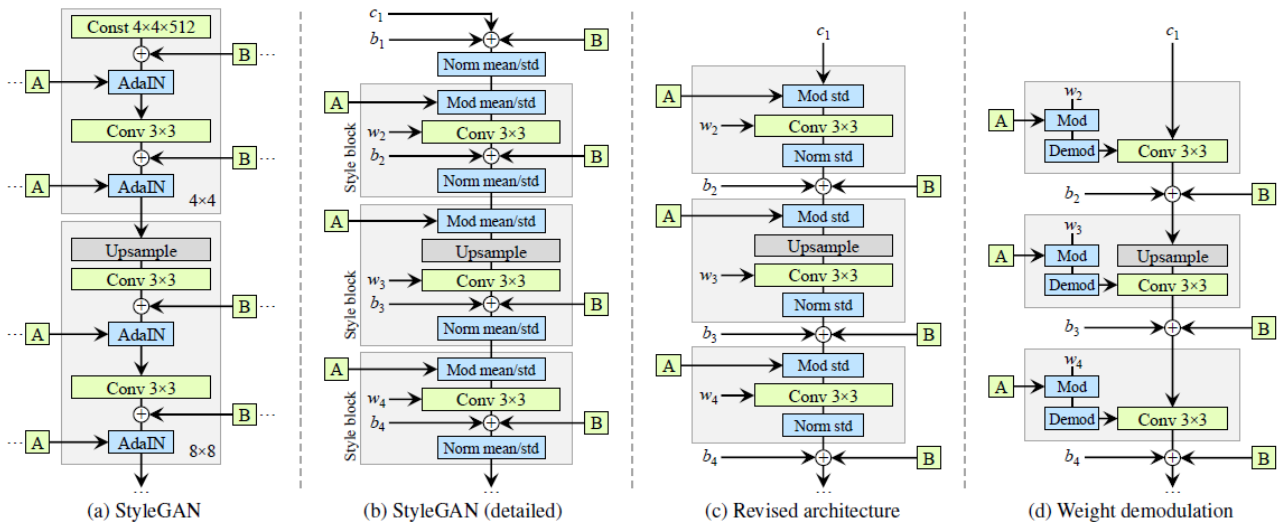


Fig.21 Steps in removing AdaIN layer [3].

$$AdaIN(\mathbf{x}_i, \mathbf{y}) = \mathbf{y}_{s,i} \frac{\mathbf{x}_i - \mu(\mathbf{x}_i)}{\sigma(\mathbf{x}_i)} + \mathbf{y}_{b,i}$$

/ Normalization \
|
/ Modulation \

Fig.22 Adaptive Instance Normalization.

The authors have redesigned the architecture of StyleGAN synthesis network. The figure 21(a) depicts the original StyleGAN, where "[A]" is the modified latent vector called "learned affine transform" derived from "w" that produces a style and "[B]" is noise broadcast operation.

fundamental parts i.e. modulation and normalization. Mean and standard deviation both were operating per feature map. Here, "w" and "b" stands for weights and biases with "c" being constant input. The "style block" indicated by gray boxes signify that one style is operating per box. Leaky ReLU is the activation function that is applied immediately following the adding of bias.

Moving onto figure 21(c) the authors made various changes to the original architecture. They removed some redundant operation in the beginning (i.e. removing activation, bias and noise). Moved the addition of bias "b" and noise "[B]" to outside of activity area and adjust only the standard deviation per feature map. Making changes in figure 21(c) enabled them to put a "demodulation" operation in place of instance normalization. Figure 23 depicts the results of removing normalization artifacts.

C. Image quality and generator smoothness

As there are many different way to measure GAN effectiveness such as IS and FID scores which capture numerous characteristics of generator, they are still ineffective against image quality. Perceptual Path Length or "PPL" in short solves this issue. As you can see in figure 24 that Images with low PPL score



Fig.23 Images and its activation layer after fixing the normalization artifact[3].

Figure 21(b) is the same diagram as figure 21(a) but with more accuracy. Here they have fragmented Adaptive Initialization into its

can be better recognized as cats as compare to images with high PPL score.

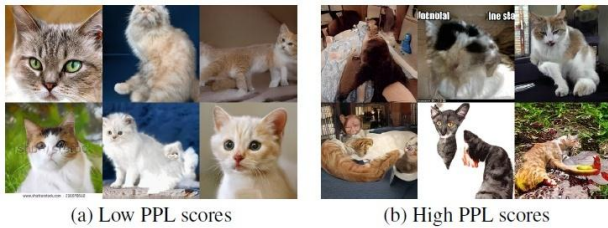


Fig.24 Comparison between low and high PPL scores. Low PPL scores generate more realistic and cat-like images [30].

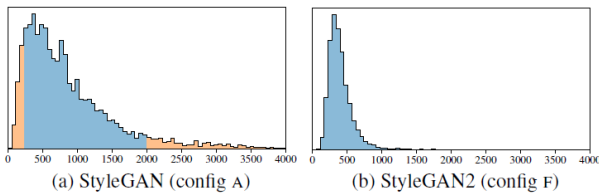


Fig.25 Comparison of PPL scores between the original StyleGAN and fully completed StyleGAN2 [3].

Figure 25 depicts a graphical view showing the improvement on PPL scores even when the FID scores remains the same. The basic StyleGAN can generate low quality images with PPL score of 924. With the final StyleGAN2 we can create higher quality images that can be inferred visually from figure and mathematically from lower PPL scores. The authors decreased (improved) the PPL score of StyleGAN through two techniques: (a) Lazy regularization and (b) Path length regularization.

1) *Lazy Regularization*

Generally, the regularization terms and main loss function are written as a single expression. The authors observed that it is safe to reduce the computation of regularization terms but compute the main loss function regularly. Hence, it greatly reduces the memory usage and computational cost of StyleGAN2 compared to its predecessor i.e. StyleGAN. Also, Performing R1 regularization once every 16 mini-batches does no harm to the image quality.

2) *Path Length Regularization*

The perceptual smoothness of image quality and latent space has a likely relationship between Perceptual Path Length (PPL) score. The authors integrated it into the model as a regularization term.

The formula is given in equation (5) where, "y" is a random image generated from normal distribute and "a" is constant. J_w is a jacobian matrix that uses modified latent variable w and to avoid explicit computation of the Jacobian matrix, we use the identity $J_w^T y$. Equation (6) shows expanded Jacobian equation J_w .

$$\mathbb{E}_{w,y \sim N(0,I)} (\|J_w^T y\|_2 - a)^2 \tag{5}$$

$$J_w = \delta g(w) / \delta w \tag{6}$$

D. Progressive growing Problem

Progressive growing GANs (PGGAN) [6] is very helpful in creating high resolution images, but it generates its own characteristic artifacts. The core problem here is there is a strong location preference for generator in progressive growing. This was easily solved by replacing progressive growing with Multi-Scale Gradients (MSG-GAN) [10].

Logic-Guided GAN

A limitation of standard GAN is that discriminator does not provide corrective feedback to the generator [4]. That is, generator only knows if the generated data is accepted or rejected by the discriminator. The limitation of this approach is that the generator has to create better images simply by the input that the previous images were correct or fake. Hence, the question arise: Is it possible to provide more detailed feedback to the generator from discriminator? And if it is possible, does it make the generator efficient and better accuracy?

A. LogicGAN Architecture

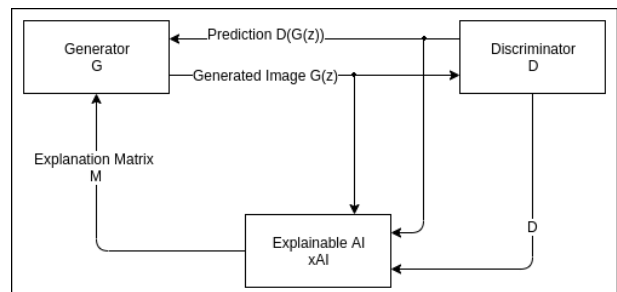


Fig.26 LogicGAN Architecture[4].

In order to understand the architecture let's consider the problem of training a GAN with the aim of producing images of digits. Initially, from a randomly noise sample (latent vector), the untrained generator G produces a fake

image. The equation is given as $G(z)$ which is then given to the discriminator for calculating the loss function. After the loss function is evaluated, $G(z)$ (i.e. Generated image), D (i.e. the discriminator) and, $D(G(z))$ (i.e. prediction matrix) is given to xAI system for evaluation. xAI system such as SHAP justifies the loss value. The generator then uses this justification provided by xAI system to modify its training parameters automatically.

B. eXplainable AI (xAI)

While training AI, even though the programmer is responsible for adjusting the hyper parameters, the programmers does not know "how" the data is being trained or what are the parameters the AI model is using as AI is a "black box" in its core.

Explainable AI helps to uncover the secrets to AI black box with the help of various tools and frameworks. With this xAI can improve models performance, debug it and help others understand the model's behavior.

C. Overview: SHAPxAI

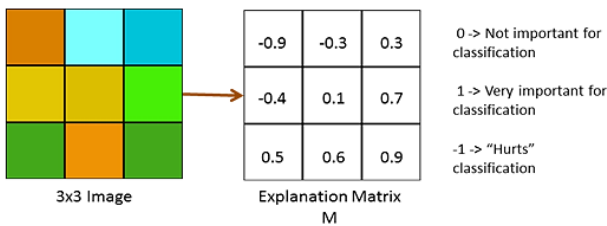


Fig.27 SHAP Working

SHAP that was introduced in 2017 by authors Lundberg and Lee [15]. The working of SHAP can be inferred from figure 27 which explains the process with the help of 3x3 image. Each pixel here is a feature that can be either useful, hurtful or neutral in classification. SHAP creates an "explanation matrix" M wherein every features is given value in the range [-1, 1].

If a feature or more precisely, the corresponding cell in M (referenced in figure 27) is allocated a value near to 1, it signifies that the feature is very important for classification by discriminator D and this feature does not needs to be changed. If a feature is allocated a value near to 0, it signifies that the feature is not important for classification by discriminator D and can be either left as it is or can be tried to improve it to closer to 1. If a feature is allocated a value

near to -1, it signifies the feature "hurts" the confidence of discriminator D and needs to be changed.

D. The DeepSHAP xAI System

The authors used the DeepSHAP xAI system, which is one of the most widely used xAI systems developed by Lundberg and Lee [15]. Introduced in 2017, DeepSHAP is mixture of Shaply value and DeepLIFT. It is an open source library and is freely available. This platform is well-desired for neural network application.

1) SHapely Additive exPlanations (SHAP)

In this method, re-training models on every subset of features $S \subseteq F$ is used to compute values, weighting each and every feature depending on if that features appears in prediction values. Unfortunately, remarkable re-training is essential and it also demands at least $2^{|F|}$ independent models to make up for all the combinations of every features.

To reduce the computational efforts, we can apply methods to approximate the SHAP "explanation matrix". This can be done by iterating over local feature regions and using approximating importance from training dataset.

2) The DeepLIFT xAI system

Using gradient descent from the DeepSHAP algorithm, a feature importance values can be generated which are in the range [-1, 1]. We then take the absolute value of the explanation matrix M and normalize them to the range [0, 1] to use as a mask [4].

Taking absolute values assists us to target learning procedure on most dominant features even if the feature is helpful or hurtful to the classification.

To recognize the significance of features, DeepLIFT utilizes a set of reference inputs and the consequent model outputs. Δy is used to distinguish the distinction between a reference output and an output. x_i is used to distinguish between reference input and a corresponding input. Reference determined from domain knowledge by user to depict the uninformed state.

E. xAI-guided Generator Training in LogicGANs

The entire goal of xAI-guided training is enhance the feedback a discriminator gives with "reason" from an xAI system such as DeepSHAP.

Figure 28 focuses on gradient descent computation during the training of generator. For xAI-guided gradient descent, the back-propagation algorithm is improved to emphasize generator training on important features for discriminator's prediction.

Following with propagating the loss through the discriminator to find $\Delta G(z)$, we use an xAI system E to find $M = E(G(z))$ (line 6 in figure 28). M is a set of real values $\in[0, 1]$, where greater values represent features that are more important to the discriminator's prediction. The Hadamard (piecewise) product of $\Delta G(z)$ and M is calculated to get the modified gradient $\Delta'G(z)$ (line 7 in figure 28). From there, the gradients of the generator ΔG are calculated from $\Delta'G(z)$ (line 8 in figure 28) and the parameters are then updated (line 12 in figure 28).

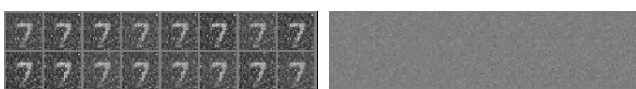
Algorithm 1: Generator Training Algorithm. Note that the highlighted part only applies to xAI-guided generator training.

```

input : generator G
input : discriminator D
input : boolean Flag use_xAI
output: trained generator G
1 foreach noise sample z do
2   Loss L = Loss(1 - D(G(z)))
3   compute Discriminator Gradient  $\Delta_D$  from L
4   compute Generated Example Gradient  $\Delta_{G(z)}$  from  $\Delta_D$ 
5   if use_xAI is True then
6     compute Explanation Matrix M using xAI
7     compute Modified Gradient
8      $\Delta'_{G(z)} = \Delta_{G(z)} * M$ 
9   else
10    compute Generator Gradient  $\Delta_G$  from  $\Delta_{G(z)}$ 
11 end
12 update Generator parameters  $\theta_G$  using  $\Delta_G$ 
    
```

Fig.28 Generator Training Algorithm [4]

F. LogicGAN Results



(a) Samples at epoch 1 on single-class LogicGAN (b) Samples at epoch 1 on single-class standard GAN

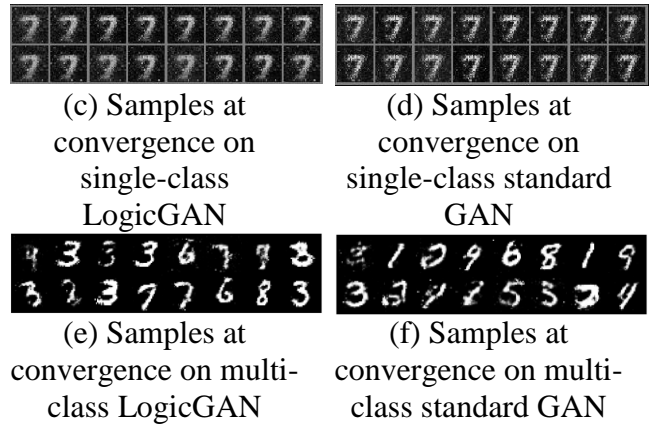


Fig.29 LogicGAN image samples [4].

In the figures from 29(a) through 29(d) the system has been trained on a single class i.e. number 7 on MNIST(Modified National Institute of Standards and Technologies) database. The LogicGAN algorithm has a head start on image generation at epoch 1 as the number 7 can be faintly made out. The standard GAN as expected produced noise. But at convergence both LogicGAN and Standard GAN produces the same quality images. The same can be said for multi-class MNIST database (figures 29(e) &29(f)). At convergence both the LogicGAN and standard GAN produces same quality images.

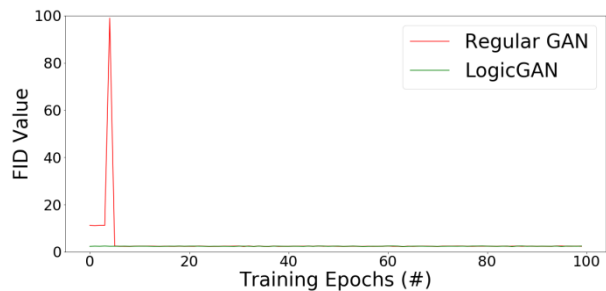


Fig.30 Single-class dataset training showing FID values over epoch [4].

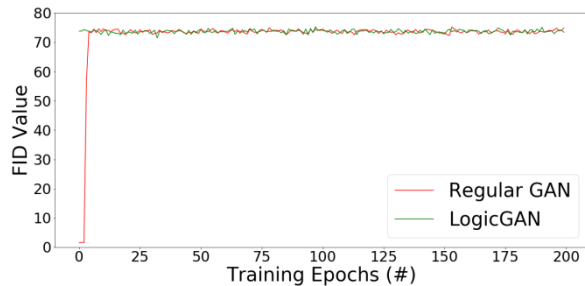


Fig.31 Multi-class dataset training showing FID values over epoch [4].

Comparing FID Scores of MNIST Single-class and Multi-class we get similar FID Scores. But

as observed in previous slides at start LogicGAN get better FID Scores in comparison to standard GAN and after some epochs their FID Score matches resulting in similar image at convergence.

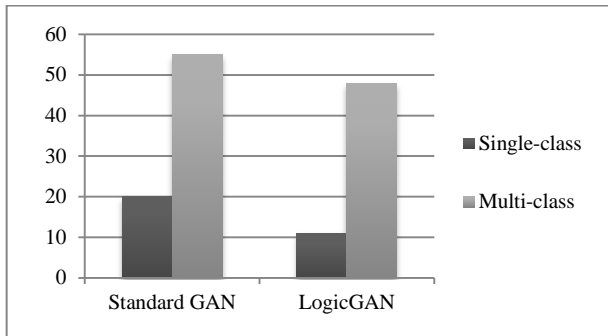


Fig.32 Total amount of epochs required to reach convergence for both standard GAN and LogicGAN [4].
Fig.33

Class Settings	Standard GAN	LogicGAN - xAI	LogicGAN +xAI	xAI Only
Single-class	243.2	352.1	994.4	642.3
Multi-class	27,735.27	31,408.66	88,294.15	56,885.48

Fig.34 Total amount of time required (in seconds) to reach convergence for standard GAN, LogicGAN -xAI system and LogicGAN +xAI [4].

Class setting	Standard GAN	LogicGAN -xAI	LogicGAN +xAI	xAI Only
Single	0:04:03	0:05:52	0:16:34	0:10:42
Multi	7:42:15	8:43:29	24:31:34	15:48:05

Fig.35 All time that appeared in figure 33 converted into hh:mm:ss format for convience.

To achieve convergence of single class image, the standard GAN needed 20 epochs while LogicGAN needed only 11 epochs (as seen in figure 32) thus, resulting in an 45% improvement in data efficiency.

However, the authors noted that standard GAN needed 243.2 seconds (4 mins) while LogicGAN took 994.4 seconds (16 mins) of run time - out of which the xAI system required 642.3 seconds (10 mins).

Again, figure 32, 33 and 34 outlines the results of data efficiency metrics and time required for convergence for LogicGAN and standard GAN. The authors found that standard GAN took 55 epochs to converge while LogicGAN took 48 epochs - resulting in a 12.73% improvement in data efficiency. However,

standard GAN required 27,735.27 seconds (7:42 hrs) while LogicGAN needed 88,294.15 seconds (24:31 hrs) (out of which xAI system required 56,885.49 seconds (15:48 hrs)).

As it can be observed from the experiment, in terms of data efficiency, LogicGAN surpasses standard GAN by a huge margin while preserving identical quality scores. A vital discovery of this paper is that LogicGAN manages to learn quickly with less training cycles.

Comparison of GAN

	COCO-GAN	StyleGAN 2	LogicGAN
Can create convincing images?	Yes	Yes	No
Is Computationally Friendly	Yes	No	No
Goal	Creating parts of an image	Create visually convincing images	Adding a way for discriminator to send rich feedback to the generator
Generator Training Method	Wasserstein Distance	Wasserstein Distance	Jensen-Shannon divergence
Ancestor	WGAN, ACGAN	StyleGAN, MSG-GAN	GAN
Applications	Re-generating corrupted images generating alternative	Mixing different images	Can be used when data is not sufficient
	Restoring old paintings	Converting RGB image onto latent vector	
	In VR as computational friendly image generation alternative	Identify generated images along with the database they have been trained with	Reducing the number of epochs to generate image and reducing training database sizes
Limitations	NA	Can still not produce convincing image	The xAI takes up impractically more

TABLE I. GAN Comparison

GAN Timeline

Here in figure 35, the GAN timeline derived from paper published by Jie Gui et.al [5]. We have added the GANs that were studied i.e. StyleGAN, StyleGAN2, COCO-GAN and Logic GAN. These added GANs have further dependencies like MSG-GAN [10] and ACGAN[18] which we have added.

Flaws of StyleGAN2

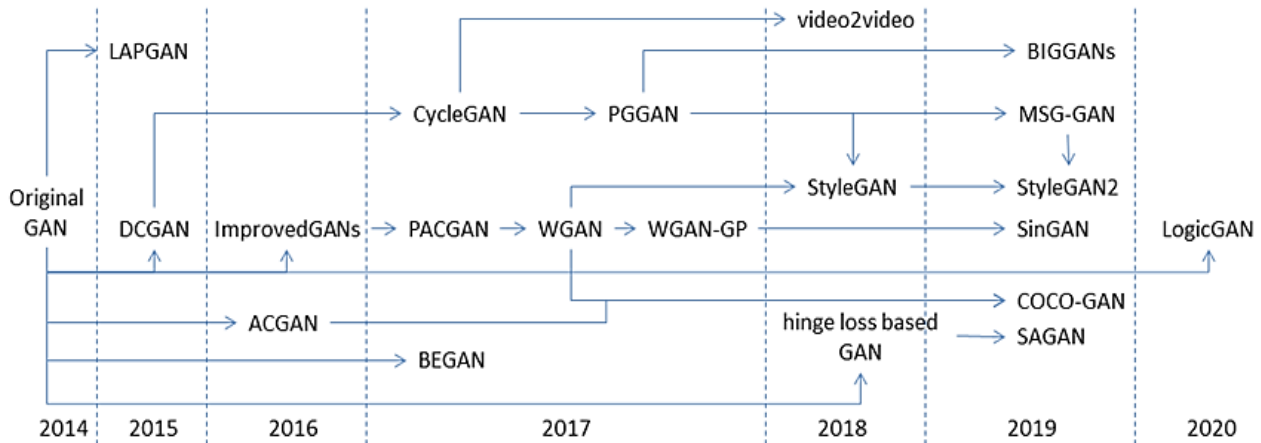


Fig.36 Timeline of GAN



Fig.37 Images generated by StyleGAN2 [3]

StyleGAN2 is good at generating just one thing and optimal at others.

Take the figure 35 as an example, the faces are perfect but looking closely at the background we can easily recognize it as fake. The top right image has a weird background that could not be captured through any photograph. The bottom right image as “wavy fence” and the bottom left image has the whole background tilted.

Another giveaway from this GAN is the earrings. They are asymmetrical. Take for example the image on top-right of figure 35, she has earring only on her left ear.

And last but not least their clothing. The image on top-left has stripes on left side but not on the right. Some images have holes on their clothing (e.g. hat in figure 1), some have irregular coloring like red color on left side and green on right. One way to solve this issue is divide the GAN into parts where background is trained first, then faces, then earrings and then clothing. This could solve those issues our my opinion.

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FACTORS INFLUENCING PURCHASE INTENTION TOWARDS E-VEHICLES AMONG THE POTENTIAL INDIAN CONSUMERS- A STUDY ON KARNATAKA REGION**Prof. Nagaraj Navalagund¹, Dr. Shashidhar Mahantshetti², Dr. Gurudas Nulkar³**^{1,2} School of Management Studies and Research, KLE Technological University, Hubballi, India³ Symbiosis Center of Management & HRD, Symbiosis University, Pune, IndiaEmail: ¹nagaraj.n@kletech.ac.in, ²shashidhar.mahantshetty@kletech.ac.in, ³gurudasn@gmail.com**ABSTRACT**

There is a serious threat of degrading natural environment which is assuming dangerous proportions as pollutions of all forms and destruction of natural resources are abound. In the wake of this, there is an increasing concern for the environment and the adoption of responsible behavior among consumers to address the deterioration of the environment. The present study is an attempt to understand the underlying attitudinal and behavioral factors influencing the consumer adoption of electric-vehicles (e-mobility) in the state of Karnataka. With the enhanced concern towards environment and sustainable development, there is a surge towards exploring alternative modes of transportation. An exploratory research approach is incorporated by surveying the opinions of 384 respondents spread across the state. Structural equation modeling revealed that Pro Environmental Behavior (PEB) played a partial mediation in the purchase intention. Interestingly, analysis showed that, financial advantage and cost has no significant relation with purchase intention. Electric vehicle ecosystem is also an important attribute, as it had a significant influence on purchase intention among the consumers.

Keywords: *E-vehicle adoption, Consumer behavioral and attitudinal factors towards E-mobility, Environmental & sustainable transportation*

I. Introduction

India is one among the five fastest-growing economies in the world and seventh-largest in terms of nominal GDP. India is only trillion-dollar economy in the top five developing nations (Prablen Bajpai, 2019) and (Surveys, 2017). Over 285 million motorized vehicles are registered in India (Ministry of Road Transport and Highways, VAHAN) as on 14th February 2019, out of which around 20 million are there in Karnataka state alone (TOI-October 11, 2018). The transport department's records show that the number of vehicles is increasing every year. It is expected that there is an 8-10% annual growth in this figure.

Bangalore urban district with 10 regional transport offices, continued to lead in the number of vehicles at 76.2 lakh followed by Belgavi transport division at 35.7 lakh which consists of Belagavi, Dharwad, Gadag, Haveri, Bagalkot, Vijayapura and Uttar Kannada districts. Shivamogga division with Shivamogga, Dakshina Kannada, Udupi, Chitradurga, Davangere, and Chikkamangaluru districts stood third with 29.9 lakh vehicles and with 22 lakh vehicles Mysore division stands at 4th position which constitutes Mandya, Kodagu and Hassan districts.

These numbers point towards the massive contribution of the transport sector to India's carbon emissions percentage. A study by (Malhotral, 2019) shows that transportation contributes to over 10% of India's carbon emission. This has significantly contributed to the increase in air pollution.

India is a signatory to the Paris Agreement, which agrees to immediate efforts to keep the global average temperature below the critical of two degrees Celsius above pre-industrial levels. Towards this objective, the Government of India has set an ambitious target to cut carbon emission to 33% by 2030 (Economic Times dated October 3, 2015) the dual pressures of resource depletion and environmental changes, are driving increased use of electrical vehicles (EV). It is expected that EVs will reduce pollution which will be beneficial for human and environmental health. However, the production and sale of EVs in India have been far from encouraging. The ecosystem needed for charging EVs, servicing them, and recycling the batteries is yet to open up in India. Moreover, the prices of EV are high and the distance they can travel is limited. These and several other challenges have been discouraging consumers from purchasing EVs.

This study intends to delve deeper into the drivers and challenges influencing consumer intention for the purchase of EVs. For this, we develop a conceptual model, which is tested and validated by Structural Equation Modeling (SEM).

II. Literature review

Automobile industry in India is considered as a largest growing market in the world and contributes on an average 15% to the GDP. The industry is expected to touch 25% mark by 2024. Post the global climate change agreement, India is targeting to deploy 6 to 7 million EVs by the end of 2020 under the scheme of “Faster adaptation and manufacturing of Hybrid and Electric vehicles” (FAME). Post this implementation the EV market is expected to grow in India, at present electric market in India is in nascent stage when compared to US, China and other European markets. Presently India has less than 0.1% share when compared to other nations. “Indian EV Sales reached 22,000 vehicles in 2016. This was an increase of 37.5% over the last year and is expected to steadily rise on the back of the declining cost of lithium-ion batteries and favorable government initiatives and policies.”

Review of Theoretical Framework

The focus to this section is to discuss purchase intention for EVs in the context of utility, behavioral components, technology acceptance and the impact of five prominent factors on purchase intention such as performance, features, financial benefit, environmental concerns, cost of ownership, and ecosystem availability.

Purchase intention in the context of Utility Theory

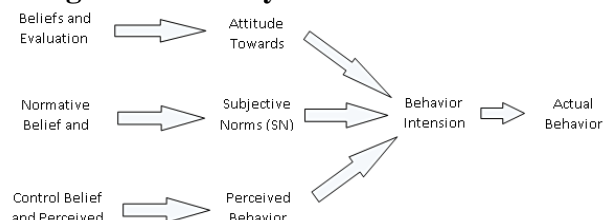
Utility Theory is considered as one of the widely accepted theories of consumer behavior, which intends to explain rationally about why people perform objectively and how they maximize the expected utility for personal benefit to achieve satisfaction (Rian van der Merwe, 2010). Consumers will think about the choices to the preferences and maximize the utility rationally. However, in the context of consumer decision making this economic perspective may not be sufficient enough to

explain behavior regarding selection between two or more alternatives. As pointed out in studies carried out by earlier authors, consumers decision is based upon a set of motives and alternatives which has a significant influences on the action, (Sheth, 1970) psychological factors, (J.A, 1958) and learning history comprising by personal factors and state variables(R, 2001). (Urban, 1979) described utility function through physical cues and psychological attributes. Thus, consumers choose alternatives to enhance expectations; consumer’s decision making may depend on perceived utility, benefit, or perceived value offering. Several psychological and social factors influence consumer decisions. In addition to past experiences; emotions will significantly influence behavior and thinking. Purchase intentions are influenced by consumer purchase decisions based on various alternatives to enhance expectations within a given set of risks and benefits framework.

Theory of Planned Behavior

(I., 1991) proposed the Theory of Planned Behavior (TPB). TPB contains the perceived behavioral control dimensions (PBC) which is used to explain the limitations of Theory of Reasoned Action (TRA). TRA is based on a relationship between attitude towards behavior (ATB), behavioral intention (B.I) and actual behavior (Fishbein, 1967). In Continuation with earlier work carried by researchers (Ajzen, 1975) have incorporated subjective norms dimensions (SN) into TRA model.

Fig. No.1- Theory of Planned Behavior



Technology Acceptance Model (TAM)

Above model was proposed by (Davis, 1989), Derived from the theory of reasoned action proposed by (Ajzen, 1975), and aim to assess/interpret the usage behavior of technology users (Fred D. Davis, 1989), Paul Legrisa, 2003 showed that technology

acceptance model can roughly explain how external factors influence the internal “attitude”, “belief” and “behavioral intentions”.

III. Systematic Literature Review:

Performance Feature (PF)

Kenan Degirmenci, 2017, indicated customers concern for the longest range that Electric Vehicles (EVs) that can drive in one charge. (Lebeau, 2013) Consumer Attitude towards Battery Electric vehicles charging time (Ona Egbue, 2012) is acted as barriers to widespread adaptation of electric vehicles. A deeper analysis of consumer attitude and perceptions, safety and reliability towards the mass adoption of Electric vehicles, carried by (M.K. Lim, 2015) showed that average travel per charge, cost per mile dimensions are acting as a motivation factors to purchase EVs. The electric cars/ two-wheelers, authors found performance considerations such as comfort, quietness, ease of driving an automatic transmission, and conveniences of use are predominant factors influencing the adoption. Similarly, a study carried out by (Xian Zhang, 2013) found that Chinese consumers prefer performance feature “such as. riding comfort, safety, convenience to use, and operability were found to have an impact on the acceptance of new energy vehicles. The consumer tends to adopt new technology such as EVs when they see the higher performance of the EVs compared to conventional vehicles (Long, 2012). (THOMAS F. GOLOB, 1997), and (Zins, 1997) found out that long charging time and traveling distance as shortcomings for consumer adoption towards EVs. (Achtnicht, 2010) investigated German consumer behavior and found that the majority of the respondents proffered more horsepower (hp) and pickup when making a purchase decision.”

Consumer Awareness towards EVs

EV is a relatively new technology that has captured the attention of customers in the last decade. The study undertaken by (Yong Zhang, 2011) analyzed consumer awareness towards EVs and examined the factors that affect consumers’ choices in China. The Study revealed, government policies, increasing conventional fuel prices and the number of drivers within the household significantly

influence whether a consumer purchases an EV. Age, educational qualification, annual income, number of the family members, maintenance cost, and opinion of peers play a vital role in creating awareness among the consumers (Yong Zhang, 2011)and (McElgunn, 2018). (Labbé, 2013)and (Stephens-Davidowitz, 2014)studied the role of Google trends in influencing customer awareness and in turn to purchase intension towards EVs in the USA. (Kleinberg, 2010)were able to identify the role of social networking sites such as Facebook, Instagram, etc. on growing public awareness about the EVs in the European nations. On flipside study carried out by (Singer, 2017)found that there is a general lack of knowledge and awareness about electric vehicles, and less than 35% of California households are aware of EVs and their benefits (Jonn Axsen, 2012) and (Tal, 2018). Consumers who have exposure to EVs are more likely to value them more highly and consider them as a choice for the future purchase (Kurani, 2016), (Larson 2014) (Gyimesi and Vishwanathan 2011). A wide variety of activities are in practice that helps to reduce consumer barriers related to understanding and awareness of EVs.

Initiatives by NGOs, local and national state agencies, automakers and infrastructure providing companies jointly can focus on the outreach and awareness activities such as clean cities, incentives, tax cuts, etc, are the outcomes of (Bailey et.al. 2015), (Bunce et.al. 2014), (Edwards Turrentine et.al 2016) studies.

Financial Advantage (FA)

Earlier study on EVs indicated consumer interest for vehicles reflected that financial gains are the locus of attraction to buy EVs and they show an inclination towards adopting greener vehicles which could lessen the operational cost of running vehicles and increase fuel efficiency (Malmgren, 2016). (J.-J. Chanaron, 2007) described the rising fuel prices as a critical factor considered by the people. Consumers may be willing to adopt EVs depending upon the direct financial benefits, conveniences/ habits / indirect advantages such as lower fuel costs, reduced energy consumption, and lower maintenance costs. (Mohammed Albrahim1 · Ahmed Al

Zahrani1 · Anvita Arora2 · Rubal Dua2 · Bassam Fattouh3, 2019)

The benefits of EVs may be limited if the buyers use the vehicles for a short-distance commutation (Kenan Degirmenci, 2017). Also, the resale price of EVs as a decision variable in the purchase of the vehicles is considered important. Resale anxiety in the consumers is also a key factor influencing the purchase intension, as they believe that secondary market demand for the EVs is still unpredictable. (Trin Thananusak, 2017)

The price of the EVs is considered to be the main component which is negatively influencing the consumer to buy electric vehicles as the cost of Li-ion battery costs more in the present day & age forcing the prospective buyer to elude purchase decision. (Edelstein, S 2017), (Al-Alowi, Brandly T H. et.al 2013)The limited infrastructure support for the charging stations or points, the uncertainty about the running cost and performance, the financial support or facility extended by the institutions, and rate of the interest charged by them in comparison with the conventional energy vehicles, post-sales support, service & maintenance cost are few factors /components which are having considerable influence on the prospective buyer/owner intension to buy Electric Vehicles (EVs) by (Delang C.O and Cheng W.T 2013). But the study carried by (Chanaran and Teske et.al 2007) reveled that rising fuel prices and uncertainty about the fuel availability forcing present generation to consider alternative available in front of them before they make buying decision. Perceived Initial Cost (PIC) and recurring cost of service& maintenance of Electric vehicles adoption are acting as barriers as per the study carried by (Bockarjova, 2014). (JIAN LIU1, 2015) had a similar finding in China.

Environmental Concern (EC):

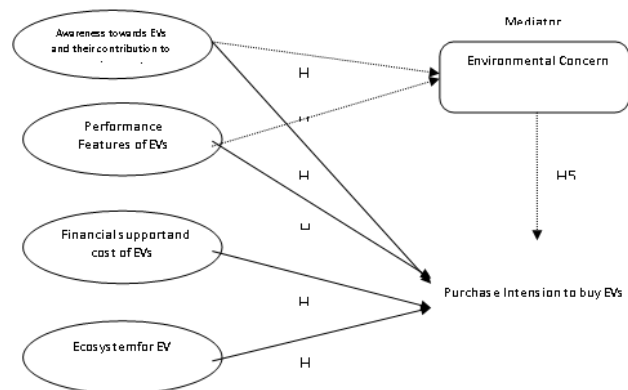
Environmental concern is considered as a degree of people’s knowledge and awareness towards environmental consciousness and support they are ready to provide to preserve the environment and solve problems regarding the environmental issues. Past studies indicated that consumers with stronger concern towards environment or people, who identify and

associate themselves as members of green army or who depict themselves as pro environmentalist are more likely to adopt the EVs in comparison to others. (Banerjee,2009)(Krause, 2013) Sensitivity to climate change issue and inclination towards energy conservation thoughts act as explicit dimensions of the environmental concerns. A study by (Laroche, 2001) considers environmental concerns to have direct and indirect effects on the consumer willingness to purchase green products at a premium price. Rising fuel prices, new technology in the vehicles, influence the purchase of the EVs and hybrid vehicles (Muehlegger, 2011) seconded by (Geertje Schuitema, 2013). Similarly (Erdem, 2010) studied the willingness to adopt the energy-efficient cars in Turkey, found that people with pro-environmental behavior likely to purchase EVs in comparison to traditional vehicles which run on the non- renewable energy.”

Eco-system for EVs:

Infrastructural support and Government policies towards EVs are driving factors in consumer purchase intensions of whether to buy or not to buy vehicles running on the new technology are revealed in the study carried out by the (Traber, 2012).

Theoretical framework (Fig.2)



S No	Constructs
1	Awareness towards EVs and their contribution to the environment
2	Performance Features of EVs
3	Financial aid and Cost of EVs
4	Ecosystem for EVs
5	Pro-Environmental Behavior

6	Purchase intension to buy EVs
S. no	Proposed Hypothesis
H1	“Awareness towards EVs and their contribution to the environment has a significant positive relationship with purchase intension for EVs”
H2	“Performance features have a significant and positive relationship with purchase intension for EVs”
H3	“Financial factors have a significant and positive relationship with purchase intension for EVs”
H4	“The ecosystem support positively influence the purchase intension for EVs”
H5	“Pro-environmental behavior has a significant positive relationship with purchase intension for EVs”
H6	“Concern towards environment mediates the relation between performance and purchase intension for EVs.”
H7	Concern towards environment mediates the relation between product awareness and purchase intension for EVs

IV. Methodology:

Research methodology briefs the methods and procedures adopted in collecting and analyzing the data to arrive at meaningful inferences. This study focuses on determining the factors that drive the e-vehicle purchase intent among potential Indian consumers. Potential Indian consumers refer to young consumers who are going to be potential users of the E-vehicles. Hence the researchers choose the respondents who were in the age group of 18 to 25 years. In India, EVs are scarce on the road and are not available readily in the market (Anil Khurana 2019). Because of this, it is critical to build the study by gathering the data from the consumers in India. The research model envisages the empirical approach. Hence the data required was gathered through a self-administered and structured questionnaire. The items used in the questionnaire are all based on literature and were close-ended questions. Initially, the questionnaire was reviewed by 4 subject experts for its content and face validation as recommended (Zaich kowsky 1985). The questionnaire was subjected to a pilot test and

based on the feedback, necessary changes were incorporated. Cronbach’s test was used to test the reliability of the items. The respondents were asked to reply to a questionnaire on a 5-point Likert scale which ranged from strong disagreement (1) to strong agreement (5).

Sampling method and size: A sample size of 384 was finalized based on the (Raosoft, 2004) and (Morgan, 1970) table as the total population was huge. Initially, 400 questionnaires were mailed to the respondents of which 384 were selected owing to the inadequacy of the 16 questionnaires. Both online and offline modes were used to collect the data. Multi-stage sampling was adopted for sample selection as recommended (Ackoff 1953). Initially, 10 cities of Karnataka were selected, and further in the second stage samples were selected randomly. Since the multi-stage sampling offers the benefit of saving time and expenses, the method was selected.

V. Data Analysis

This research adopted structural equation modeling (SEM) to identify influence of different parameters on purchase intention. SEM permits estimating different dependent and independent relationships simultaneously. As prescribed by Hair et al. (1998), a Dual-step model building process was deemed to be appropriate. The two steps consist of the assessment of the constructs and the path model. Initially, confirmatory factor analysis was carried out and subsequently the model was subjected to structural assessment in line with the envisaged hypotheses using AMOS (version 20). Structural equation modeling offers multiple benefits as it assesses the effect of one construct on the other and it does so simultaneously when multiple constructs are involved. It is considered as a more powerful method than multiple regressions by several researchers. Structural equation modeling is a very effective tool to understand and interpret very intricate relationships. It

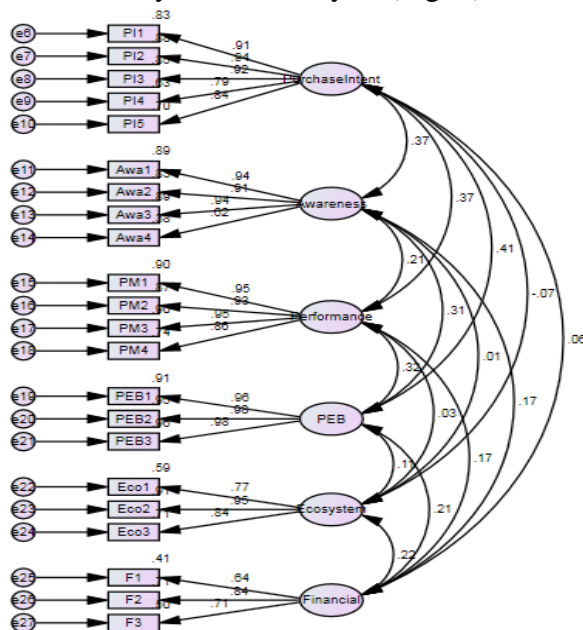
The Measurement Model

A brief explanation of the different variables that are critical to the present study has been covered in the literature review. A 5-point

Likert rating system was employed to assess all the items reflecting the various constructs. Reliability and validity assessments were done to verify the measurement model. Environmental concern was measured using a 5-item scale as used by (Yusof et al., 2014). The scale for financial aid and cost was adapted from Sweeney & Soutar, 2011 which comprises of 4 items such as “I think the subsidy policy for purchasing EVs is sufficient”, “I know well about the subsidy policy for purchasing EVs”, ‘Subsidy policy and preferential tax policies are important for me to purchase EVs, ‘the overall cost of owning an electric vehicle is cost-effective’. The items for performance were drafted from Sweeney & Soutar, 2011. “Knowledge and awareness about electric vehicle” construct was measured using the scale which was derived from Zografakis et al. (2010). Ecosystem variable was measured with, the three items taken from Axsen and Kurani (2013), it mainly collected one piece of information about access to residential recharge infrastructure. We used those three items to test the good construction of charging infrastructure, which has a positive effect on willingness to purchase electric vehicles. Finally purchase intention was measured with the (Zia-Ur-Rehman & Dost, 2013)- 5 items.

latent constructs included; purchase intention scale of 5 items), Degree of knowledge & awareness (scale of 4 items), performance (4-item scale), pro environmental behavior (scale of 3 items), ecosystem (scale of 3 items) and financial aid and cost (scale of 3 items). The CFA result revealed an acceptable fit to the data: $\chi^2 = 341.902$, degrees of freedom (df) = 194, normed $\chi^2 = 1.762$, adjusted goodness-of-fit index (AGFI) = 0.903 and comparative fit index (CFI) = 0.982. Similarly other measures such as GFI = 0.926 and root mean square error of approximation (RMSEA) = 0.045 were also within the prescribed band. The respective t-values of all items were significant ($p < 0.001$). Prior literature review shows that the metric values obtained in the CFA were within an acceptable band (Byrne 2001; Hair et al. 2010). The factors loadings of all the items corresponding to their constructs were adequately above .6 thresholds as recommended (Hair et al., 2010). Factor loadings of the items ranged from .619 to .980. The study further considered the reliability and validity of the constructs. Reliability was assessed through the composite reliability, a measure to assess the consistency of the items reflecting a construct. Similarly, the validity of convergence and discriminant was also carried out.

Confirmatory Factor Analysis (Fig: 3)



A total of 6 constructs envisaged for the study were part of the measurement model. The

Composite reliability is another variant of measuring uni-dimensionality among the items associated with a latent construct. It indicates the consistent among the items measuring a latent construct. Values above 0.6 indicate good convergent validity (Bagozzi 1988).

Convergent validity assesses whether two measures of a construct that are theoretically supposed to be measuring the latent variable are indeed measuring that variable. To gauge the convergent validity, we assessed the factor loadings and average variance explained as suggested (Forenell and Larcker 1981). Average Variance Explained (AVE) is the amount of variance The values of factor loading are supposed to be above .6, which was met by all the indicators in our study. The higher the factor loadings, the higher is the connection between the variable and the latent construct.

Convergent Validity- (Table -2)

	Item	Factor Loadings	CR Composite Reliability	AVE Average Variance Extracted	MSV
Ecosystem for EV	Eco1	.770	0.892	0.735	0.048
	Eco2	.951			
	Eco3	.841			
Purchase Intent	PI1	.911	0.888	0.726	0.171
	PI2	.939			
	PI3	.923			
	PI4	.795			
	PI5	.836			
Awareness	Awa1	.942	0.920	0.746	0.093
	Awa2	.909			
	Awa3	.941			
	Awa4	.620			
Performance	PM1	.947	0.958	0.851	0.103
	PM2	.930			
	PM3	.947			
	PM4	.862			
Pro Environmental Behavior	PEB1	.956	0.980	0.942	0.171
	PEB2	.975			
	PEB3	.980			
Financial Advantage	F1	.641	0.776	0.539	0.048
	F2	.842			
	F3	.705			

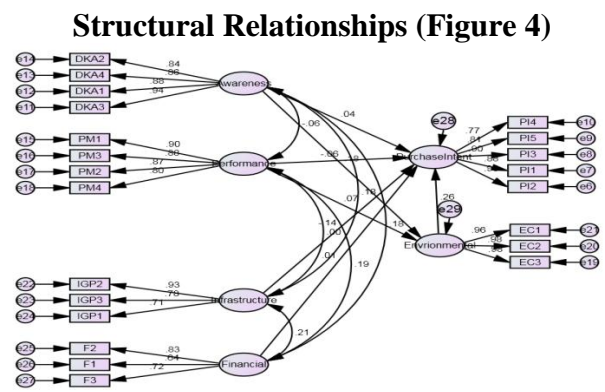
Discriminant validity: The second test that the constructs have to undergo for validation is the discriminant validity, which signified the uniqueness of each of the constructs. Discriminant validity ensures that each of the constructs under the study is unique and the measures of each of the constructs do not overlap with the measures of any other construct (Schwab 2005). It can be evaluated by comparing the variance captured by the latent construct with that of the shared variance of other latent constructs. Discriminant validity was validated by Fornell & Larcker, (1981). Table 3 depicts correlation among the constructs in the model, with the square roots of average variance explained (AVE) on the diagonal of the table. All of the diagonal values are greater than the non-diagonal values and therefore it satisfied the test of discriminant validity (Farnell & Larker 1981). Discriminant validity was evaluated by comparing the AVE of each latent construct with the square of correlations between the other latent constructs (Fornell & Larcker,

1981). As evident from Table 3, the assessment of the data provides the Discriminant validity for all of the latent constructs. The AVE of each latent construct was greater than its shared variance with any other latent construct. It can be claimed based on the above results that each of the construct is unique and has no link with the other latent constructs (Lings, 2005).

Discriminant Validity of the constructs- (Table-3)

	Ecosystem	Purchase Intent	Awareness	Performance	PEB	Financial
Ecosystem	0.857					
Purchase Intent	0.071	0.852				
Awareness	0.011	0.370	0.863			
Performance	0.035	0.373	0.215	0.922		
PEB	0.113	0.414	0.305	0.321	0.970	
Financial	0.219	0.063	0.171	0.174	0.214	0.734

Structural Model Results: The hypotheses were analyzed by running a structural equation modeling technique with a maximum likelihood estimation technique. Owing to the confirmatory nature of the study, a covariance-based SEM approach was used (Hair et al., 2011). The indices of the structural model showed χ^2/df (1.788), GFI (.924), AGFI (.901), NFI (0.958), and CFI (.981), RMSEA (.045) which satisfactorily fit the indices as recommended (Hair et al., 2011). Further, the research hypotheses were verified with the path analysis.



Path Analysis & Hypotheses Testing (Table-4)

		Estimate	S.E.	C.R.	P	Results of Hypotheses
Purchase Intention	<--- Awareness towards EV	.218	.044	4.925	***	Accepted
Purchase Intention	<--- Performance	.264	.053	4.955	***	Accepted
Purchase Intention	<--- Financial Supp & Cost	-.098	.088	-1.121	.262	Rejected
Purchase Intention	<--- Ecosystem	-.129	.060	-2.132	.033*	Accepted
Purchase Intention	<--- Pro Environmental Beh	.255	.045	5.715	***	Accepted

*** p < 0.001; *p < 0.05; sig= significant

It is noticeable from the path analysis, that awareness towards electric vehicles has a significant and positive influence on purchase intention. Similarly, performance features of the electric vehicles have a positive impact on purchase intention as posited in several prior studies. Interestingly, financial advantage and cost factors did not seem to have any influence on purchase intention. The electric vehicle ecosystem had a positive and substantial influence on purchase intention. Pro Environmental Behavior has a positive and substantial influence on purchase intention.

Examining the mediating effects

Structural equation modeling enables a researcher to study the mediating effects of the constructs. An indirect effect is observed when a variable affects an endogenous variable through its influence on some other variable, known as a mediating variable. (Agresti & Finlay, 1997). A mediation analysis was

carried out as prescribed Preacher and Hayes (Preacher, K. J. (2015), Hayes, A. F. (2009).

Mediating Effect – (Table 5)

Hypothesis	Direct effects (X-Y)	Indirect	Result
Performance à Pro Envnt Beh à PI	.243*** (Sig)	.076*** (Sig)	Partial Mediation
Awareness à Pro Envnt Beh à PI	.241*** (Sig)	.070*** (Sig)	Partial Mediation

*** p < 0.001; *p < 0.05; sig= significant

The indirect path can be observed after conducting the bootstrapping procedure. The rule of thumb says, if both the direct and indirect effects are significant, then there is a partial mediation if the direct effect is not significant and if the indirect path shows significance then there is a full mediation

Indirect Effects of the Different Paths- (Table 6)

Parameter	Estimate	Lower	Upper	P	Result of Hypotheses
Performance → Pro Env't Beh → PI	.082	.052	.122	.001***	Accepted
Awareness → Pro Env't Beh → PI	.063	.040	.097	.000***	Accepted

*** $p < 0.001$; * $p < 0.05$; sig= significant

Hence it is evident from table 5, that there is partial mediation of pro environmental behavior between performance and purchase intention, and on the other hand it appears that environmental concern is fully mediating the relationship between awareness and purchase intention. Similarly, pro environmental behavior plays a partial mediation between awareness about electric vehicles and purchase intention. The upper bound limit and a lower bound limit for both the indirect paths does not contain zero, indicating significance.

VI. Results & Discussion

The path analysis shows that hypothesis 1 is supported in our study. Awareness about the availability of EVs and the environmental problems associated with conventional vehicles is an important influence in the Purchase intention. When a person is not aware of the availability of EVs and the environmental damages caused by carbon emission from fossil fuel vehicles, then the Purchase Intention would be weak.

Our second hypothesis that performance features of EVs have a significant and positive relationship with purchase intentions of EVs is also accepted. This indicates that alternative solutions to current transport solutions must fulfill the performance criteria of the current solutions. If their performance falls short of conventional vehicles, that would discourage people from using them.

The third hypothesis was that financial factors have a significant influence on the intention to purchase EVs. This hypothesis was rejected in our study. In current times when there is increasing affluence in Indian society, the vehicles being bought are not the ones which are the cheapest. Advanced features and Technology is a prime consideration when buying vehicles. The rejection of this hypothesis shows that this thinking is bound to be extended towards EVs. There is no reason

why the purchase of EVs will be done considering the price and financial advantage alone.

Our fourth hypothesis is accepted by the study. This very clearly shows that unless Indian cities and rural areas support the use of EVs, with charging stations, repairing workshops, and availability of spare parts, it is unlikely that EVs will be considered as a suitable alternative to conventional transport. It is thus important that the government encourages the establishment of an enabling ecosystem for the diffusion of EVs in India.

Our fifth hypothesis is also accepted in our study. Our questionnaire tested were various aspects of pro environmental behavior in the respondents. We can say that those respondents who demonstrated pro environmental behavior more likely to purchase EVs.

The sixth hypothesis for the study was the mediating role of the PEB between awareness and purchase intention and it turned out to be partial mediation. It is evident that there is some indirect effect through the intervening variable PEB.

Similarly, the final hypothesis for the study was the mediating role of the PEB between performance and purchase intention and that too turned out to be a case of partial mediation. Again, there is some mediating effect of PEB displayed in the overall relationship.

VII. Recommendations

The data gathered from the study and the literature review carried out by us helps to make several recommendations to improve the diffusion of EVs in Indian society. It is clear that various stakeholders will be either beneficiary of or contributors to the EV market in India.

We make recommendations for some of these stakeholders.

For government and policymakers:

1. We consider it very important that civil society at large is made aware of EVs and their benefits to the environment and therefore human health. At the same time, the problems associated with fossil fuel use must be communicated in school education and True mainstream media. This is possible at the state level and City or village administration level.
2. Our study shows that a pro-environmental solution must match the performance of conventional solutions. It is thus critical that the government encourages the development of EV technology to match or improve upon the current transport solutions. When the demand for conventional vehicles is large and growing then the mainstream vehicle manufacturers are likely to channelize their research and development activities in improving the current solution. However, if there is a government incentive towards the diffusion of EV Technology, they will likely undertake EV development, to bring it at par with conventional vehicles.
3. From our study, it is clear that for EV purchase to be accepted in society there must be a suitable ecosystem. Here again, the government has a role. Without any EVs plying on the road, it is difficult for private operators to put up charging stations or repair shops. However, if the government steps in to help private operators for setting up such enabling infrastructure, then the diffusion of EVs is likely to be faster.

For civil society

1. It is important that the next generation should be made aware of the ill effects of

fossil fuel vehicles. Every vehicle added in the country will contribute towards polluting the air we breathe. Our transport choices have a significant effect on the quality of the air. An informed society is likely to make choices that are better for the environment.

2. It is not just the government which can diffuse the EV technology in society. if people start buying EVs then answer papers and companies will be encouraged to put up an enabling ecosystem.

For EV manufacturers

1. These manufacturers have a large role to play in educating society. Advertisements and communication programs aimed at reducing vehicular pollution will contribute in a significant way to the diffusion of EV technology.
2. Our study shows that performance is a very important criterion in EV purchase intentions. Manufacturers should not just look at keeping costs down but must focus on matching the performance with the conventional transport vehicles.
3. Promoters should also focus on PEB as an important element in their narration, as it is found to be partially mediating the relation between the (exogenous variables); performance & awareness, and the (endogenous variable) purchase intention.

As the population of India grows and cities get larger, the need for individual transport is found to increase. If we are not able to reduce conventional vehicles and the use of fossil fuels in the transport sector it is highly likely that the pollution levels will rise and directly impact the health of the nation.

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FOOD SUPPLY CHAIN DISRUPTIONS AS A RESULT OF COVID-19**Anupam Saxena¹, Preetam Suman², Puneet Rai³**¹ Associate Professor, Operation Analytics, Jaipuria Institute of Management, Lucknow, India² Assistant Professor, Business Analytics, Jaipuria Institute of Management, Lucknow, India³ Associate Professor, Marketing, Jaipuria Institute of Management, Lucknow, IndiaEmail: ¹anupam.saxena@jaipuria.ac.in, ²preetam.suman@jaipuria.ac.in, ³puneet.raai@jaipuria.ac.in**ABSTRACT**

Food supply chains are the most significant piece of economic and human activity during the COVID-19 pandemic. It has also generated considerable interest from researchers, practitioners and policy makers to explore the major challenges posed by the pandemic in the food supply chain. Consequently, the purpose of this work was to examine key supply chain challenges related to COVID-19. using a systematic inventory of literature published in interdisciplinary journals. Thirty-one documents were selected using a research protocol which assisted in the selection and identification of research documents coded using qualitative Atlasti 9.0 software. Determining which supply chain challenge among disturbances, predictions and inventories was the most researched in the literature. The results of the software coding revealed that the disturbance was coded 170 times, while the forecasts 10 times and the inventory 37 times were food supply chain management (GSA) challenges. As a result, it was concluded that most researchers view disruption as one of the significant challenges in the food supply chain. Further coding also revealed that segregation and work problems were the primary reasons for disrupting the food supply chain.

Keywords: Covid-19, Disruption, Lockdown, Labour issues, Food Supply Chain Management

I. Introduction

The pandemic, which has been going on for more than a year, has changed the lives of people everywhere. It has impacted every aspect of life and every business. There is no element of society that is perfect as a result of COVID-19. The most important food of all endurance exercises is that which has been seriously influenced by the effects of this pandemic. Global food supply chains have solved tough problems.

These issues have happened because of different reasons like absence of estimating, unexpected change in political choices, severe limitations in the development of individuals and products, lockdowns, transport and coordinations being bungled because of deficiency of HR. This burden of cause significantly affects the food inventory network, and exploration has shown that this effect leads to a lack of food and food security. This work needs to investigate the critical difficulties of the food inventory network exhaustively with the assistance of a precise writing survey and recognize the reasons for store network issues and which significant store network issue has been broadly considered by writing.

For this reason, a precise writing survey was directed, 56 papers were gathered and in light of the exploration convention 31 examination papers distributed between March, 2020 to January, 2021 were chosen and investigated for store network issues like disturbances, gauging and stock.

The main finding was that the disruption is considered a more critical issue in the store network, unlike anticipation and inventory. Additionally, the documents were coded due to interruptions during the COVID-19 pandemic. It was found that most newspapers viewed lockdown and restriction of people and products and lack of work as critical reasons for interruption.

II. Systematic Literature Review

The work performed in close proximity follows a specific audit of the writing as a philosophy of the examination. This examination procedure has been generally acknowledged in the area of inventory network the executives and is being utilized by creators like Aria and Cuccurullo, 2017; Kamal and Irani, 2014; Pereira, Christopher and Lago Da Silva, 2014; Petticrew, 2001; Queiroz et al., 2019; Queiroz et al., 2020; Schanes, Dobernick and Gözet, 2018; Tachizawa and Wong, 2014.

Weasel (2005) defines written verification as "an effective, explicit, wide-ranging, and reproducible strategy to distinguish, evaluate, and integrate the current collection of finished and recorded documents. The Work of Scholars, Researchers and Experts" (Okoli, 2015). The study of the precise philosophy of writing auditing helped the specialist with the reasoning that this procedure is suitable for the kind of exploration this work means leading. To lead the editorial audit, a keyword search was conducted that included expressions such

as "Coronavirus food inventory network", "Pandemic and horticulture inventory network sway", "Food production network issues during Covid-19". Thought was given to documents being distributed about food inventory network issues focusing on COVID-19. Modified works of the selected documents were read for more in-depth agreement, and documents were chosen based on the exploration convention noted below (Table 1 and Figure 1).

Table 1: Research protocol

Serial Number	Research Protocol	Descriptions
1	Research Databases	Elsevier, Wiley, MDPI, Cambridge University Press, Springer, Taylor & Francis, BSAAE, Oxford University Press, FRM, JAFSCD, Nature publishing group and much more.
2	Publication Type	Peer-Reviewed journals
3	Language	Only English-language documents were taken into consideration.
4	Date Range	Between March 2020 and January 2021.
5	Search terms	The food supply chain related to COVID-19, the implications of the pandemic and the agricultural supply chain, the food supply chain issues during the pandemic.
6	Search fields	Headline and key words.
7	Inclusion requirements.	Documents dealing with food supply chain disruptions during the COVID-19 pandemic.
8	Analysis and synthesis of information.	Used Atlasti 9.0 Qualitative software version 9.0 was used to carry out the encoding.

After selecting research papers based on the protocol mentioned above, it was found that thirty-one research papers were most relevant in the context of the current study (table 2 & figures 2a & 2b). It was also observed that Sustainability Journal published by MDPI has a maximum number of papers, followed by journals like the Canadian Journal of Agricultural Economics published by Wiley and the Journal on Food security by Springer, as depicted in figures 2a & 2b. These journals and editors were appropriate to the scope of the current study and presented articles on the topic of the food supply chain. An important observation was that most of the journals were interdisciplinary and were not specific to supply chain and operations management; however, they gave valuable insights about disruptions in food supply chain management.

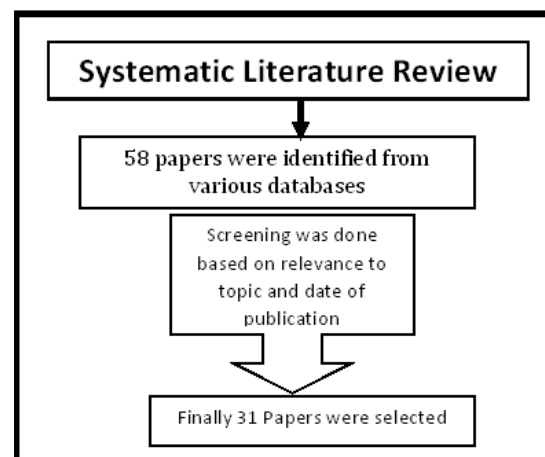


Figure 1: Research protocol

The selected articles came from a mixed category of journals, giving us a holistic picture of how disruptions have been studied across all disciplines, particularly in the context of the pandemic.

Table 2: List of Selected Journals and Publishers

Journal Name	Publisher	Number of articles
American Journal of Agricultural Economics	Wiley	1
Asian Journal of Economics, Business and Accounting	Asian Journal of Economics, Business and Accounting	1
Canadian Journal of Agricultural Economics	Wiley	3
Current Research in Behavioral Sciences	Elsevier	1
Current Research in Environmental Sustainability	Elsevier	1
Discussion paper series in Economics	Ashoka University	1
Economics of Agriculture	BSAAE	1
European Journal of Risk Regulation	Cambridge University Press / European Journal of Risk Regulation	1
Food Quality and Safety	Oxford University Press	1
Food Security	Springer	2
Foods	MDPI	1
Foods and Raw Materials	FRM	1
International Journal of Production Research	Taylor & Francis	1
Journal of Agriculture, Food Systems, and Community Development	JAFSCD	1
Journal of Integrative Agriculture	Elsevier	1
Nature Food	Nature	1
Outlook on Agriculture	Sage	1
PLOS ONE	PLOS ONE	1
Progress in Disaster Science	Elsevier	1
Sustainability	MDPI	7
Transportation Research Part E	Elsevier	1
Trends in Food Science & Technology	Elsevier	1

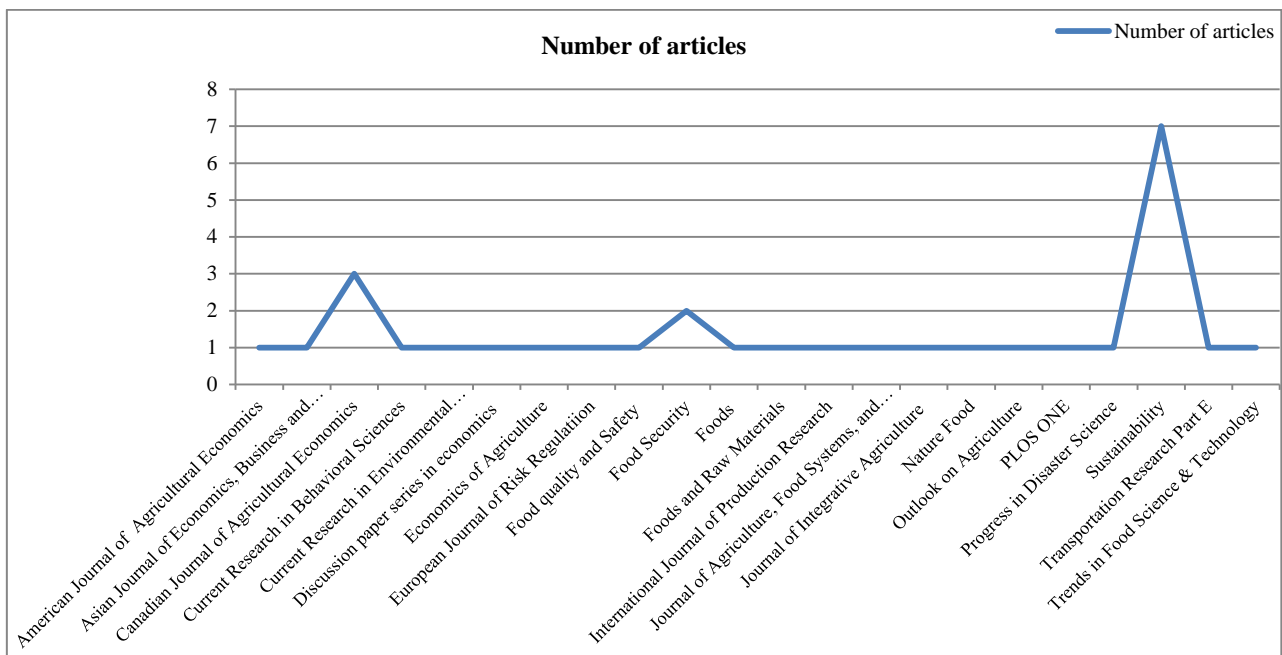


Figure 2a: Number of articles in selected Journals

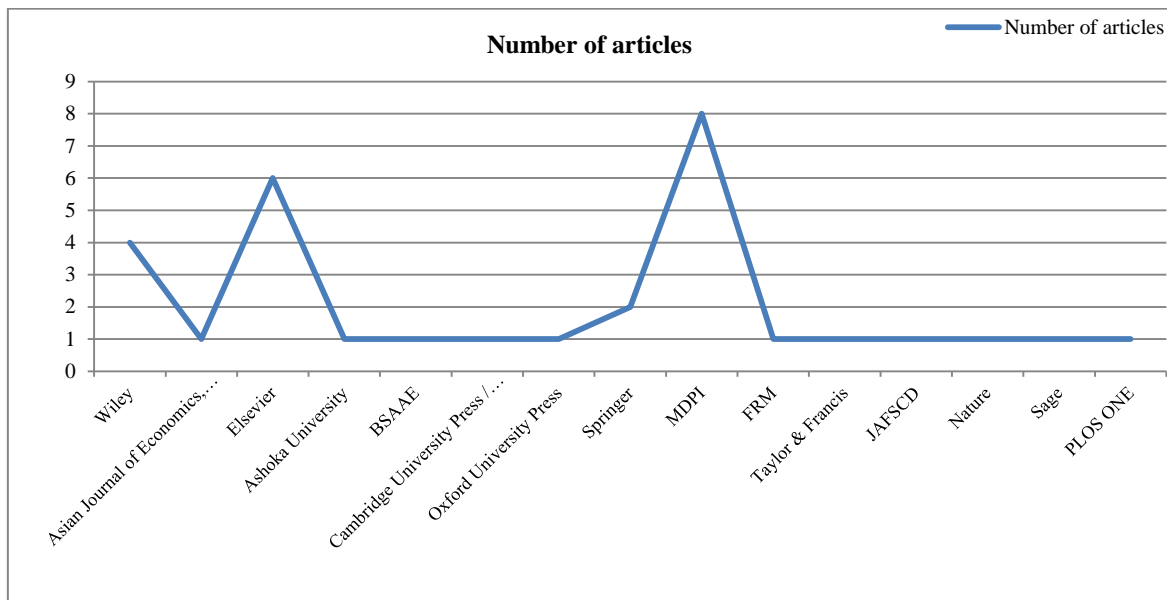


Figure 2b: Number of articles in selected Journals

III. Literature Review

Disruption to the store network may result from normal and man-made disasters. A few calamities have happened around the world, similar to the torrent in Japan in 2011, the tidal wave in 2004 and the Gujarat seismic tremor of 2001 (Gou and Lam, 2019), prompting store network disturbances in the food and farming industry previously. However, these interruptions were not similar to the disturbances caused by the COVID-19 given that the effect of COVID-19 is felt globally simultaneously and comparative limitations are obliged to travel the entire world for a long period of more than a year. There is no guarantee that the pandemic will end because it changes its variations and structures. Subsequently the handling of this is most convoluted contrasted with another kind of fiascos.

Coronavirus has affected each circle of human existence, and the food inventory network isn't immaculate by the effect (Sowinski, 2020; Workie et al., 2020). As properly said by Szegedi, 2021 "Coronavirus pandemic have definitely affected the fundamental progression of food from homesteads and makers to buyers" This has seriously affected food supply chains, the lockdown has "allegedly prompted gigantic interruptions in worldwide and homegrown stock chains", and accessibility of food items that were obtained from distant spots got seriously affected because of

disturbance in the inventory network brought about by the limitations (Mahajan and Tomar, 2021). Particularly, "work lack because of COVID-19 emergency caused extreme interruptions in certain areas like domesticated animals creation, cultivation, planting, gathering, and harvest handling which are generally work escalated" (Stephens et al., 2020). Subsequently the manipulation of this is more intricate contrasted with another kind of fiascos. (EDP, 2020) as referred to in (Aday and Aday, 2020a).

In addition, the coronavirus pandemic "has had an enormous impact on food trade and disrupted the food store system due to product limitations. Limited commodity agreements have increased the world costs of staple foods such as wheat, corn and rice. These have led to a reduction in the amount and type of food consumed" as reported in (Aday and Aday, 2020a). The financial mess caused by the pandemic is hampering access to money and real access to food. Interruptions and potential problems with advertising, coordination and exchanges may limit entry to food at certain locations and times. As a consequence, hunger and unhealthy conditions can develop (FAO, 2020).

Food supply anchors need to acclimate to changing interest by alarm purchasing and change in food purchasing behaviors and supply disturbances because of deficiencies of labor force and work (Hobbs, 2020).

This important literature has highlighted the manner in which food supply chains have been disrupted by containment and other restrictions of this kind. Scientists recognized the disruption as the key challenge of the food production system during the pandemic.

IV. Results & Discussion

The literature review conducted for thirty-one papers from reputed journals and publishers (Table 2) was conducted to analyse which supply chain challenge is the most prominent one in Covid-19 and which food supply chain risk has been significantly studied and identified by the literature. As discussed above, thirty-one papers were coded through qualitative software Atlas ti 9.0 for three types of common food supply chain risks, namely: forecast, inventory and disruption through the coding method. It was observed that the thirty-one research papers considered disruption as the significant supply chain risk or challenge for food supply chains against forecasting and inventory (as depicted in figures 3 and 4). In 31 documents, the disruption was coded 170 times compared to the predictions, which were coded only 10 times and the inventory only 37 times. The statistics generated from qualitative software also clearly indicate that most papers have discussed disruption and risk, meaning that disruption is the primary food supply chain risk during the Covid-19 identified by the literature (as depicted in figures 5 and 6).

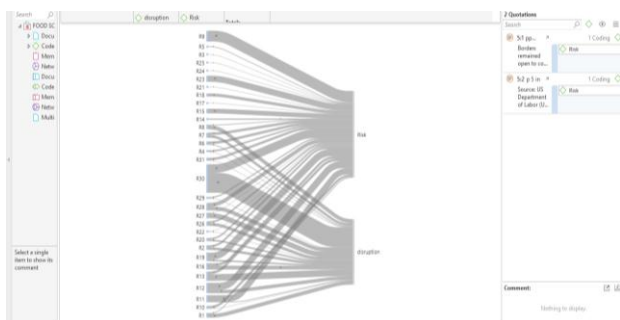


Figure 3: Output from the software depicting the relationship between risks and disruptions

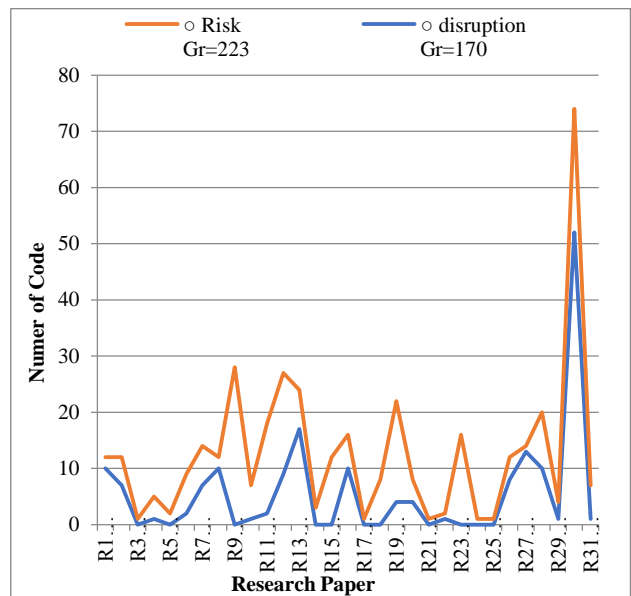


Figure 4: Graph depicting coding trend of risks and disruptions

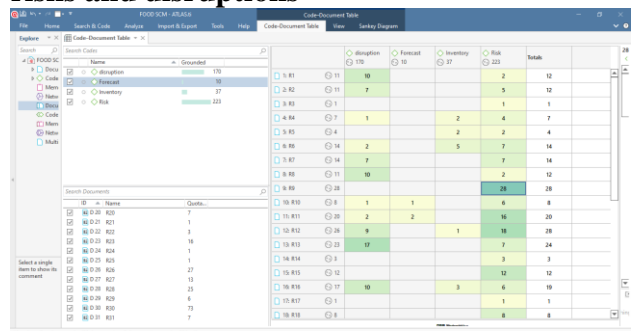


Figure 5: Output from the software depicting the relationship between disruptions, forecasting and inventory with risks

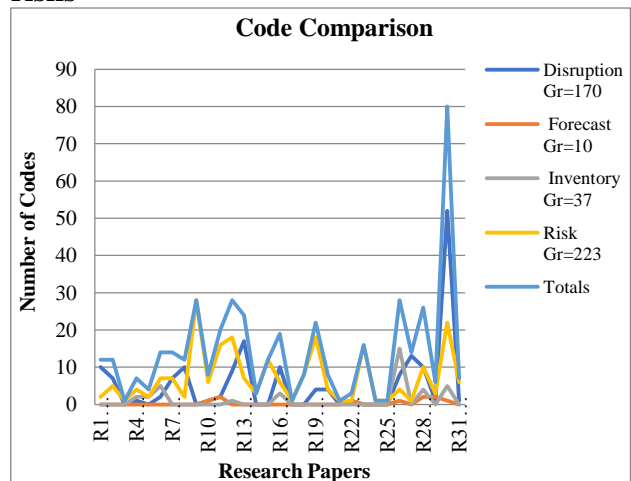


Figure 6: Graph depicting coding trend for three types of risks

After identifying disruption as a significant risk for the food supply chain, the work also wanted to look at the critical factors of disruption during the Covid-19 for the food supply chain

in the thirty-one papers selected for review. For this purpose, further coding was being conducted, and it was found that most researchers had a common understanding about the fact that lockdown and labour issues are the significant reasons for disruption of food supply chains (figures 7 and 8). Mahajan and Tomar, 2021 quantified that "the level of disruption in food supply chains in India as a result of the containment imposed by COVID-19 is high. Their work suggests that "disruptions in the supply chain during barricaded containment are likely to be more serious for products that travel long distances."

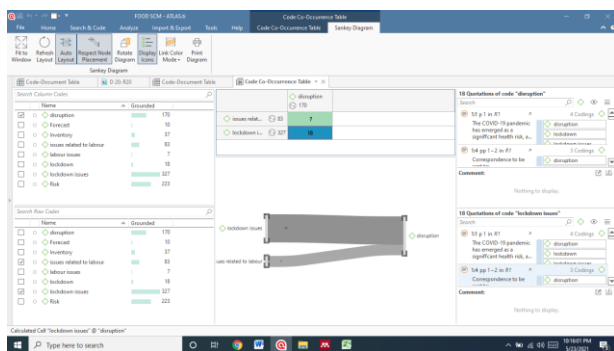


Figure 7: Output from the software depicting the relationship between disruptions, lockdown and labour issues

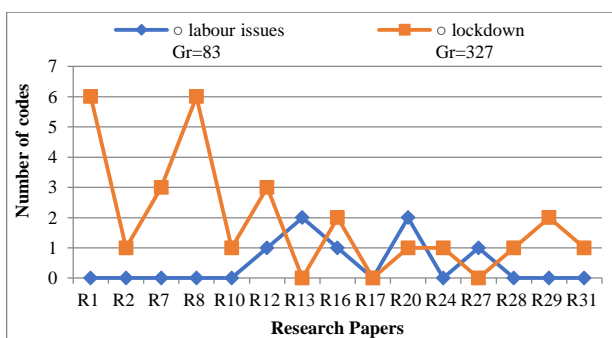


Figure 8: Graph depicting coding trend for labour and lockdown

According to Workie et al., 2020, the lockdown has severely impacted the income and availability of food items due to disruptions that have affected the food supply and buying patterns, thereby indicating that disruption and lockdown affect food supply chains.

In underdeveloped and developing countries, temporary employment is common, especially in the processing and transportation of harvests, affecting supply chains. Restrictions imposed by solitary confinement may affect

the availability of migrant labour and disrupt production and overall CMS. Shortage of labour due to Covid-19 has shown a lot of impact on food production processes at the farm level, leading to delaying the final product availability and disrupting the processes (Stephens et al., 2020). Restrictions imposed by lockdown can affect the availability of migrant labour and disrupt production and CMS in general. Shortage of agricultural labourers can severely disrupt field operations, considerably reduce agricultural production and increase food insecurity at local levels (Savary et al., 2020). The shortage of labour due to lockdown restrictions in India has severely disrupted certain food items supply chain, raising the whole sale and retail price of common used food commodities like pulses, flour, and vegetables (Cariappa et al., 2021).

As we can see from the systematic literature review, most articles viewed disruptions as an important issue and risk to food supply chains. Disruptions have been identified and studied in the selected research papers, which also state that lockdown and shortage of labour are essential concerns during the Covid-19 crisis for food SCM disruption.

V. Conclusion

The COVID-19 crisis has created havoc and uncertainty around the world. It has changed the way people live and operate productively. All spheres of human life have been deeply affected by the pandemic, and food supply chains have not been spared. They have faced many types of challenges, and it has been difficult to manage the entire production system and food supply. The work in progress was aimed at studying the significant risks or challenges facing the CMS during the COVID-19 pandemic, which were discussed by the academic authors. For this purpose, a systematic literature review was conducted for thirty-one research papers published in reputed journals coded through qualitative software Atlas ti 9.0, revealing that disruptions in the food supply chain are the major challenge compared to other commonly known difficulties of food supply chain forecasting and inventory. After learning about the significant challenge, further analysis was undertaken to determine the primary reasons

for the disruption during the COVID-19 pandemic. Coding through the software also revealed that labour confinement and unavailability were the major causes of disruption to food-borne LCH.

VI. Recommendations & Directions for Future Research

Since Covid-19 is a pandemic affecting food security and people's lives, the government should take care of policies that can stop or deal with disruption for a long time because short-term policy planning is not effective in Covid-19, which does not seem to end soon. Second, strict provisions should be made to deal with the labour shortage and the crisis caused by the unavailability of labour during

harvest and seeding seasons. "Governments should also develop and apply emergency sourcing strategies to support production. Temporary input subsidy programs are expected to protect areas hardest hit by the epidemic. Early support is essential for the spring planting season" (Aday and Aday 2020b).

Future research can investigate other supply chain risks, in addition to disruptions, forecasts and stocks, to see if they have an impact similar to that of disrupting food supply chains. Dietary BSM can be studied and compared with well-established frameworks such as Chopra & Sodhi, 2004.

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Annexure 1: List of Research Papers used for Systematic Literature Review (SLR)

Sl. No	Journal Name	Publisher Name	Title of the Paper	Reference
R1	American Journal of Agricultural Economics	Wiley	Covid-19 and Supply Chain Disruption: Evidence From Food Markets in India	(Mahajan & Tomar, 2021)
R2	Asian Journal of Economics, Business and Accounting	Asian Journal of Economics, Business and Accounting	COVID-19 and Supply Chain Disruption: A Conceptual Review	(Odunayo & Victor, 2020)
R3	Canadian Journal of Agricultural Economics	Wiley	The impact of COVID-19 on the grains and oilseeds sector	(Brewin, 2020)
R4	Canadian Journal of Agricultural Economics	Wiley	Food supply chains during the COVID-19 pandemic	(Hobbs, 2020)
R5	Canadian Journal of Agricultural Economics	Wiley	COVID-19 impact on fruit and vegetable markets	(Richards & Rickard, 2020)
R6	Current Research in Behavioral Sciences	Elsevier	Impact of COVID-19 in food supply chain: Disruptions and recovery strategy	(Barman et al., 2021)
R7	Current Research in Environmental Sustainability	Elsevier	Deciphering the impact of COVID-19 pandemic on food security, agriculture, and and livelihoods: A review of the evidence from developing countries	(Workie et al., 2020)
R8	Discussion paper series in economics	Ashoka University	Here Today, Gone Tomorrow: COVID-19 and Supply Chain Disruptions	(Mahajan & Tomar, 2020)
R9	Economics of Agriculture	BSAAE	Uncertainty in SMES' Assessment of Coronavirus Pandemic Risk Impact on Agri-Food Sector in Western Balkans	(Popović et al., 2020)
R10	European Journal of Risk Regulation	Cambridge University Press / European Journal of Risk Regulation	The Covid-19 crisis: An opportunity to integrate food democracy into post-pandemic food systems	(Petetin, 2020)
R11	Food quality and Safety	Oxford University Press	Impact of Covid 19 on Food supply chain	(Aday & Aday, 2020a)
R12	Food Security	Springer	Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks	(Béné, 2020)
R13	Food Security	Springer	Mapping disruption and resilience mechanisms in	(Savary et al., 2020)

			food systems	
R14	Foods	MDPI	The Food Systems in the Era of the Coronavirus (COVID-19) Pandemic Crisis	(Galanakis, 2020)
R15	Foods and Raw Materials	FRM	Food safety practices in catering during the coronavirus COVID-19 pandemic	(Mayurnikova et al., 2020)
R16	International Journal of Production Research	Taylor & Francis	Impact of COVID-19 on logistics systems and disruptions in food supply chain	(Singh et al., 2021)
R17	Journal of Agriculture, Food Systems, and Community Development	JAFSCD	Pandemic and food security: A view from the Global South	(Zurayk, 2020)
R18	Journal of Integrative Agriculture	Elsevier	Impacts of the COVID-19 pandemic on vegetable production and countermeasures from an agricultural insurance perspective	(Gu & Wang, 2020)
R19	Nature Food		Towards food supply chain resilience to environmental shocks	(Davis et al., 2021)
R20	Outlook on Agriculture	Sage	Impact of COVID-19 on the Indian agricultural system: A 10-point strategy for post-pandemic recovery	(Cariappa et al., 2021)
R21	PLOS ONE	PLOS ONE	Impact of COVID-19 on vegetable supply chain and food security: Empirical evidence from Bangladesh	(Alam & Khatun, 2021)
R22	Progress in Disaster Science	Elsevier	Global food security in the context of COVID-19: A scenario-based exploratory analysis	(Udmale et al., 2020)
R23	Sustainability	MDPI	Impact of the SARS-CoV-2 on the Italian Agri-Food Sector: An Analysis of the Quarter of Pandemic Lockdown and Clues for a Socio-Economic and Territorial Restart	(Barcaccia et al., 2020)
R24	Sustainability	MDPI	Food First: COVID-19 Outbreak and Cities Lockdown a Booster for a Wider Vision on Urban Agriculture	(Pulighe & Lupia, 2020)

R25	Sustainability	MDPI	Growing and Eating Food during the COVID-19 Pandemic: Farmers' Perspectives on Local Food System Resilience to Shocks in Southern Africa and Indonesia	(Paganini et al., 2020)
R26	Sustainability	MDPI	Managing a Sustainable and Resilient Perishable Food Supply Chain (PFSC) after an Outbreak	(Zhu & Krikke, 2020)
R27	Sustainability	MDPI	The COVID-19 Induced Disruptions across Groundnut Value Chain: Empirical Evidence from South India	(Mahajan & Tomar, 2021)
R28	Sustainability	MDPI	The Compounded Effects of COVID-19 Pandemic and Desert Locust Outbreak on Food Security and Food Supply Chain	(Xu et al., 2021)
R29	Sustainability	MDPI	Towards Territorially Embedded, Equitable and Resilient Food Systems? Insights from Grassroots Responses to COVID-19 in Italy and the City Region of Rome	(Zollet et al., 2021)
R30	Transportation Research Part E	Elsevier	COVID-19 pandemic related supply chain studies: A systematic review	(Chowdhury et al., 2021)
R31	Trends in Food Science & Technology	Elsevier	Safety of foods, food supply chain and environment within the COVID-19 pandemic	(Rizou et al., 2020)

A RESTING STATE FMRI ANALYSIS AND PREDICTION OF AUTISM USING VOXEL BASED FEATURE EXTRACTION AND GRNN-LSTM FRAMEWORK

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ABSTRACT

The brain analysis for complex neurological disorder is made possible through fMRI images. Many research work continued with task fMRI for understanding various behavioural patterns of brain. Different task may lead to different patterns which may not be a consistent approach in decoding the brain. Through rs-fMRI analysis of the brain is now taking a stand for clinical traits. The rs-fMRI can be treated as independent analysis of brain, away from any particular type of task performed behavioural patterns. The rs-fMRI can be a promising cognitive biomarkers providing realistic benefits as it can be performed for any population with less setup and non expertise can handle it. It looks for statistical reliance between time series. In this work, voxel based- Independent Component Analysis (ICA) method is used for feature extraction from 4-D rs-fMRI images and further adopted a robust Neural network model LSTM for classifying the autism case from the healthy controls. fMRI images are a time function data which discloses the brain connectivity over time. LSTM neural network model features time course data analysis. LSTMs Positivity in temporal data analysis are exploited in the proposed framework out-performing an accuracy of 78.9% for 400 samples, experimented over rs-fMRI data for better classification of Autism (ASD) from the healthy controls.

Keywords: Long Short Term Memory-LSTM, Autism Spectrum Disorder-ASD, independent component analysis-ICA, Resting state-Functional Magnetic Resonance Imaging-rs-fMRI.

I. Introduction

The rs-fMRI plays its significant role especially when the subject is not able to perform the task for examining the task based fMRI analysis and also when the scope of the data available for the task -fMRI is constrained. The brain intrinsic functional connectivity is well assessed by the rs-fMRI image. It becomes easy dealing with rs-fMRI, as the data availability is surplus and complex analysis is possible. According to [1] the author concludes that the functional networks seen in active brain is also evidently dynamic for the resting state fMRI. The Basic unit for functional networks are neural connections that exist in both functionally active and rest state. In [2]-[3] Intrinsic nature of the brain is accurate when the brain is at rest. Further several network images of interest can be derived in the rest condition to use it as reference or masks of region of interest analysis. For prospective neuroimaging the masks derived during rest can be used as a seed to analyse the other networks. The inherent issues of the brain will be well understood in the intrinsic mode. The rs-fMRI data and Human Connectome Projects started gaining its

importance in depicting the internal architecture and functional connectivity of the brain [4]

The Functional connectome measure is usually quantified through the pearson's coefficients. But these coefficients are to standardized to overcome the bias of the sample correlation errors or the variance cluttering because of Fisher's transformation[5]. Further they have proposed an effective degree of freedom correlation correction to mitigate the issue of bias and variance. In [6] the significance of rs-fMRI assessment is observed noting increased connectivity between basal ganglia and visual cortex in normal children compared to the individual with motor impairments. The individuals with lot of brain connectivity [7] in resting state shall not be able to increase the efficiency of the network connectivity while transitioning from the the rest to the task mode. Resting state fMRI is congruous across the subjects. Feature extraction is performed using data driven approach Independent Component Analysis (ICA). There are two analytical way of executing feature curing, Functional Segregation (FS) and Functional Integration(FI). The FS mainly helps in the understanding of local function of specific ROI

in the brain, basically used for mapping of the brain. whereas the latter FI focuses on the functional relations or connectivity thus providing the inference about connectivity of the brain. The functional connectivity measure of FI can be done through density analysis, ROI based, ICA based and graph based. In [8] ICA is adopted to reduce the complexity of dimension and further Gated Recurrent Unit is used to classify the ICA extractions achieving 72.2% of accuracy of classification of diseased from that of normal subjects. ICA is an efficient way of analyzing the neuroimage data[9]. ICA is a [10] probabilistic model which separates out the whole brain network into independent connectivity networks showcasing the Blood Oxygen Level Dependent(BOLD) activity. The measure of independence between the network is the cost function of the ICA. In [11] this paper, Z score is used as correlation descriptor parameter and holds no statistical description. Also ICA adopts higher order statistics that can reveal their dependencies. With the feature extraction next step would be to classify the diseased from normal individual. An experimental implementation of autoencoder [12] along with Convolutional Neural Network(CNN) is used achieving the accuracy of 84%. Another [13] framework of 3 dimensional CNNs and 3 dimensional Convolutional Long short Term Memory(LSTM) applied on publicly accessible ABIDE Dataset performed F1 score of 0.78 and 0.7 scores on NYU site and UM site respectively. Other than Deep Neural network, in [14] a novel framework of Deep Transfer Learning (DTL) is used for different site data, wherein the UM site depicted better accuracy of ASD classification of 70.4%.

All the above works indicates that the neural activity in the whole human brain is best measured in a non-invasive way, through fMRI. Establishing functional connectome among neurons gives insight of brain development. The subject interested in this work is ASD(Autism Spectrum Disorder) which relies on the connections established between neurons. In general, the Autism depicts largely as a disorder in the functional connectivity. The correlation build between functional networks [15] over the time would help in getting the functional connectivity

information about the ASD. Many Machine Learning Models [16] are used over the ASD data to classify from Typical controls. In this work, since the dataset is 4-dimensional data where the 3-dimensional are spatial data and it is learnt with respect to time stamp. So, it's a combination of spatial information and temporal information. As time is involved in the data it is quite impossible to handle them with conventional neural network models or any superior neural model. In that direction Recurrent Neural Network(RNN) would be the better option.

II. Proposed Methodology

The fMRI data is accessed from the publicly available ABIDE datasets. The preprocessed data was accessed from Connectome project (<http://preprocessed-connectomes-project.org/>). The Dataset used is preprocessed with a standard format Brain Imaging Data format (BIDS) which are organized in a structured manner. The 4-dimensional data has time stamp variations from 82 to 320 time stamps. The Field strength of MRI scanner is 3T. The proposed LSTM-RNN scales better option in learning fMRI data by keeping their contextual information of the data. The voxel size of the data used is about 3mm^3 and typically the image contains $73 \times 61 \times 61$ voxels over the time stamps of 196. Fig. 1 showcase the general workflow of the proposed method.

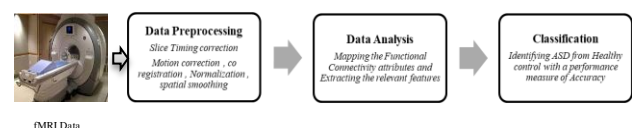


Fig. 1 General Dataflow of the proposed method

III. Feature Extraction

Extraction of features in resting state data is unbiased connectivity measure, hence the Resting state Networks(RSNs) are identified explicitly through Brain map database related to functional imaging that includes around 30,000 Human Connectomes. Smith et.al.,[1] introduced that rs-fMRI is able to point the brain activity network pattern that matches with task based, hence widely accepted for implication. This led to fast publications in the field of rs-fMRI in PubMed and so on. The resting state functional MRI data cannot relate

the active brain region at any time stamp with that of output, hence the data is not labeled. Therefore the resting state data learning [17] is UnSupervised learning. The Functional connectivity realm is now crafted by using a data driven approach of finding the similar functional voxels at a given time. In Neuroimaging, ICA [18] is the best approach of crafting the functional connectivity realm based on time stamps. Through BrainMaps Projects, smith et.al. atlas of 20 and 70 decompositions are chosen to understand the functional connectivity realms of the resting state fMRI data of ABIDE. The Fig. 2 shows the 20 decomposed components through ICA approach of the given data. In the proposed framework of feature extraction the process of feature extraction are well depicted in the Fig. 2

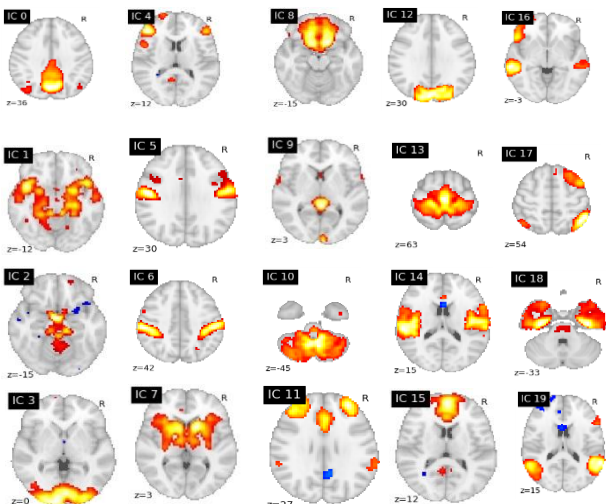


Fig. 2 fMRI data decomposed into 20 independent components through Independent Component Analysis

IV. Classification

After the feature extraction, the functional connectivity features are fed to the GRNN-LSTM model for classifying the ASD from the healthy controls. GRNN-LSTM is best as it take cares of time attributes and also the confounds of the resting state GRNN-fMRI data. Because the confounds will make the model to keep track of the textual information which is well taken by the GRNN-LSTM model. Also the GRNN-LSTM adopts back propagation through time(BPTT) to adjust the weights of the model. There are possiblility of the weight adjustment leading to very small value called vanishing gradient and other

extreme to very high value called exploding gradient. To overcome this the model will include optimized adaption of the gradient descent and overfitting is overcome by dropouts inclusion in the GRNN-LSTM model.

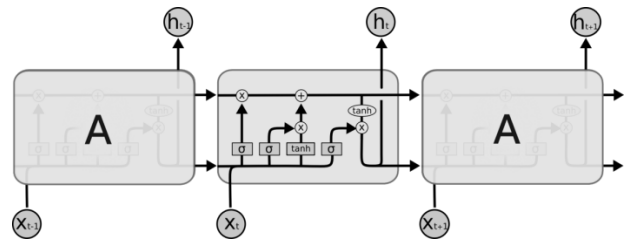


Fig. 3 Internal Architecture of GRNN-LSTM Model (Source: Medium.com)

The GRNN-LSTM model as in Fig. 3 is built to classify ASD from healthy based on its functional connectivity attributes and its temporal dependencies. The architecture of the GRNN-LSTM used is illustrated in Fig 4a and 4b, including 3 hidden LSTM layers and one fully connected dense layer. The three hidden layers are used to encode the functional connectivity information with its temporal information at each point and the fully connected dense layer is used to delineate between the learned feature and the state of the brain. Further the functional connectivity representations are calculated as below equations.

$$f_t^l = \sigma(w_f^l \cdot [h_{t-1}^l, x_t^l] + b_f^l) \tag{1}$$

$$i_t^l = \sigma(w_i^l \cdot [h_{t-1}^l, x_t^l] + b_i^l) \tag{2}$$

$$\tilde{C}_t^l = \tanh(w_c^l \cdot [h_{t-1}^l, x_t^l] + b_c^l) \tag{3}$$

$$C_t^l = f_t^l * C_{t-1}^l + i_t^l * \tilde{C}_t^l \tag{4}$$

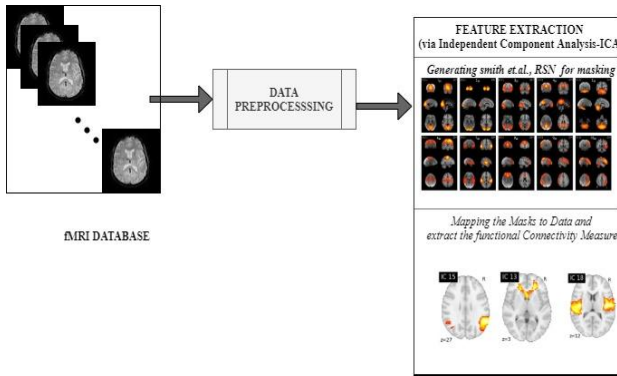
$$O_t^l = \sigma(w_o^l \cdot [h_{t-1}^l, x_t^l] + b_o^l) \tag{5}$$

$$h_t^l = O_t^l * \tanh(C_t^l) \tag{6}$$

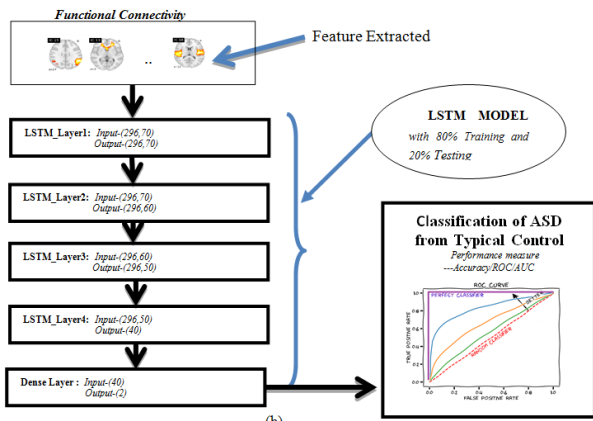
$f_t^l, i_t^l, C_t^l, h_t^l, x_t^l$ denote the output of forget gate, input gate, cell state, hidden state and the input feature vector of 1th GRNN-LSTM layer at the tth time stamp respectively. Where $l=1,2,3$

Equation 1 is a forget gate layer of LSTM including the relevant information and excluding the irrelevant by boiling down to value between 0 and 1. Zero significe to

completely exclude the feature and one signify to completely include. Equation 2 and 3 tags as input gate layer accounting for selection of the value to be updated using sigmoid function and then create new vector cell values C_t^l .



(a)



(b)

Fig. 4a. Pipeline of the Proposed framework for Feature Extraction

Fig. 4b. Pipeline of the Proposed framework for ASD Classification from Healthy Controls using ICA-GRNN-LSTM Model

V. Results and Discussion

The measure of the classification derived from True positive Rate and False Positive Rate relation Curve as depicted in Fig 5.

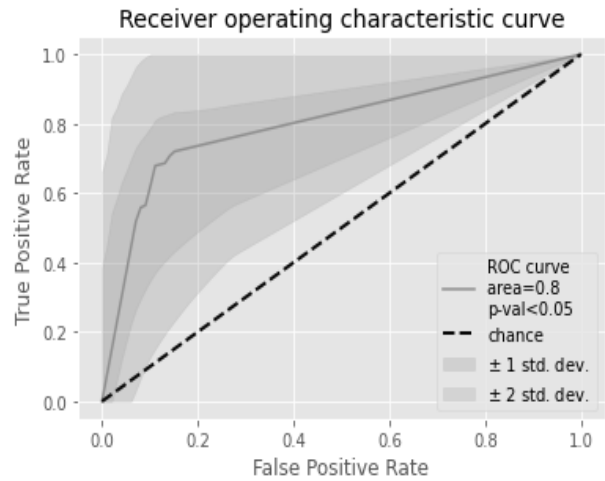


Fig. 5 Receiver Operating Characteristic Curve with AUC of 0.8

The proposed GRNN-LSTM Model stamps its score with accuracy of 78.8% , the Area Under Curve(AUC) measures 0.80 with the p-value of 1.81×10^{-5} . The p-value signifies the statistical significance which should be typically < 0.001 . The p-value obtained from the Receiver Operating characteristic curve plugs its value below the typical value.

The observation in Table.1 shows the comparison of the result [19-20] with other related works to prove the stat-of-the-art. As expressed in the table different models are compared with single site as well the multisite. Since the work done is on multisite and the comparison holds good with the multisite performance measures. Because the multisite would give the model performance more towards the generality as it should handle wide variety of data for modelling.

The Multichannel Deep Neural Network in[21] could achieve 70.7% accuracy in classifying the ASD from the healthy control. Various Machine learning models and neural network models are used to bringout better classification of ASD. But all these models lack handling the time stamps, hence GRNN-LSTM model would prove better way to handle time based data.

Table 1. Comparison of various framework with proposed framework.

RESULT COMPARISON TABLE					
	DATA	MODEL	SUBJECTS	ACCURACY	F1-SCORE
Leonardo Cerliani et al [13] 2019	ABIDE	3DCNN C-LSTM	AUTISM-184 CONTROL-110 TOTAL-294	NYU-77% UM-71%	NYU-0.78 UM-0.70
Heinsfeld et al [19] 2016	ABIDE	SVM	AUTISM-505 CONTROL-530 TOTAL-1035	MULTISITE 65%	-
		RF		63%	-
		DNN		70%	-
Marcel Bengs [20] 2020	ABIDE	CNN3D-TC	TOTAL-184	NYU-57%	0.61
		CNN3D-MS		NYU-60%	0.65
		convGRU-CNN3D		NYU-67%	0.71
PROPOSED FRAMEWORK	ABIDE	ICA-LSTM	AUTISM-176 CONTROL-124 TOTAL-300	MULTISITE 73%	0.68
		ICA-LSTM	AUTISM-205 CONTROL-195 TOTAL-400	MULTISITE 78.9%	0.8

VI. Conclusions

The proposed GRNN-LSTM model with multisite dataset could perform the accuracy of 78.9% of accuracy in classifying the autism subject from that of the healthy control. In comparison of other related works, achieving good accuracy with Multi site data base can arrive the Model to more generality and make its performance more robust. In this work 4-dimensional fMRI data is preprocessed in a standard format so as to extract the features and train the model for classification. The number of samples from the multisite taken are 400 samples, 205 ASD individuals and 195 Healthy individuals. With reference to the comparison

Table 1, Leonardo Cerliani et al gained an accuracy at 77% but it was confined to single site NYU of ABIDE. Therefore the proposed GRNN-LSTM model excels its performance of multisite to 78.9% accuracy of classifying ASD from the healthy control. Further, the GRNN-LSTM model can be trained for more samples of multisite and can achieve more generality and robustness in classification of Autism. Early diagnosis of higher side of Autism is becoming more important to address this complex neuro developmental disorder to make the ASD individual an better individual to face challenges in the society.

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RAILWAY PRIVATISATION IN INDIA

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ABSTRACT

Indian Railways (IR) is in for change over next few years. Major policy changes are recommending towards private participations. IR is currently inefficient in meeting requirements which is evident from irregularity in traffic distribution between Roadways and Railways which is at 70% to 30%. Economic Survey (2017-18) highlighted that increasing competitiveness from other modes of transport has resulted in IR slowdown. Hence recent policy changes encouraging privatization.

This paper examines different modes of providing railway infrastructure in India, ranging from government owned to railways built/upgraded through Public Private Partnerships(PPP). Paper also include analysis of railway infrastructure by benchmarking against railway infrastructure in China, Europe. Benchmarking parameters considered are rail network penetration, electrified network, fares, speed, safety, operating ratio.

IR are behind foreign peers in terms of infrastructure and performance. Implying government has to take coercive action to improve their state. Budgetary support worth Rs 5,21,608 crore aims for such actions. Government is still in a learning mode as far as railway infrastructure provision is concerned. Governments ability to garner support for initiatives like Station Redevelopment, Private Trains, Catering Services, Kisan Rail through PPP mode will outline growth of railways.

Keywords: Privatization, PPP, Benchmarking railways

I. Introduction

Indian Railways (IR) is one among the largest rail network in the world. USA, China, Russia are among the others who are having large rail network infrastructure. The Indian Railways rail services are run by the Railways Board and have a clear authority over the entire infrastructure. The proportion of traffic from railway sector has largely moved towards other modes of transport like airways and roadways in the recent decades. The lack of efficiency and upgradation in terms of infrastructure and services provided by the IR is one sole reason for this change. Moreover, the financial state of the IR has been following a deteriorating trend and has resulted in substandard infrastructure while comparing with other modes of transport. Indian Railway is centralized when it comes to judgement regarding matters related to its operations. The zonal and divisional benches are not given much liberty in matters relating the financial segment.

Rail Networks Length: Indian Railways has a rail network of about 67,416 km of route length of which BG covers 62,891 km, MG covers 2,839 km and NG 1,686km. Of the total route length 24,412 km has tracks with multiple

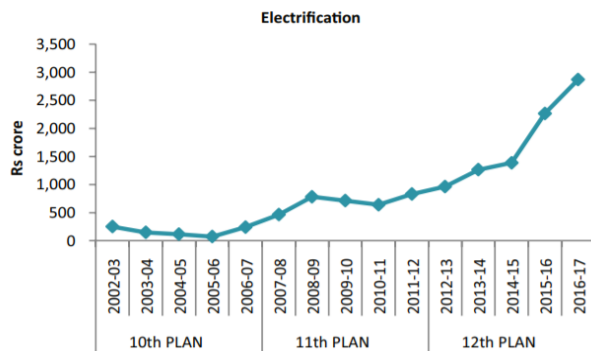
lanes. 34,319 km of route length is electrified. India's track density at 45.74 per square km.

Railways runs about 9,200 freight trains daily and 13,300 passenger trains, which caters to 7,200 stations. Railways on average carry around 300 thousand tonnes of freight, 23 million passengers on a particular day. 19,133 people are having access to service provided by IR per km in India.

Electrification Network: Electrified network on Indian Railways has accounted to 34,319 km out of the total rail network of 67,415 km as per reports on March 2019. The statistics above dictates that 50.91% of the railway network is electrifies as of March 2019. The electrified routes can be further categorized as, passenger traffic being 56.2% and freight traffic being 65.4%. The fuel cost on electric traction accounts to only 33.2% of the total cost incurred as fuel costs by the Indian railways. The next major milestone of Indian Railways is to attain 100% electrification of BG routes by 2021-22.

Indian Railways infrastructure development plan identified electrification as a key domain that requires sudden upgradation. The pace of electrification has increased in the last 4-5 years which is backed by increased fund allocation. Indian Railways main aim is to

reach an electrification rate of 90% of the total railway routes.



Electrification of Indian Railways

Speed: The rail network density clearly depicts the potential IR is having, however the speed of movement of the locomotives on the network are substandard.

Average Speed of Passenger Trains (Indian Railways) = 60-70 kmph

Average Speed of Passenger Trains (Developed Countries) => 200 kmph

Average Speed of Freight Trains (Indian Railways) = 25-30 kmph

Average Speed of Freight Trains (Developed Countries) => 100 kmph

The locomotives in developed countries have attained speed of 200 kmph for conventional passenger trains. Certain countries are also equipped with high speed trains as well touching high speeds of 300-350kmph

When it comes to high speed train, there is high end requirements in terms of infrastructure like tracks which are dedicated to attain such high speeds, could be elevated or fenced, etc. All these requirements can only be met with heavy capital investments. This is where the Indian Railways falls behind. The capacities of trains being over stretching, tacks of poor infrastructure and traffic which is mixed proportioned has caused the Indian trains to run at lesser efficiencies. The incompetency in infrastructure facilities has in turn affected the superfast services namely as Durgam, Rajdhani and Shatabdi. These high speed trains on providing services along with other incompetent services in turn affects their schedule and hence not able to meet the actual requirements that were to be catered by the high speed services.

Fares: The operating ratio of Indian Railways have been crossing the 90% mark repeatedly in the past years. Operating ratio is a factor which clearly depicts whether the services are profitable or not. High operating ratio clearly depicts that Indian Railways operational surplus is not enough to meet their requirements. Even though the income from services has been continuously meeting a downward trend the outgoing expenses like pension and staff salary is continuously increasing. Hence the Indian Railways has to rely upon borrowing money. This trend would only result in further financial crisis of the Indian Railways.

On comparing the freight transportation rates among roadways, airways and railways, even though its competitively priced the uncertainty of delivery with railways is higher. This is clearly depicted by the change in industry trends of FMCG and automobile industries. Statistical data also clearly depicts a fall in the freight transport business. The freight traffic has declined from 89% in 1950-51 to 30% in 2011-12. Another reason for the change is the environmental constrain. Freight transport heavily rely on usage of coal as a fuel and the current environmental regulations might clearly affect this.

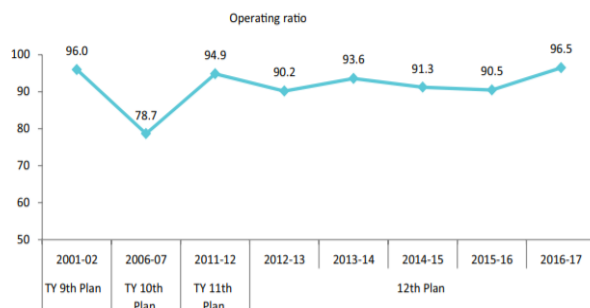
A hike in fare in order to cater the issues is difficult for Railways because of stiff competition from bus fares (roadways) and airlines (airways) is one major issue. Even the slightest of increase could result in losing a large traffic proportion to other modes of travel, which offers services with better last mile connectivity or faster.

Safety: Safety is a key pointer or concern when it comes to any mode of transport whether its passenger or freight transport. The lack of revenue from rail services clearly shows the lack of investment for improvements in the safety mechanism in Indian Railway. Even though the number of accidents followed a downward trend it well above 100 each year indicating the outdated safety systems. Compromises in safety has been unaccounted during the expansion works and the expansion further create heavy congestions creating extra burden on the rail infrastructure and services. New passenger trains being added upon the existing network without providing

capacity augmentation, resources (for operations and maintenance) has led to network safety compromises.

The most recent upgradation in safety criterion was during the Standing Committee on Railways (2016) which identified that the major cause of accidents was due to under investment in the existing rail network infrastructure and services. In order to prevent such issues in coming period required clear improvements in terms of maintenance and infrastructure through heavy capital investment. The priority works in order to improve safety included signaling, level-crossing removals and modernization or renewal of existing tracks. Causes of accidents were mainly derailments (75%). Accidents at level crossings accounted to 19%. The major cause of casualties was derailments.

Operating Ratio: Indian Railways is finding it difficult in order to create expansion initiatives as IR is in no financial position due to increasing expenditures and declining growth in revenues. During the 2016-17 period the permissible limit proposed for operating ratio was between 80–85%, however 96.5% was reported during the same period. For every Rs 100 earned the amount to be spent is defined as the operating ratio. The graph below clearly depicts that the operating ratio is well above 90% in the past decade.

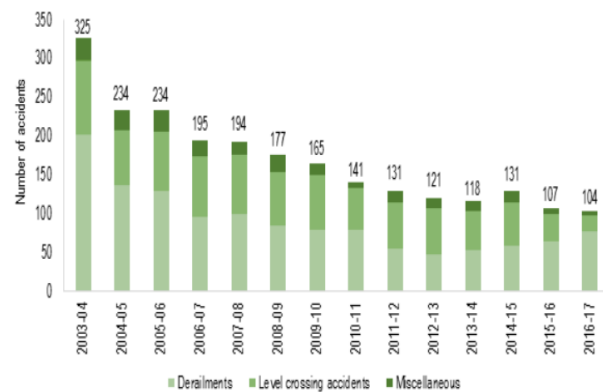


Operating Ratio of Indian Railways

Level crossings: Level crossings are meant in order to facilitate a regulated traffic flow manner governed by specific conditions and rules. UMLCs resulted in major casualties in rail accidents.

Total level crossings = 22388
 Manned level crossings = 21340
 Unmanned level crossings = 1048

A progressive elimination of level crossings is being considered by the Indian Railways to improve the road user and train passenger safety. About 631 manned level crossings and 3479 unmanned level crossings have been eliminated by the period 2018-19. The BG rail routes have completely eliminated unmanned level crossings. Recent innovation for safety was “Automatic Train Protection Systems” which is being implemented in major routes of Indian Railways rail network.



Accident Statistics of Indian Railways

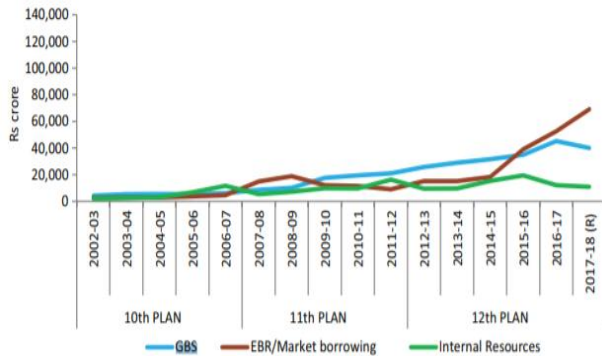
Financial Performance: “Indian Railways rely heavily upon the freight segment in order to meet requirements as well as augmentation of infrastructure. This is based on the fact that freight accounts for about two-thirds of the inflow of funds. Key challenge of Indian Railways is meeting social obligation through cross subsidization of passenger movement and is cited as one of the main reasons for poor financial performance of the organization.”

There key sources of funds are allocation through budget, other budgetary sources through borrowings from market and revenue generation by internal resources from the traffic income.

- “The dependence on other budgetary sources through borrowings from market due to lower share of revenue generation by internal resources in total fund required for infrastructure expansion, is not sustainable.”
- “A sudden spike in revenue generation through internal resources during 2014-15 was a result of increase in tariff rates of passenger and freight services. However, there has been a continuous decline in

revenue generation by internal resources thereafter.”

- The major boost of funds was through budgetary allocation.



Sources of revenue for the Indian Railways

II. Literature Review

The article identifies the effects of privatization on British rail and the corresponding political and economic impacts. The paper reviews not just the subsidies and profitability of privatization, but also on accounting arrangements created. The subsidy schemes of the Network Rail are scrutinized in this article, which enabled to achieve high profitability to train operators without any increase in the direct support from the state. Thus resulted in supporter of privatization claim the British taxpayer is benefited by the train operators. This claim formed the backbone for industry to try privatization which was backed by political parties by neglecting the criticisms.

This research report is based on passenger services in Great Britain being privatized and reorganized. The 1993 Railway Act had enacted privatization of rail services in Great Britain. It was created with an intention to bring about competition in passenger rail services. Off-track and on-track competition were the major areas considered after being privatized. The background resulting in privatization of rail services and the result of off-track and on-track competition analyzed through different models were also covered in the report. The benefits and limitations on privatization of rail services and recommendation on measures to improve rail privatization in Great Britain was also mentioned in the report.

“Privatizing Rail, Avoiding the Pitfalls: Lessons from the British Experience”, Iain Murray, Competitive Enterprise Institute Research Methodology

The research methodology used is comparative research. Indian Railways is compared to that of British Railways in terms of infrastructure and services offered. The major infrastructure measurement criteria are rail network length, electrification network, speed of trains, fares of travel, operating ratio, level crossings, financial performance, etc. The major services measured are for the passenger and freight traffic. Based on the information attained an analysis is carried out on both the Indian and British Railways to identify the limitations and merits of the systems adopted.

Further the research weighs in on the privatizing angle of railways. The scenario of British Railways before and after privatization of its infrastructure and services are researched on. Based on the research the merits and limitations of the British railways after privatization is referred for such initiatives to be incorporated in the Indian Railways. Moreover, the existing privatization initiatives of Indian Railways are also discussed upon.

III. Results and Analysis

A) Indian Railways

Passenger Traffic:“Passenger traffic mainly cater to two modes of traffic. Suburban traffic and non-suburban traffic. Passenger trains which are covering distances of up to 150 km, and are used by passengers to commute within suburbs and cities are classified as suburban trains. Major share of revenue from passenger traffic 94% is coming from the non-suburban traffic and only 6% is coming from suburban traffic in 2017-18.”

Further classification of non-suburban traffic indicated that 67% of the non-suburban revenue was contributed by second class (includes sleeper class). 32% of the non-suburban revenue was contributed by AC class (includes AC 3-tier, AC Chair Car and AC sleeper). Only remaining 1% revenue was contributed by AC First Class (includes Executive class and First Class).

Passenger traffic are sustaining only because of cross subsidies from freight traffic. Indian Railways major proportion of profit is from

freight traffic which accounts for the losses in passenger traffic. The financial statistics of period 2014-15 clearly depicts this scenario.



Passenger Traffic Growth

“In 2014-15, when Railways freight business made a profit of about Rs 44,500 crore, its passenger business incurred a net loss of about Rs 33,000 crore. The total passenger revenue during the period was Rs 49,000 crore. This implies that losses in the passenger business were about 67% of its revenue. Therefore, in 2014-15, for every one rupee earned in its passenger business, Indian Railways end up spending Rs 1.67.”

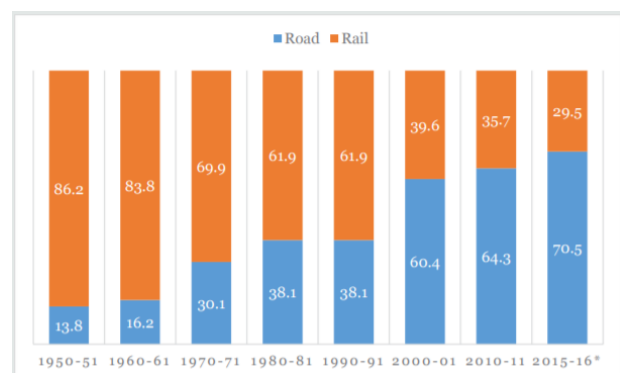
Freight Traffic: “The transport of freight has been undergoing changes significantly nature during the last few decades. The major reason for the change in mode of transporting freight goods was due to the rapid growing economy resulting in exponential growth in the volumes of freight transport. The declining share of freight transport on railways have been capitalized by the road transport sector which have, in the last couple of decades, become the dominant freight transport mode in the country.”



Freight Traffic Growth

However, the IR couldn't meet the requirements and rapid development in the road sector has resulted in rising dominance of freight transportation segment. The share of railways in total freight, in terms of net tonne km has declined over the years. As per the estimates, based on the findings of the Ministry of Road Transport and Highways and the Indian Railways, the share of railway had declined from 39% in 2002-03 to 27% in 2014-15.”

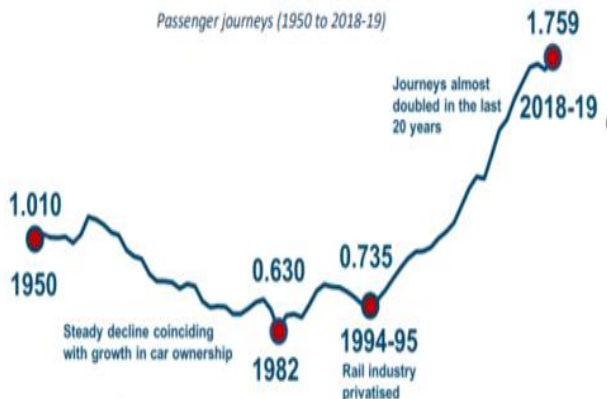
Recent economic survey indicated that the increased competitiveness from other modes of transport has been the major constraint of decline of freight transport using railways. Several other issues like constraints on capacity, financial limitations for upgradation in infrastructure, outdated trunk routes, non-flexible policies, inability to attract traffic through commercial and marketing initiatives.



Distribution (%) of Overall Freight Traffic between the Roadways and Railways

B) British Railways

Passenger Traffic: “British Railways has a track length of 31091 km and 15847 km of route length. By the end of 2018-19 there was a total of 6012 km of electrified route which is 38% of the total railway track. In Great Britain, passenger journeys have doubled over the last 20 years.”



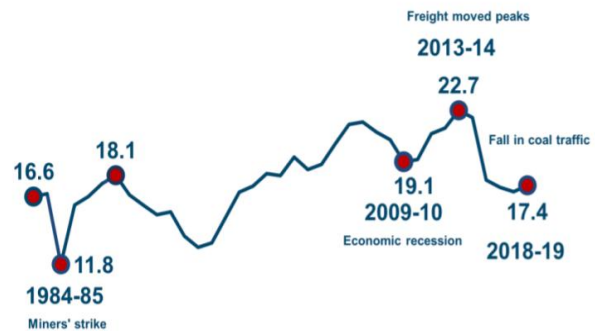
Passenger Rail Usage

The passenger journeys using rails recorded a volume of 1.759 billion during the period 2018-19 in Great Britain. Comparing with the previous year traffic volume a 3.0% increase was shown which was mainly contributed by increase in the passenger volumes in London and South East sector. Revenue growth annually had reached 6.1% which is the highest since 2014-15. This was due to the increased revenue from passenger ridership which incurred a revenue of £10.3 billion during the period 2018-19.

London and South East sector had achieved a 7% rise in passenger revenue due to increased ridership. This accounted to almost half of the total revenue and accounted to £5.1 billion during the period 2018-19. Passenger km during the period 2018-19 was 67.7 billion. During 2018-19, volume of passenger train km amounted to 529 million.

Freight Traffic: During the period 2018-19, the total rail freight volume amounted to 17.4 billion net tonne km. This is increase of 3% compared to the period 2017-18. Since 2013-14 the volume had been on the low until 2018-19. In 2017/18, 7.2 million lorry journeys were avoided as a result of rail freight movements, providing environmental benefits and reducing road congestion

Freight moved (billion net tonne kilometres) 1982-83 to 2018-19



Freight Rail Usage

The reason for decline in freight traffic since 2013-14 was due to environmental actions that resulted in phasing out of coal production in UK. This resulted in the freight services drop by about 85% or more. The recent years have seen a pickup in the volume of freight services as other commodities have found interest in being moved by rail services offsetting the decrease in services that accounted for coal.

Punctuality: Due to large increase in passengers, a 24 % increase was seen in the planned passenger train services since 2009-10. This resulted in increased congestion affecting the punctuality. But in the most recent period 2018-19, a 3% increase in planned train services and a 1.2% improvement in punctuality was seen compared to the previous years.

Passenger Satisfaction: During the period of 2018-19 frequent category of complaint were punctuality or reliability, facilities on board, sufficient room for all passengers to sit and stand. More than 1 in every 5 complaints was about punctuality or reliability.



Passenger Satisfaction Rating

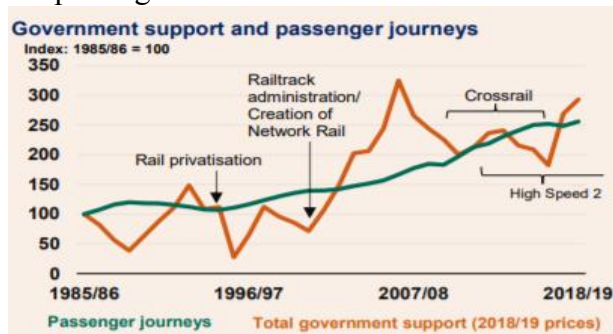
Fares: Fare pricing had created a difficulty among different income levels. The ones earning high were seen making thrice the travel than that taken by the ones in lower income level. Rail user population were mainly

managers and professionals. Unemployed ones used buses rather than railways.

Rail Investment and Subsidies: In the recent year's government support has increased due to new infrastructure projects like the "Cross rail" and "High Speed 2" projects. Since mid-1980s the government support has increased in accordance with passenger journeys.

Government Support and Passenger Journeys

Safety: The safest mode of transport was rail in Europe as it had the least rating of 0.3 fatalities per billion passenger miles. During the past 12 years no casualties have been reported from a mainline train accident. This decrease in rate of accident is despite the fact that passenger traffic has increased drastically. Major cause of fatalities is by public trespassing's.



IV. Discussions

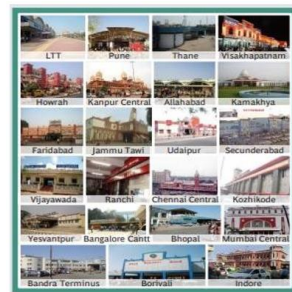
A) Government Privatisation Initiatives

Station Redevelopment Programme: "The Indian Railways has more than 8,000 stations, which are classified into seven categories as per their annual earnings from passenger traffic. In June 2015, the railways proposal to redevelop A1 and A category stations (about 400 stations) was approved by the Union Cabinet. Parties interested could submit their designs and business ideas through open bids, duly providing for amenities and other requirements of the railways."

"Accordingly, the Station Redevelopment Programme was launched in February 2017. In the first phase, 23 railway stations were selected for redevelopment by individual zonal railways and PSUs in collaboration with state governments, the Ministry of Defence, the Ministry of Urban Development and other ministries. The Indian Railways has more than 8,000 stations, which are classified into seven categories as per their annual earnings from passenger traffic."

"Accordingly, the Station Redevelopment Programme was launched in February 2017. In the first phase, 23 railway stations were selected for redevelopment by individual zonal railways and PSUs in collaboration with state governments, the Ministry of Defence, the Ministry of Urban Development and other ministries."

"Further, the Indian Railway Stations Development Corporation Ltd (IRSDC), a JV of Icon International and Rail Land Development Authority (RLDA), was entrusted with the redevelopment of 12 stations: AnandVihar, Bijwasan, Chandigarh, Habibganj, Gandhinagar, Nagpur, Gwalior, Baiyappanahalli, Amritsar, Shivaji Nagar, Surat, and Gandhinagar (Jaipur)."



Stations selected initially under Phase I of Station Redevelopment Programme

"On July 4, 2016, an agreement was signed between the IRSDC and the Bansal Group for the redevelopment and modernisation of Habibganj railway station located in Bhopal, Madhya Pradesh. Habibganj is the first station to be redeveloped through PPP under the Station Redevelopment Programme. The total estimated cost of station redevelopment is Rs 1 billion and of commercial development is ~Rs 3.5 billion. As on December 31, 2018, 70% of the redevelopment work (civil works) has been completed. The redeveloped station is expected to be ready by December 2019."

"On January 3, 2017, the Gandhinagar station project was awarded on engineering, procurement and construction (EPC) basis to Kunal Structure India Pvt Ltd. As on December 31, 2018, 82% of the work (civil works) was completed. The Rs 2.50 billion project is an SPV between IRSDC and the Gujarat government. The redeveloped station is expected to be ready by September 2019."

“Further, in October 2018, the Union Cabinet approved the redevelopment of 600 railway stations by the IRSDC as the nodal and main project development agency. The programme has been tweaked with simplification of procedures, adapting various business models and a longer lease tenure of up to 99 years with option of subleasing. Also, the Ministry of Finance has given approval for station redevelopment as an infrastructure project, thus paving the way for enhancing private sector interest.”

“The IRSDC, being the nodal agency, will prepare the strategic and business plans for individual or a group of stations, ensuring cost-neutrality of the programme. Upon approval of business plans by the MoR, the IRSDC or other project development agencies will take up the work of redevelopment.”

B) Privatization of Catering in Trains

Mobile Catering Services: Catering services in Indian Railways is being provided by IRCTC in about 460 passenger service trains with pantry wagons like Rajdhani, Shatabdi, Durgam, Gatimaan Express and Mail/Express train. Passenger trains that were introduced recently like Vande Bharat Express and Tejas Trains also has catering services provided by IRCTC. The mentioned trains have on board pantry wagons taking care of the catering services in their respective trains.

Train Side Vending (TSV): Trains not having pantry wagons are catered with services by IRCTC through train side vending contracts. Mail/Express and Superfast trains are example of such services. The passengers are provided with a menu chart from which the passenger can select and an on board vendor takes the respective orders. As per the specified order, the food is collected from issued pick up points which is then supplied to the passengers by the on board vendor.

E-Catering Business: Latest technology advancement provided by IRCTC towards improving catering and hospitality services in trains is the e-catering business. Passengers are allowed to book/choose their meal through a mobile application at the time of booking tickets or during the travel on the train. Based on the bookings, passengers are provided with

food from partner restaurants and food outlets on their respective seat/berth.

The services provided, terms and conditions of E-Catering are as follows:

- Passengers who have reserved ticket can avail e-catering services.
- The range of dishes offered provided in the mobile application at the time of booking can only be availed by the passengers.
- Restaurants providing services and based on bulk orders by the passengers the food menu is set.
- Roughly about 325 stations is provide with e-catering service of IRCTC.
- Payments for the meals can be made through online or cash on delivery (COD) by the passengers.
- A feedback for the services provided is available for the passengers to give their response and suggestions.
- SMS services are put in to provide the passengers with a notification of availability of booking meals before the travel begins.

C) Private Trains

Private Player Participation: “Indian Railways first attempt to let private companies run trains have received a warm welcome from marquee global and local players. In Union Budget 2020-21, the Indian Railways is all set to introduce more private trains like the Tejas Express to connect tourist places. The Railways have recently proposed a mega plan to include private players in 100 routes across the country. The response so far has been good. More than two dozen global firms including Alstom Transport, Bombardier, Siemens AG, Hyundai Rotem Company and Macquarie have shown interest. Among home-grown companies, Tata Realty and Infrastructure, Hitachi India and South Asia, Essel Group, Adani Ports and SEZ, and of course, Indian Railway Catering and Tourism Corporation (IRCTC) are also participating in the race to run private trains in the country. The government has said that, by the end of this year, 150 modern trains would be run by private operators across 100 routes, offering world-class technology and services to passengers. The move will end the longstanding monopoly of the national

transporter in running trains and likely start a rush of private investment into the Indian Railways, which is in the midst of a massive infrastructure upgrade.”

IRCTC Tejas Express: The entry of Indian Railways towards private trains was through the launch of Tejas Express services. On 4 October 2019, Lucknow-Delhi Tejas Express was launched which marked the 1st private train of the country. On 17 January 2020, Ahmedabad-Mumbai Tejas Express was launched which was the 2nd private train. On 19 January 2020, the commercial operations started. These private trains feature air-conditioned coaches consisting of executive and non-executive chair car coaches. Executive chair car coaches catered to 56 seats each. Non-executive chair car coaches catered to 78 seats each. Free rail travel insurances, compensation in case of delays, exclusive coverage against household theft or robbery are some salient features of the private train services.

The basic amenities and facilities provide by the private trains by IRCTC were of high standards. Safety features like CCTVs, automatic entry and exit doors, sliding doors; Comfort features like wide glass-bottom luggage racks, mobile charging points, call buttons, personalized reading lights, personalized LED entertainment-cum-information screens and windows with button-operated blinds, tea and coffee vending machines; Hygiene facilities modular bio-toilets were present in these private trains.

Financial Aspects: “Tejas Express has made a profit of around Rs 70 lakh in October while earning a revenue of nearly Rs 3.70 crore through sale of tickets, sources said, signalling a steady start for the Railways' first "privately" run train. The numbers for the other months are not available but it is estimated that Tejas is a profitable venture. Perhaps more importantly, the passengers have been happy with the train and think it's worth the extra price. “The blinds are automatic and tea is being served continuously,” one of them was heard informing his family on a video call. Towards the end of the journey, IRCTC circulates tablets where passengers can fill in their feedback.”

“The train offers a 1:30 staff: passenger ratio, and the crew is friendly and efficient. The crew classification is streamlined, with work being divided between coach-attendants, security personnel, sanitation staff and ticket collectors.”

“On January 16, 2020, share price of IRCTC hit the four-digit mark for the first time ever a day ahead of launch of India's second private train Ahmedabad-Mumbai Central Tejas Express. The firm followed dynamic fare scheme for both trains. IRCTC will soon start its third private train, Indore-Varanasi Tejas Express. The IRCTC stock has risen nearly five times its IPO issue price. The Indian Railway firm made its stock market debut on October 14 and is among the best performing stocks since then.”

V. Conclusion

The study helped in identifying certain key benefits and drawbacks of complete privatization on benchmarking with railways in other developed countries. Inferences that were beneficiary to the system where improved infrastructure, normalization of prices due to competition, improved security, netter technological innovations. However, there were certain drawbacks to the system like limited coverage, lesser inclusiveness, issue of accountability, exploitation of revenue rich zones alone.

The current situation of the Indian Railways clearly indicates the need for change. The research indicates that privatizing railway sector in India clearly has its benefits but cannot be considered as the complete solution for Indian Railways. The government is still in a learning mode as far as railway infrastructure provision is concerned. It has started experimenting with Station Redevelopment Program, Private Trains, Catering Services. The future growth of railways will depend to a large extent on the will and ability of government to garner support to ongoing initiatives.

Improved Infrastructure: Currently the situation of many train services are lacking the basic amenities due to mismanagement of the existing facilities. This can be explicitly seen in washrooms which are unhygienic, interrupted water supply and platforms that are dirty.

Privatization can lead to betterment and improvement of infrastructure.

Normalized pricing due to the competition: In order to create improvements in the services there has to be a hike in prices which could affect different classes of commuters availing such services. The issue of hike in prices can be normalized if private players enter the sector and thereby creating competition and leading to service quality improvement.

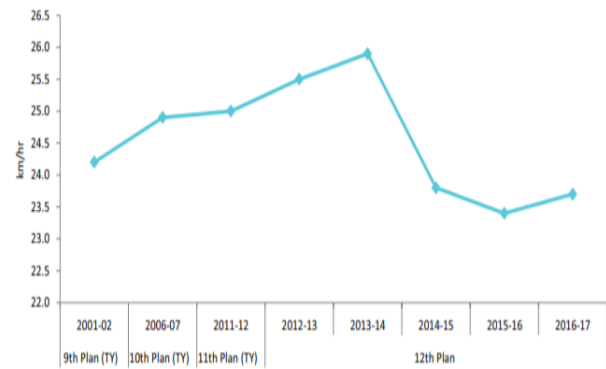
Security Advancement: Better accountability and monitoring can be attained through private participation which can substantially reduce the number of accidents in railways.

Better Technological Innovation: Infusion of modernized technologies and capacity building of railway services and infrastructure can be attained through private participation.

VI. Limitations

Line capacity: “The line capacity was at 100% along 40% sections across different zones of Indian Railways. As a result, majority of the zones under Indian Railways fall under the category of optimal and higher than optimal utilization of line capacity. Further, 65% of the 247 high-density sections were running at a line capacity of 100% or above. Indian Railways’ initiative to ease capacity, namely DFC projects, has expected to be considerably improve its capabilities in carrying higher traffic, particularly freight.”

Higher transit time: Time component for logistics is one of the prime factor that is being looked upon for deciding mode of transport. Uncertainty in the timing of delivery services of IR has resulted in shift of freight traffic towards roadways. This is clearly depicted by the FMCG and automobile industries availing the transportation services through roadways. The prioritization of passenger trains and constraints in infrastructure has further created uncertainty of freight trains. This trend is clearly visible from the decline in average speed of freight train since 2013.



Average speed of Freight Trains

Terminal infrastructure and operation: Improper functioning or lack of infrastructure facilities has resulted in facing difficulties for smooth and efficient operation of terminals. Obsolete equipment’s and mechanization, lack of fixed assets maintenance, issues pertaining to security and safety are some of the concerns stakeholders has raised. The non-flexibility in policies especially related to terminal policy of IR has prevented attracting interested private players in acquiring land to develop green-field terminals. Perspective planning pertaining to these constrains must be taking into consideration by the Indian Railways so that the terminal infrastructure can be backed by adequate policies that could encourage participation from private players for the operation and management of terminals resulting in proper utilization resources.

Passenger traffic are sustaining because of cross subsidies from freight traffic: The major reason for the non-profitable running of suburban and non-suburban services are due to the following reasons:

The costs incurred are higher than the fares collected from the passenger. NITI Aayog report inferred that 77% to 80% of losses are being resulting from the non-suburban services.

Various concessions that is being awarded to specific categories of passengers. This cause accounted about 4% of the losses

Limited Coverage: Indian Railways currently owned by the government provides wide connectivity within the nation irrespective of the profit. However, privatization of the railways will result in the industry being profit

driven resulting in isolating several existing routes which are non-profitable.

Lesser Inclusive: The existing prices of railways are comparatively affordable for the low income classes as well. Privatization might result in hike of fares and thereby render services of railways to such groups.

Issue of Accountability: Indian Railways is a huge network which requires proper coordination between different zones for the efficiently providing services. If such a system

is split among different private players it will create a negative impact on connectivity and create zonal divisions between the urban and rural regions.

Vertical Integration: Vertical Integration of railways refers to the ownership and maintenance of rail services and infrastructure which is currently being carried out by the Ministry of Railways. Hence privatization of a particular portion of operations will be difficult.

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INTEGRATION OF AHP AND TOPSIS FOR EVALUATION AND SELECTION OF ARTIFICIAL INTELLIGENCE VENDORS

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ABSTRACT

Artificial Intelligence (AI) refers to technologies that try to mimic various attributes of human intelligence, such as learning, understanding, problem-solving, and judgment. Therefore, AI can help businesses improve customers' satisfaction and firms' productivity, make smart decisions, etc. To optimize the efficient implementation of AI, firms have to consider all resources and options available. In the development and implementation of an AI technology, the first question is whether firms should outsource it to an AI vendor, or insource it. Once a firm decides that it wants to outsource the execution of an AI project, the selection of the best vendor is critical. Vendors must be evaluated and selected against some conflicting factors that may not be equally important. In this study, we first discuss how to (1) make a wise insourcing-outsourcing decision, and (2) determine the important criteria for vendors' evaluation and selection. We then integrate the Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) that helps facilitate the accurate evaluation of the potential vendors. We also use numerical analysis to illustrate the accuracy and effectiveness of the proposed model.

Keywords: Artificial intelligence; Supplier selection problem; MCDM; AHP; TOPSIS

I. Introduction

Technology is a force of change that successful businesses must keep front of mind. Artificial Intelligence (AI) is no exception, and in fact, is maybe the biggest technological advancement that will change the world in the coming years. A survey of industry scholars and practitioners defined AI as a software that exhibits traits that we find in humans (Wollowski et al., 2016). There is no doubt that AI benefits firms in various ways. Compared to human beings, AI machines can analyze large amounts of data within a few seconds to make a quick and accurate decision. Also, AI machines can work without any break that, for example, enable firms to automate communications through emails, online chats, etc. All of these capabilities help businesses improve customer satisfaction, productivity and profitability. AI has the ability to increase firms' productivity by 40% or more, and profitability by an average of 38% (Carter, 2018). AI will soon be at the forefront of the business world and play a pivotal role in the growth of firms around the globe. Therefore, understanding how to best make use of the technologies will become increasingly important. Despite the benefits of AI for companies, only 9% of them in the U.S. have actually begun using AI (Zolas et al.,

2020), and just 10% of those have seen significant financial returns (Ransbotham et al., 2020).

One reason that firms are not getting the most out of the AI technologies can be rooted in the firms' readiness and ability to implement and adopt an AI technology. Alsheibani et al. (2018), a research-in-progress publication, draws on the TOE (technological, organizational, environmental) framework for AI adoption at the firm level. Pumplun et al. (2019) explored organizational readiness factors to adopt AI in organizations through a qualitative interview approach. Paul (2020) built on Alsheibani's work regarding the TOE framework and conducted an exploratory case study of the internal and external factors influencing an organization's ability to adopt AI. Uren (2020) investigated critical success factors of AI projects by analyzing firms based on the Technology Readiness Level scale. Jöhnk et al. (2021) presented five categories of AI readiness factors and their illustrative actionable indicators by an in-depth interview study with 25 AI experts. Denicolai et al. (2021) addressed the organizational readiness of AI within small and medium-sized enterprises.

Now, a natural next question is if companies are ready to implement and adopt an AI technology, should it be insourced, or outsourced to an AI vendor? If outsourcing is the best choice for a company, the second question should be how a firm can evaluate the vendors and select the best one? To the best of our knowledge, none of the studies in the relevant literature, has addressed these two questions. In this study, we first discuss how to (1) make a wise insourcing-outsourcing decision, and (2) determine the important criteria for vendors' evaluation and selection. We then developed an integration of AHP and TOPSIS to evaluate and rank the AI vendors.

Implementation of the AHP and TOPSIS methodologies has been studied within the context of the oil, locomotives, logistics, steel, sustainability, manufacturing, and food supply industries. Specifically, Amiri (2010) incorporated the AHP and TOPSIS techniques to help decision-makers (DMs) select the best National Iranian Oil Company by weighing six separate factors. Kumar et al. (2019) proposed two example solutions analyzing the supplier selection decision for the Indian Locomotive industry based on some criteria. Bianchini (2018) applied AHP and TOPSIS to research the decision-making process when deciding on a third-party logistics provider. Azimifard et al. (2018) explored the application of AHP and TOPSIS to determine the top sustainable supplier for Iran's steel industry. Mohammed et al. (2020) considered an integration of AHP and TOPSIS to optimize the environmentally friendly selection of suppliers. Kumar et al. (2020) utilized AHP and TOPSIS to determine the most important characteristics for the successful implementation of agile manufacturing. Leung (2020) conducted a case study researching the usefulness of AHP and TOPSIS to enhance produce selection for food retailers. Based on the above examples, we believe AHP and TOPSIS integration can help DMs when choosing the best AI vendor.

We organize the remainder of the paper as follows. In Section 2, we discussed (1) how companies can make an insourcing-outsourcing decision, and (2) what factors can be used to evaluate the AI vendors. Section 3 develops the integration of AHP and TOPSIS for the vendors' evaluation and selection. Section 4

uses numerical analysis to demonstrate the effectiveness of the proposed solution. Section 5 draws some conclusions and suggests future research directions.

II. Making an Insourcing-Outsourcing Decision

2.1. Outsourcing vs Insourcing

A question of this research considers what companies must do if they want to use an AI technology: do they have to develop it in-house, or outsource it to another firm? Figure 1, depicting the insourcing-outsourcing decision matrix, can provide direction for companies to make this decision.

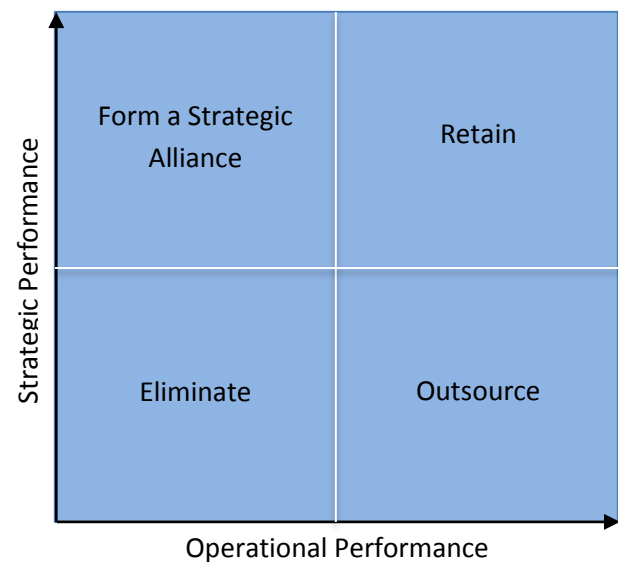


Figure 1. The Outsourcing Decision Matrix (Gado 2019).

The insourcing-outsourcing decision matrix has four options as shown in Figure 1: Eliminate, Outsource, Retain (or build in-house), and Form a Strategic Alliance. These four factors are judged based on the comparison between contribution to operational performance and strategic importance listed on the X- and Y-axis, respectively. For this research, outsourcing and building in-house are the relevant factors under consideration, because our question assumes the make or buy decision. The strategic importance of a project can be thought of as the competitive advantage of a given task. In other words, does the task in question give a business a competitive advantage? In contrast, the contribution to operational performance can

be thought of as the operational importance of the task. How much does the task contribute to the efficiency of an organization? If a task has high strategic importance and has a significant contribution to operational performance, then it makes sense to build the solution in-house.

Consider the case of Zillow, a real estate company founded in 2004, packaged automated valuation (Machine learning) methods for retail on a large scale as their core innovation (Soper 2021). Zillow's AI initiatives make a high contribution to its both operational and strategic performances because its business is based on the optimization of the data and insight. As a result, they have established their own AI and Analytics team to further advance their business objectives using AI. They not only care about successfully implementing AI projects, but owning the rights to the data, knowledge, and technology to separate themselves from their competitors. On the other hand, if a task has low strategic importance but high contribution to operational performance, then the project should probably be outsourced. For example, Denny's realized that they needed to invest in a technology solution that would strengthen and improve their visibility across online search results. Denny's used the Yext technology platform to resolve the issue instead of creating proprietary technology (Yext 1; Yext 2). Yext is a technology company operating in the area of online brand management. As discussed, Taco Bell and Denny's did not require proprietary AI, but rather utilized applications already built by Yext. In their case, the implementation of AI significantly contributed to their operational performance, but still was not of critical strategic importance. By choosing to outsource, they saved time and money by not having to create a new department. If a firm is confident the use of AI will contribute to its operational performance, but not its long-term strategy, then it is time to choose an AI vendor.

In order to determine whether it makes more sense to build in-house, or outsource to a consultant or a vendor, we also discuss the following determinative factors based on research conducted by Porter (2019).

Cost and Resources

1. What resources and technology are required to do the job? Does the organization already possess them?
2. What data is required and is the company equipped to collect and manage this itself?
3. How much would it cost to outsource compared to developing the solution in-house?

For the first two questions, if the company does not already possess the necessary staff and technology for data collection, etc., then naturally, the next question is whether outsourcing will be cheaper than acquiring all these resources. If you find outsourcing would be a good deal less expensive, then that probably makes sense. However, the expected quality and efficiency of the project should also be considered.

Quality and efficiency

4. Would outsourcing or building a team in-house produce a higher quality product?
5. How much does the quality of the solution matter?
6. How long will it take to outsource compared to doing in-house? Is the project time-sensitive?
7. Would outsourcing increase the organization's operational efficiency?
8. Can the company trust a third party to develop this part of the business?

For the above five questions, one really has to consider what the overall goal with the project is, and how the task fits into the organization's pre-existing operations over time. Is the quality paramount to the project's success? Then building in-house may make sense due to contractors not putting the same level of care and commitment as its own organization. Must the project be executed before a specific date or is there a looser timeline for completion? If you determine the task has a project deadline and could be performed faster by a consultant, then it probably makes sense to outsource. Of course, you also have to consider the competitive advantage you seek to gain from the project and the strategic importance down the road.

Competitive advantage and strategic importance

9. What is the strategic importance of this project?
10. Will this project be a part of the company's competitive advantage in the future?

These final two questions are the most important to answer. If a company determines that the project is of high strategic importance and will play a critical role in its competitive advantage, it may make sense to make the long-term investment to build the solution in-house; the intellectual property will eventually become a crucial asset. Overall, the main factors for consideration are the project's timeline, cost, and strategic importance. If the task is time-sensitive and cheaper to hire outside talent, then outsourcing may be wise. However, the strategic importance of the project should not be forgotten and may be the deciding factor depending on the significance of the intellectual property rights. If a competitive advantage can be developed through the utilization of data and AI, then it can oftentimes make sense to develop a team to work within the organization. As discussed, Zillow, Taco Bell, and Denny's are the examples.

2.2. Factors Used for Vendors' Evaluation and Selection

The next relevant question is if a firm decides to outsource an AI project to a vendor, what factors should be considered to evaluate the vendors and select the best one. The following question framework may help firms apply the important factors for vendors' evaluation and selection. The questions were developed based on the research of Porter (2019):

1. How complex will the AI solution be? (difficulty to deliver)
2. Do the vendors prioritize align with the project needed? (compatibility)
3. How many vendors offer the required service? (number of options available)
4. How knowledgeable are the vendors? Are they an expert in your domain/industry? (knowledge)
5. How long have they been in business? (longevity)

6. What is the quality of the vendors' product? (quality)
7. How reliable are the vendors? (reliability)
8. How is the vendors' reputation? (reputable)
9. Are the vendors available and how long will it take to do it? (timing)
10. Do the vendors maintain professional communication? (communication)
11. What is the cost? Is the cost hourly or by the project? (cost)

First, what is the use case, and what features and services are needed? The primary goal of this question is to determine what specific technology is needed. Second, do the vendors prioritize align with the project needed? A firm should know and trust that the vendor's interests are aligned with its organization to avoid conflict down the road. Third, how many vendors offer the required service? This will let the firm know to what extent AI has been implemented into their industry and whether the buyers or vendors hold the power for its specific project. Similarly, how knowledgeable are the vendors, and are they an expert in the firm's domain? The firm likely does not want to hire an outside team if they are not well versed in the inner workings of its industry. Industry knowledge is often very important, because companies typically do not want to pay a vendor while they come up the learning curve of a particular market. Ideally, the vendor is so experienced they can actually teach the company some things. Fifth, how long have the vendors been in business? It is important to know whether the vendor has been running a successful operation for a long time or just beginning the endeavor. Next, what is the quality of the vendors' product? The quality of a vendor should always be weighed against the price they are asking. Additionally, how reliable are the vendors? In other words, do they have a solid track record of meeting deadlines and delivering projects on time? A firm should also consider the reputation of the vendors. Is there any history of shady business dealings or questionable ethics regarding data protection? Can the vendors provide sufficient data security? Subsequently, are the vendors available and how long will it take them to complete the project? A firm should also

examine the vendors’ ability to communicate. Namely, has the vendor demonstrated a history of maintaining professional communication? Last but not least, what is the asking price of the vendors? Does the price seem reasonable based on the firm’s appraisal of their business? As discussed here, the factors for vendors’ evaluation and selection are summarized as: Compatibility (F_1), Knowledge (F_2), Longevity (F_3), Product Quality (F_4), Reliability (F_5), Reputation (F_6), Availability (F_7), Communication (F_8), and Cost (F_9).

III. Integration of AHP and TOPSIS

After identifying the factors to be considered for vendors’ evaluation and selection, we propose a methodology consisting of two stages as follows. We first obtain the weights of each factor by using the AHP technique, and then input these weights to the TOPSIS method to evaluate and rank the vendors. Assume that there are n vendors, $i = 1, 2, \dots, n$, and m factors, $j = 1, 2, \dots, m$. Some of the factors are benefit attributes, such as reputation, and some are cost attributes, such as cost and time.

3.1. Determine Weight of Factors by AHP

In this stage, we use the AHP technique to quantify managerial judgments of the relative importance or the weight of each of factors determined in the previous section. To do so, we use the following steps:

Step 1. List the goal and the factors.

The goal is to determine the factors’ relative importance or weight. As discussed in the previous section, the factors are Compatibility (F_1), Knowledge (F_2), Longevity (F_3), Product Quality (F_4), Reliability (F_5), Reputation (F_6), Availability (F_7), Communication (F_8), and Cost (F_9).

Step 2. Develop a pairwise comparison matrix PW expressed in (1).

$$PW = \begin{bmatrix} PW_{11} & \dots & PW_{1m} \\ PW_{21} & \dots & PW_{2m} \\ \vdots & \dots & \vdots \\ PW_{m1} & \dots & PW_{mm} \end{bmatrix} \quad (1)$$

where PW_{tl} is a pairwise comparison between factor (row) t (F_t) and factor (column) l (F_l).

It may be easier for DMs to express their opinion on only two factors than simultaneously on all the factors (Saaty, 1987). By using the fundamental scales, provided in Table 1, DMs can perform pairwise comparisons of the factors with respect to the goal. For example, Table 1 shows that if Quality (F_4) is strongly more important than Cost (F_9), then $PW_{49} = 5$ and $PW_{94} = 1/5$. It can be concluded that $PW_{tl} = 1$ when $l = t$.

Table 1. The fundamental scale (Saaty, 1987)

Intensity of importance on an absolute scale	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment strongly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is strongly favored, and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed
1/3, 1/5, 1/7, 1/9	Values for inverse comparison	

Step 3. Develop a normalized matrix in (3) by Eq. (2). Normally, the numbers in the first row of (1) are larger than the rest of the numbers indicating some inconsistency in the comparisons. Therefore, we normalize the numbers.

$$PW_{tl}^* = \frac{PW_{tl}}{\sum_l PW_{tl}} \quad \forall lj \quad (2)$$

$$PW^* = \begin{bmatrix} PW_{11}^* & \dots & PW_{1m}^* \\ PW_{21}^* & \dots & PW_{2m}^* \\ \vdots & \dots & \vdots \\ PW_{m1}^* & \dots & PW_{mm}^* \end{bmatrix} \quad (3)$$

Step 4. Calculate the weight of each factor by Eq. (4).

$$W_j = \frac{\sum_{t=1}^m PW_{tj}^*}{m} \quad (4)$$

3.2. Rank vendors by TOPSIS

After determining the factors' weight by AHP, we now start evaluating the vendors against the factors by TOPSIS. In TOPSIS, developed by Hwang and Yoon [16], the best vendor should have the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS). Assume that there are n vendors, $i = 1, 2, \dots, n$, and m factors, $j = 1, 2, \dots, m$.

Step 1. Construct the decision matrix D expressed in (5).

$$D = \begin{bmatrix} X_{11} & \dots & X_{1n} \\ X_{21} & \dots & X_{2n} \\ \vdots & \dots & \vdots \\ X_{m1} & \dots & X_{mn} \end{bmatrix} \quad (5)$$

where X_{ji} represent the score of the Vendor i on factor j .

Step 2. Normalize the decision matrix D in (7) by Eq. (6). This step transforms different units among the factors into a common measurable unit.

$$X_{ji}^* = \frac{X_{ji}}{\sqrt{\sum_i X_{ji}^2}} \quad \forall ji \quad (6)$$

$$D^* = \begin{bmatrix} X_{11}^* & \dots & X_{1n}^* \\ X_{21}^* & \dots & X_{2n}^* \\ \vdots & \dots & \vdots \\ X_{m1}^* & \dots & X_{mn}^* \end{bmatrix} \quad (7)$$

Step 3. Construct the weighted normalize decision matrix in (9) by Eq. (8).

$$X_{ji}^{w*} = X_{ji}^* W_j \quad \forall ji \quad (8)$$

$$D^{w*} = \begin{bmatrix} X_{11}^{w*} & \dots & X_{1n}^{w*} \\ X_{21}^{w*} & \dots & X_{2n}^{w*} \\ \vdots & \dots & \vdots \\ X_{m1}^{w*} & \dots & X_{mn}^{w*} \end{bmatrix} \quad (9)$$

In Eq. (8), $W_j \forall j$, is the relative importance of factor j , determined by AHP.

Step 4. Find the best, S^b , and the worst, S^w , possible vendors as the referential ones by Eqs. (10)-(11), respectively.

$$S^b = \{B_1, B_2, \dots, B_m\} \quad (10)$$

$$S^w = \{N_1, N_2, \dots, N_m\} \quad (11)$$

Where, $B_j = \min(X_{j1}^{w*}, \dots, X_{jn}^{w*}) \forall j$ and $N_j = \max(X_{j1}^{w*}, \dots, X_{jn}^{w*}) \forall j$ for cost attributes, $B_j = \max(X_{j1}^{w*}, \dots, X_{jn}^{w*}) \forall j$ and $N_j = \min(X_{j1}^{w*}, \dots, X_{jn}^{w*}) \forall j$ for benefit attributes.

Step 5. Calculate the separation of each vendor from the best and the worst possible vendors by Eqs. (12)-(13), respectively.

$$S_i^+ = \sqrt{\sum_{j=1}^m (X_{ji}^{w*} - B_j)^2} \quad \forall i \quad (12)$$

$$S_i^- = \sqrt{\sum_{j=1}^m (X_{ji}^{w*} - N_j)^2} \quad \forall i \quad (13)$$

Step 6. The relative closeness to the ideal solution is calculated by Eq. (14) as follows

$$R_i = \frac{S_i^-}{S_i^+ + S_i^-} \quad \forall i \quad (14)$$

Sort the vendors in descending order of R_i . Larger R_i indicates larger distance from the worst possible vendor and closer to the best possible vendor.

IV. Numerical Analysis

Here, we assume that there are seven possible vendors who are evaluated against the nine aforementioned factors.

Use AHP to determine weight of factors

In Stage 1, we apply AHP to determine the factors' weight. We assume that the DMs use Table 1 to create a pairwise comparison matrix for the factors and present them in Table 2. Numbers in Table 2 are randomly generated by "RANDBETWEEN" function in Ms. Excel.

Table 2. The pairwise comparison matrix

	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
Capability (F_1)	1.00	3.00	5.00	1.00	0.20	0.33	0.14	3.00	0.14
Knowledge (F_2)	0.33	1.00	7.00	1.00	3.00	3.00	0.14	0.20	3.00
Longevity (F_3)	0.20	0.14	1.00	3.00	1.00	3.00	0.33	0.20	0.20
Product Quality (F_4)	1.00	1.00	0.33	1.00	3.00	5.00	0.33	0.20	5.00
Reliability (F_5)	5.00	0.33	1.00	0.33	1.00	5.00	1.00	3.00	3.00
Reputation (F_6)	3.00	0.33	0.33	0.20	0.20	1.00	3.00	5.00	7.00
Availability (F_7)	7.00	7.00	3.00	3.00	1.00	0.33	1.00	5.00	3.00
Communication (F_8)	0.33	5.00	3.00	3.00	0.33	0.20	0.20	1.00	3.00
Cost (F_9)	0.14	0.33	5.00	0.20	0.33	0.14	0.33	0.33	1.00
Sum	18.00	18.13	25.66	12.73	10.06	18.00	6.47	17.93	25.34

By Eq. (2), we normalize the pairwise matrix and present the result in Table 3.

Table 2. The normalized pairwise matrix

	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
Capability (F_1)	0.056	0.165	0.195	0.079	0.020	0.018	0.022	0.167	0.006
Knowledge (F_2)	0.018	0.055	0.273	0.079	0.298	0.167	0.022	0.011	0.118
Longevity (F_3)	0.011	0.008	0.039	0.236	0.099	0.167	0.051	0.011	0.008
Product Quality (F_4)	0.056	0.055	0.013	0.079	0.298	0.278	0.051	0.011	0.197
Reliability (F_5)	0.278	0.018	0.039	0.026	0.099	0.278	0.155	0.167	0.118
Reputation (F_6)	0.167	0.018	0.013	0.016	0.020	0.056	0.464	0.279	0.276
Availability (F_7)	0.389	0.386	0.117	0.236	0.099	0.018	0.155	0.279	0.118
Communication (F_8)	0.018	0.276	0.117	0.236	0.033	0.011	0.031	0.056	0.118
Cost (F_9)	0.008	0.018	0.195	0.016	0.033	0.008	0.051	0.018	0.039

Finally, the factors' weight is calculated by Eq. (4) as follows:

Table 3. The weight of the factors

Factors	Weight	Ranking
Capability (F_1)	0.081	7
Knowledge (F_2)	0.116	4
Longevity (F_3)	0.070	8
Product Quality (F_4)	0.115	5
Reliability (F_5)	0.131	3
Reputation (F_6)	0.145	2
Availability (F_7)	0.200	1
Communication (F_8)	0.100	6
Cost (F_9)	0.043	9

One can see that Availability (F_7), Reputation (F_6) and Reliability (F_5) are the top three factors, and Cost (F_9) is the least important factor for the DMs. Now, we can move to the second stage and apply TOPSIS to evaluate and rank the vendors based on the nine factors.

Use TOPSIS to rank suppliers

To construct the decision matrix, we randomly generate the vendors' score for each factor by "RANDBETWEEN" function in Ms. Excel.

Table 4. The decision matrix generated by "RANDBETWEEN" function in Ms. Excel

Factors	Weight	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Capability (F_1)	0.081	9.00	10.00	8.00	9.00	10.00	9.00	9.00
Knowledge (F_2)	0.116	0.00	81.00	88.00	30.00	17.00	63.00	84.00
Longevity (F_3)	0.070	0.75	0.70	0.53	0.45	0.24	0.48	0.24
Product Quality (F_4)	0.115	0.81	1.00	0.97	0.92	0.28	0.56	0.21
Reliability (F_5)	0.131	0.82	0.11	0.83	0.26	0.36	0.40	0.11
Reputation (F_6)	0.145	5.00	3.00	4.00	7.00	4.00	3.00	2.00
Availability (F_7)	0.200	10.00	8.00	8.00	9.00	9.00	8.00	9.00
Communication (F_8)	0.100	5.00	9.00	12.00	12.00	9.00	12.00	7.00
Cost (F_9)	0.043	19.00	20.00	7.00	5.00	18.00	19.00	19.00

Now, we use Eq. (6) to normalize the decision matrix presented in Table 5.

Table 5. The normalized decision matrix

Factors	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Capability (F_1)	0.371	0.412	0.330	0.371	0.412	0.37	0.37
Knowledge (F_2)	0.000	0.497	0.540	0.184	0.104	0.387	0.52
Longevity (F_3)	0.547	0.510	0.386	0.328	0.175	0.350	0.18
Product Quality (F_4)	0.411	0.508	0.492	0.467	0.142	0.284	0.11
Reliability (F_5)	0.621	0.083	0.629	0.197	0.273	0.303	0.083
Reputation (F_6)	0.442	0.265	0.354	0.619	0.354	0.265	0.177
Availability (F_7)	0.432	0.346	0.346	0.389	0.389	0.346	0.389
Communication (F_8)	0.193	0.348	0.464	0.464	0.348	0.464	0.271
Cost (F_9)	0.438	0.461	0.161	0.115	0.415	0.438	0.438

Eq. (8) is used to incorporate the weight of each factor, obtained by AHP, into the evaluation process as presented in Table 6.

Table 6. The weighted normalized decision matrix

Factors	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Capability (F_1)	0.030	0.033	0.027	0.030	0.033	0.030	0.030
Knowledge (F_2)	0.000	0.058	0.062	0.021	0.012	0.045	0.060
Longevity (F_3)	0.038	0.036	0.027	0.023	0.012	0.024	0.012
Product Quality (F_4)	0.047	0.059	0.057	0.054	0.016	0.033	0.012
Reliability (F_5)	0.081	0.011	0.082	0.026	0.036	0.040	0.011
Reputation (F_6)	0.064	0.039	0.051	0.090	0.051	0.039	0.026
Availability (F_7)	0.086	0.069	0.069	0.078	0.078	0.069	0.078
Communication (F_8)	0.019	0.035	0.046	0.046	0.035	0.046	0.027
Cost (F_9)	0.019	0.020	0.007	0.005	0.018	0.019	0.019

Here, we use Eqs. (10)-(11) to find the best, S^b , and the worst, S^w , possible vendors, and then use Eqs. (12)-(13) to calculate the separation of each vendor from them. Finally,

we use Eq. (14) to compute the relative closeness of each vendor to the ideal solution as follows:

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
R_i	0.554	0.467	0.718	0.548	0.309	0.456	0.351
Vendors' Ranking	2	4	1	3	7	5	6

Here, one can observe that Vendor 3 is the best one due to its performance, mainly on Availability (F_7), Reputation (F_6) and Reliability (F_5). We call the numerical example of this section as Case 1. To evaluate the effectiveness of the proposed model in incorporating the DMs' preferences in the decision process, we do the following sensitivity analysis.

Perform Sensitivity Analysis

The DMs can incorporate their preferences or strategies in the decision process by assigning different weights to the factors. We do so by the following cases.

Case 2. In this case, we assume that Communication (F_8) and Cost (F_9) are the most important factors for the DMs, and thus, W_8 and W_9 are 0.465. The weight of the other factors is 0.01. TOPSIS is again used to calculate the vendors' relative closeness as follows:

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
R_i	0.063	0.299	0.897	0.971	0.334	0.457	0.178
Vendors' Ranking	7	5	2	1	4	3	6

Here, one can see that Vendor 4 is the best because it has the highest score on Communication (F_8) and the lowest score on Cost (F_9).

Case 3. In this case, we set W_3 and W_5 to 0.465, and the others to 0.01. The vendors' relative closeness is calculated as follows:

	S_1	S_2	S_3	S_4	S_5	S_6	S_7
R_i	0.974	0.380	0.785	0.283	0.269	0.425	0.017
Vendors' Ranking	1	4	2	5	6	3	7

One can observe that Vendor 1 is the best one due to its performance on the third and fifth factors.

The three cases show that Vendor 3 is one of the top two vendors. By analyzing its scores and performance on $F_3, F_5, F_6, F_7, F_8,$ and $F_9,$ presented in Table 4, we can observe that it is one of the top vendors and the model accurately gives it a higher final score.

V. Conclusion

It is necessary to consider all of the resources and options available to optimize the efficient implementation of AI. After all, AI is not a magic solution, and will only produce results equal to the planning and preparation of an organization. The question framework we developed for the make or buy decision can help businesses determine their best course of action. Overall, the decision will boil down to the strategic importance of the project and the

contribution to operational performance for a given firm. Once [if] a firm decides they want to outsource the execution of a given project, the selection of the best vendor is critical. The question framework for vendor selection can be a helpful tool for determining the criteria and requirements of vendors' comparison. Once the DMs are in agreement of the criteria, AHP and TOPSIS analysis can help facilitate the accurate evaluation of the potential vendors.

The limitations of this paper include the narrow scope given the research stayed theoretical within our application of the AHP and TOPSIS method. Instead of identifying real vendors, we created fictional vendors and data to test the utilization of the guide we developed. Future research could explore specific AI adoption decisions and apply the make or buy framework to real data and vendors.

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THE WOMEN AND THE LAND: THE CONCEPTION OF BELONGING IN HADHRAMI SOCIETY THROUGH ALMEHDAR'S OPERETTAS (THE VICTIM AND THE BEDOUIN GIRL)

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ABSTRACT

Almehdar's treasury of Hadhrami original traditions that creates the DNA of Hadhrami identity has not been investigated to reveal its due value. Therefore, this article aims at scratching upon the surface of this issue through investigating the portrayal of the women and the land, as two major interlinked marks of Hadhrami identity revealed in Almehdar's literature, in the selected operettas, The Victim and The Bedouin Girl, as both reflect the article's two interlinked points; women and the land, within the thorough portrayal of the original seeds of Hadhrami identity, mainly in mid-20th-century. These issues are to be discussed within the theoretical perspectives of Kathy Butterworth's (2017) conception of women as a decentered autonomous subject. She argues that between the autonomous and decentered authority, the undecidability of women can be situated. Besides, there is a symbolic link between the attachment to the homeland and that to women (central/decentered) highlighted in previous literature as Smith (2019), Tzili Mor (2016), Alexander (2011), and Linda Marina (n.d.) but from a negative perspective unlike this article. The analysis shows the situation of the two women in the texts, The Victim and The Bedouin Girl, in their relation to the patriarchal authority of the father, cousin, and the lover/potential husband. Given that, in these texts, the constructive interchangeability of women and the land reflects how Hadhrami people, though of a tribal and patriarchal mentality, are attached to their land as a source of belonging and indication of identity. Likewise, their intimate love for their ladies is a source of power that makes them do the impossible to defend them and never cede with them. As for the Hadhrami women, the texts show that they have a space of freedom to say their opinions frankly and declare, but politely, their love affairs and their right in selecting their husbands. Meanwhile, they are respectfully bound by their parental decisions. In all, these texts show the extent to which they are sacred for their men who never accept any foreign invasion to their land or ladies.

Keywords: *Almehdar, decentered autonomous woman, Hadhrami identity, operettas, The Bedouin Girl, the land, The Victim*

I. Introduction

Hadhrami¹ identity has been ignored and diluted initially by the Hadhrami's reluctance to revive and emphasize its peculiarities and show pride of being so [1], [2], and [3]. Among the few attempts to write about it is Alshatery's book *Adwar Altareekh AlHadhrami (Stages of Hadhrami History)* (1993). Alshatery explains that generally Hadhrami identity is stamped on the one hand, by the inherited Arabic and Islamic characteristics such as: generosity, hospitality, patriotism, among others. On the other hand, there are some negative features of the Hadhramis such as insulting and calling each other with bad names/ nicknames [4]. Besides, Hadhrami literature is one of the significant records of Hadhrami identity attributes. Within this article's context, Hussien Abu Bakr Almehdar represents a genuine part of Hadhrami identity in his poetic production.

As a Hadhrami whose culture is a positive hybrid/ melting pot of a wide variety of Hadhrami areas, Almehdar's works typically reflect social, cultural, political, and linguistic Hadhrami peculiarities. This significance of Almehdar's works has not yet been seriously tackled in academia, but of some web articles that give a brief overview of his works and some undocumented lectures during his anniversaries. Therefore, this article is an attempt to investigate one really neglected part of Almehdar's poetic production, his operettas. Besides, the focal issue of this article is the status of Hadhrami women in the Hadhrami tribal society of the mid-20th century and its relationship to the belonging and attachment to the land. Both issues, women and land, compose essential elements in identifying a significant part of Hadhrami identity then and now. Given that, and before elaborating the theoretical and analytical perspectives of the

article, an overview of the poet and his texts is due.

II. Hussein Abu Bakr Almehdar

Hussein Abu Bakr Almehdar (1930-2000) was born in a family who are descendants of the prophet, Mohammad, (peace be upon him) and who are distinguished for their local poetry and involvement in politics. He is a talented Hadhrami poet and musician. He is famous for his deep and multipurpose local poetry that reflects the various emotional, political, and intellectual stages in his context not only throughout his lifetime, but his genius surpasses it to touch the worries, hopes, and tastes of Hadhrami, Yemeni, and Gulf people up to today. His poems have been sung by famous singers in the area, of them, Abu Bakr Salem Balfaqueeh² is the most voice linked to Almehdar's poetic productions. His poetry is spontaneous and deep [5].

III. Almehdar's Operettas

As for his operettas, there are more than 20 operettas. Among them are: *The Bedouin Girl*, *The Victim*, *Marriage Traditions*, *The Seven Martyrs*, *The Ten Candles*. They are marked by linguistic eloquence, well-knot plots, and poetic delicacy. They discuss several issues historical, social and about the traditions and customs and prove his vast knowledge of the minute details of Hadhrami society with all its varieties. According to Alseegh (cited in Alammary 2007) Almehdar's operettas are a distinctive mark of the excellence of the poet not only in Hadhramout but in the whole country. Alammary emphasizes that, "Almehdar's operettas as his sung poetry must be scrutinized" (para 5) [6]. Therefore, and as it is clear, there is a real scarcity of academic scrutiny of Almehdar's operettas, among his poetic production, especially as preservations and presentations of genuine Hadhrami identity.

IV. Summary of the texts

As there is a shortage of sources about these texts and as they have not been translated into English, I attempt to read (as they are in Arabic) and summarize them in English. Besides, I translate the meanings of the quotations to clarify the arguments and analyses. Another important point is that I

translate the name of the protagonist in *The Victim*, as "the bride/ the victim" although it is indicated in the original text as "the bride" only because I want to highlight her situation; in between the positive image of being a bride and the negative one of being a victim of some rigid customs. As for the other operetta "The Bedouin Girl," as she is referred to in the text as the Bedouin girl, I prefer this reference to her although the original text's title is literally, "The Daughter of the Tribes" or "The tribal Daughter." I think the first reflects the connotative indication of her personality and the aim of the author well. In all, the texts are loaded with Hadhrami identity peculiarities such as polygamy, priority of tribal/societal laws over the governmental constitutions, stratification, herding and farming as means of livelihood, significance of justice, parental obedience, and good reputation, the priority of the paternal cousin to marry his female relative(s) to foreigners (from other tribes) to keep the line of ancestry and the tribe property within the confines of the tribe. These are some general features of which some have been changed since the time of writing these texts; mid-20th century. However, they are basically engendered in the Hadhrami collective identity, and some might appear occasionally.

The Victim [7]

It is targeted to discuss with potential solutions of the problem of masculine patriarchy and allow women a space of autonomy (towards a decenteredness!). The chief male character, Mukhaizem, initiates the story by declaring his love to his land and linking it to his adornment to the lady of his dreams, Al-meshqasiah (the girl is from an area in the farthest eastern parts of Hadhramout coastline called Al-meshqas). She is in love with him, but she asks him to clarify his intentions towards her, just to pass time or to get married. When he promises to propose to her, her cousin interferes and quarrels with her informing her that he, having the authority of being her paternal relative, will never allow her to marry anyone but him although he is married and has children and although she frankly rejects him.

The Bedouin Girl [8]

There are three major characters: the peasant, the Bedouin girl and her father. The story takes place on the land of the peasant who has been admiring his land and his life on it when the girl suddenly interrupted with her goats. This beautiful land and its products are the fruit of the peasant's efforts. Although being an intruder, the girl is apprehended by the presence of a man asking him who he is. He does not introduce himself by a name, but by his function/ his relationship to the land, "I am a peasant, the one who this land hath sowed and watered." The girl too identifies herself as a Bedouin shepherdess sent by her parents to herd the goats. The man becomes angry as her goats are destroying his land. She informs him that the land is the most fruitful in the area, but she apologizes and takes permission to leave. The matching beauty of the land and the girl makes the peasant fall in her love asking her not to leave and to stay for longer time accompanying him. The man is driven by this intimate moment with the girl and touches her hand which is not allowed as he is not her Mahram (a relative who is an "unmarriageable person" [9]). This act, in the tribal customs, requires a kind of penalty, called "Ano" of the actor/ doer. At that time, it was to donate a gun and a she-camel. The girl is really provoked by his action, so she cries calling her parents and complaining to them. Here the father appears defending his daughter and threatening the man that to end the scandal he must pay the Ano otherwise he dies. The man insists on his proposal that he wants to marry the tribal girl regardless of the traditions (which impose the stratifications between the tribes and the peasants, so intermarriage is not accepted especially if the man is of a lower rank than the girl) which are fading in front of the new constitution of the newly born republic then (the socialist republic of the southern part of Yemen) which gives women the full right to choose their husband. The peasant explains that women are not like cattle to be sold and bought without any hand in their fate. The father relishes the man's point of view. The marriage is to be set after the girl accepts the peasant and her parents bless their bond. The operetta ends with all engaging in chanting expressing their

love for their land and everything belongs to it and that they cannot live but in it.

In both texts, there is a common theme of the connection between the noble love of the dream lady and belonging to the land. As the land is to be protected and defended against any interruption or attack, so do the woman's relatives (chiefly the father and the tribe behind him) and her lover, to-be husband. As for the Hadhramis peculiarities in these texts, although both were written around mid-20th century, I mean that period was marked by a shift in the overall mood towards socialism. The Hadhramis basically (maybe genetically) represent a strong attachment to the land, adherence to the collective tribal/ societal norms/ laws, and observation of the good reputation.

V. Theoretical Perspective

The two texts are to be analyzed within the selected framework of Butterworth's decentered autonomous subject in which she locates women in a persistent moment in between the two extremes. Also, this perspective of the women is linked to the shared symbolic dimension between women and the land in strengthening belonging and attachment to both of them.

Feminist autonomy/ decenteredness

Kathy Butterworth's arguments reveal that there is no one fixed reading of the feminist identity either autonomous or decentered; the former reflects the traditional unified and unifying self while the latter represents the fluid self of persistent process of becoming. She asserts that the decenteredness is a post-structuralist perspective as "we can no longer properly understand ourselves as a unified, sovereign subject, insofar as the overriding experience we have of ourselves is that of a decentered self, a subject that is constantly in process of becoming" (p. 155) [10]. The autonomy, she argues, "as a set of competencies, which is compatible with a narrative account of the decentered self" (p. 155) corresponds with the narrative view of the self. More currently, some feminists welcome the decentered self considering it a way to shed the patriarchal hegemony. However, other feminists support the tendency to unify

women's fate as the fragmentary self is easily intruded. Even this last view, that women should cling to their shared universal characteristics is criticized.

Butterworth's employment of the word "subject" to refer to the carrier/ holder of these selves either autonomous or decentered shows a Marxist contextual tendency mingled with postmodern touches of the indeterminacy that echoes Derrida's *différance*. Moreover, she explains that her view, which I support, is neither autonomous nor decentered, she attempts to consider the self, with a special reference to the feminine self "whose stability and coherence is an achievement and is capable of autonomy or agency" (p. 161) which is, as I think, a view that puts the self in a persistent play between the two notions carrying traces of both but not belonging to either. Hadhrami women in the targeted texts are examples of parental obedience and freedom of choice, to love and choose her husband, to work in and outside their parents' household and declare their opinions. The image is not positive in all its aspects, as there is the cousin's interference, signifying a rigid tribal extreme, breaks the victim/bride's marriage with Mukhaizam or in the case of the Bedouin girl when the obligations of social stratification has been about to make her father reject marrying her to the peasant. However, in both cases, the two Hadhrami women do not submit to circumstances, as the first decides to wander in God's land as it is the property of no one and the second is saved by the new governmental laws that equal all people in the society and give women the right to choose a husband.

Symbolism of Women and Land

Within the aforementioned perspective, the women, in the selected texts, are related to the land; both are sources of attachment and love and must be protected and defended. This issue has been previously tackled from a different perspective. Tzili Mor (2016) provides an overall image of the link between women and the land or feminizing the land.

We feminize our planet by calling it "mother earth" -but land as a feminist issue goes beyond metaphor. It is because the majority of the world's poor depend on land for food, shelter, livelihood, and often their identity, but

lack legal control over this source of their survival. And this experience has a bias. Our relationships to land, forests, water and natural resources are not gender neutral, and our rights to these resources are gender biased. (1st para.) [11].

Other attempts to investigate this idea focus on its negative aspects. Alexander (2011) metonymically links women's bodies to the land as a colonial masculine target. The Haitian context here reveal the negative destructive desire of rape/ confiscation [12]. Smith (2019) supports Alexander's (2011) views though her focus has been on the rhetorical elements in texts of literature in which feminizing the land through language/ linguistic expressions happens unconsciously [13]. Linda Marina (n.d.) emphasizes a strong connection between land and women in several cultures. She argues that there is a need for changing the negative linkage between women and the land as subjects for exploitation to a bond of love as this transformation of thought, attitude and behavior towards both is constructive for the whole human civilization [14]. So, my point is to highlight the positive images, as recommended by Linda Marina (n.d.), that signify relationship between the Hadhrami women and their land as portrayed in Almehdar's selected texts.

Almehdar's poetic production portrays minute details of Hadhrami identity. This contribution of Almehdar's works, especially his operettas and the way he reflects the issues of women and the land as two pivotal marks of Hadhrami peculiarity, is to be highlighted in the present analytic qualitative article within the adopted theoretical perspectives of Butterworth's the autonomous decentered subject and the symbolic interrelation between women and the land. In the coming section, the selected texts are to be analyzed focusing on the lines that reveal women's position both the ones said by and to them. Also, the symbolic traces that link women and the land are highlighted to signify the relationship between them.

VI. Analysis and Discussion

The Victim

In the text, there are three female characters, the victim also called the bride, the mother, and the cousin's first wife. The protagonist is the bride. Unlike the marginalized first wife, only mentioned roughly in the discourse between the bride and her cousin, the bride and her mother are portrayed as initiative personalities who declare their opinions and reject any injustice. The bride/ the victim appears in the opening of this operetta conversing with her lover, Mukhaizam, who declares his love for her beauty, outside and inside (morality). She informs him that she is waiting patiently for him to prove his true love for her through marriage,

طعمته لا اموزون بالصبر عسل هو لو وصبري صابر
”كنينة تروح“

“Patient is me and my patience is of sour made/ If with the sweetest honey it is mixed/ but taste it and it is thy end!” (lines 7-8)

She exaggerates her endurance through the repetition of the root “S. B. R” “صبر” three times, “صابر” “صبري” “صبر” To clarify the extent of her patience waiting for him to realize his emotions and intentions to her, the use of “honey” is employed to show the difference and that her patience if it had been honey, it would have become sour. And she challenges Mukhaizam on his patience and whether his would equal or exceed hers!

الوقت بيننا يكون كيف الصبر باجر صبرك باشوف
”سنينه مطول“

“I will see/ I will examine thy endurance/ And time is our judge.” (11-12)

Then she is challenging his loyalty that she is willing to patiently waiting for him if and only if he is serious in his intention. She asks challenging,

قطع المضمون ما قلتي العشق في قصدك ايش و أنت
”رهينة ولا تبغاه“

“What is your true intention of this love? / Are you serious and intend to marry me or it just time passing?” (15-16)

The expressions used when she provides the two choices are used in trade/ merchandise, “a clear-cut deal/ transaction” (“قطع”) or “a

mortgage” (“رهن”). She clarifies, throughout this image, that she is serious and not involving in a trivial affair. When they agree on their serious intentions and true love that is to happily end, her cousin interrupts threatening her that she will be no one's wife but himself. Again, she is confronting her cousin and declares her love for Mukhaizam and that she will never marry him (her cousin) as he is married to a beautiful lady and has children.

”وبينه بيني دخلك ايش و“

“And it is not your business to interfere between me and him” (27)

”مشطون بس بصاحبي قلبي بغيتك ما ني“

“And I have no interest in you, my heart is with my lover” (36)

Here, the cousin is really provoked by her stark love declaration considering it breaking the tribal laws and he threatens to kill her before being the wife of a ‘foreigner,’ the bride/ victim asks her mother's help. The mother here is supporting her daughter to marry her lover who has already proposed to her and paid her dowry to her father.

On the wedding day, when the cousin fights with Mukhaizam, the mother asks the father to interfere to end the problem for Mukhaizam. But the father has been reminded of the obligations of the tribal laws, “عمر سارحة” (line 84) by the cousin and one of the tribe's sheikhs. So, he decides to decline Mukhaizam in favor of the cousin. The mother, here, attempts to motivate her husband's loyalty and common sense of wisdom and justice, in vain.

الميزان في عمر يا عيب اوجالك تعنا الكلمة مخيزم اوفي
”لك اعتنى بنتك شان على الخون من جا افعالك تنقص“

“Keep your word/ Shame upon you in the world/ Troubles for you and your gal he has beheld” (81-83)

The incidents about the bride/ victim, her mother and the silent marginalized first wife reveal that the woman has a voice, and she is courageous to declare her opinion even though the final word is of the hegemonic patriarchy. These features portrayed by the bride/ victim and her mother indicate that there is a space of autonomy, of independence for the Bedouin Hadhrami females to share their personalities

in a masculine-ridden community, of course with the role of the first wife representing the marginalization being practiced over other portions of Hadhrami women in the society then. Besides, the two paradoxical description of the major character, the bride/ victim, demonstrates that Hadhrami women, with a special reference to the Bedouin, are respected and they have a space of freedom and opinion expression but still they are bound by the collective tribal laws that partially protect them but also confiscate a part of their autonomy. The bride/ the victim does never submit to the tribal laws, and she threatens to go wandering in the desert/ mountains and valleys rather than marrying him,

“جبالك هي ما الله جبال في باسرح”

“I will wander in God’s land; it is not your property” (104)

At this moment, a total incarnation happens between the bride/ the victim and the land as both are independent and free of any hegemony and not the lawful property of any human being.

The three major male characters in the text are the lover, Mukhaizam, the cousin and the father. Each of the three represents an authority/ power. Mukhaizam is the weakest in the context as he is considered a foreigner in a tribal community governed by tribal laws, “عمر سارحة”. However, he is a tribesman and has his own power among his own people and wish to marry his dream lady even if she is from another tribe. Unfortunately, the tribal laws, strictly applied by the cousin and then the father, are above any love or feelings. The bride/ the victim in the text gives a clear example of the strong woman who will not submit to injustice by declaring her love to Mukhaizam and her rejection of her cousin.

The cousin’s attitude represents the extremist tribal hegemony. Not done by the father, he keeps observing the bride/ the victim and he discovers her affair with Mukhaizam,

“و السعير بيحي لو ابالدون لحد برخصش ما عمش ابن نا
”الزبيبة ابن

“Your cousin is me, and I will never allow you to marry anyone else and disgrace us/ Even Al-Se’er and Ibn Al-Zabbenah” (28-29)

And he insists on his lawful right to marry her even if she will be just a maid in his household,

“عويبة عندي نخليش لو”

“Even if I keep you a maid” (33)

Then when she argues with him, he threatens to use ‘his’ right to kill her before she defames their tribe’s reputation by marrying a foreigner,

”مسنون ” معي القديمي حد راسش باقص“

“I will behead you by the sharpest of daggers” (42)

He even threatens Mukhaizam on the day of the wedding. The cousin does not even consider the bride’s father’s consent and he challenges the bridegroom,

”وهالك ميت شفقك خطوة تقدمت وان“

“And dare to step once, and it is thy end” (64)

The cousin’s rigid attitude influences the father who initially follows his wife and daughter’s intention and accept Mukhaizam as a suitable husband for his daughter generally forgetting the tribal laws that gives the cousin the lawful priority, especially when the cousin says,

”تفترق بعلمك راضي انت ايدلك ترضى و تتبعها عم يا وانت
”موالك في يقاسمك و الجنبيي يدخل جمالك أو

“And you agree, oh uncle! / You agree to separate your cattle/ and the foreigner shares you your property?” (75-77)

Here, the cousin’s intentions are revealed that he is greedy and wants the bride’s property. This is supported by his words to her that he will marry her even if she will be only a maid. Although this point demonstrates a vicious image of materialism, at the symbolic level (as women and the land are interchangeable symbols), it shows how one should be rigid when it is about the lawful property defending it against the foreigners’ intrusion. This image contradicts the initial image in the opening lines of the text which begins with Mukhaizam declaring his love for his land and for his

beloved, the bride/ the victim. The two are linked as both provide security and intimacy. This idea is expressed by its opposite,

“محيئة صعبة الدار فرقة”

“So hard and torturing is departing with home” (2)

Using the word “home” is significant that it refers to both the homeland and one’s home where wife and children are there.

The Bedouin Girl

Here, there is only one female character, the Bedouin girl. She with her goats intrudes the land of the peasant. When he is offended, she explains,

“كماها الوادي في أرض شي مالقيت”

“No other land in valley resembles it” (13)

This description of the peasant’s land meets the peasant’s impression about the Bedouin girl,

“يسبي والحسن حسنهما وشاقتني”

“And I have been invaded by her beauty” (32)

The peasant is attracted to her beauty as she is attracted to the beauty of his land. The two the Bedouin girl and the land share attractive everlasting beauty.

She is strong and reliable that her parents send her herding, and she is not afraid to argue with him although she is the intruder,

“لي قل إنت من”

“Who are you? Tell me!” (7)

And she is initiative to introduce herself,

“بيغوني البهم وأعطوني أهلي رسلوني البادية من أني
”رعاهها”

“I am from the Badia, sent by my parents/ I have the cattle to herd” (10-11)

And when he is driven by his emotions and touches her hand, she stops him and charges him with the tribal “Ano.” Later, when her father asks her if she accepts the peasant, she reveals pure obedience to him,

“حياها قل بنتي وتقول علي وتقسى تضر بني قلت إذا خافك”

“I’m afraid you beat me/ And think your daughter is devoid of shyness” (62-63)

“ولاها واعطيته نفسي حبه الي عقد عالقروي باه يا تعال”

“Come, oh father, marry me to the peasant/ I love him and, forever, will be forever faithful” (67)

So, the Bedouin girl represents a milder example of the Hadhrami women than the bride/the victim. Both are strong and independent and have a space of freedom given to them by their parents. They are bound by their obedience to their parents and do nothing that might disgrace them. The bride/ the victim has stronger attitudes through resisting the imposed marriage to her cousin and challenging the injustice of the tribal laws.

The two major male characters here are the peasant and the father. The peasant, though of a lower rank, is a hardworking gentleman whose love for his land and whose ambition for knowledge make him turn the land to be the most beautiful in the area and to defend his lawful right of equal chance as any tribal man in marrying the Bedouin girl. Again, like Mukhaizam, the peasant’s love for the land and everything belonging to it is parallelized to his love and loyalty to the Bedouin girl. The father resembles the Victim/bride’s father in that both are tolerant in giving their daughters the right to help in the household, to declare their opinions and to select their husbands. However, unlike the victim’s father who submits to the tribal laws and stops his daughter’s marriage, the Bedouin girl’s father balances the tribal laws and the governmental laws declared by the peasant and also, he thinks well about his daughter’s right to choose. And thus gives his consent to their marriage. To emphasize their love for the land as a source of pride and a base for belonging, Almeddar ends, as he starts it this operetta by involving all characters in praising the land and declaring their love for it. But there is a slight difference that at the beginning the peasant has been singing alone while at the end all participate with him.

“في العيش لي يطيب ما /هواها أعشق و قريتي أنا أعشق”
”سواها قرية”

“I adore my village and its air/ I can’t live but, on its soil” (1-2 & 68)

VII. Conclusion

In these texts, the constructive interchangeability of women and the land reflects how Hadhrami people, though of a tribal and patriarchal mentality, are attached to their land as a source of belonging and indication of identity. Likewise, their intimate love to their ladies is a source of power that makes them do the impossible to defend them and never cede with them. As for the Hadhrami women, the texts show that they have a space of freedom to say their opinions frankly and declare, but politely, their love affairs and their right in selecting their husbands. Meanwhile, they are respectfully bound by their parental

decisions. One aspect that is negatively interpreted is comparing the woman to the cattle and property in general that should not be abandoned for the foreigners/ invaders. It gives a humiliating image of the women as animals and property.

VIII. Recommendations

With this richness and profundity of implications about Hadhrami identity, Almehdar's operettas are significant sources of all details of Hadhrami identity. Therefore, I strongly recommend tackling all Almehdar's poetic production with academic investigation to give it its due value and to highlight more features of the Hadhramis.

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CLEAN COOKING WITHOUT THE GREENHOUSE GAS: EMERGING CHALLENGES**Curt W. Plumer¹, Khimji Ravji Vaghjiani²**^{1,2}Torrens University AustraliaEmail: ¹curtwplumer@gmail.com, ²khimji.vaghjiani@torrens.edu.au**ABSTRACT**

We need to bring people out of poverty, at the same time ensure clean living and community while managing the global environmental cost of doing so. In this paper we discuss how social enterprise can take this technological opportunity to provide alternative means for billions of people to cook cleanly whilst not polluting the environment that we all share. This paper seeks to show that there is a vast market available, one which can make a difference to clean the air inside the home and the air outside in the atmosphere, while having an immediate effect on the health of each household.

Keywords: Clean Cooking, Greenhouse Gas (GHG), Household Air Pollution (HAP), Indoor Air Pollution (IAP), Social Enterprise

I. Introduction

We have watched news story after news story on how governments and global corporations are investing trillions to decarbonize the supply chains of industries (1) and address climate change to maintain a status quo. Similar problems which face those at the bottom of the pyramid are seldom known, rarely discussed, and are removed from most of the collective discussion on climate change.

One such problem is of household air pollution (HAP) or indoor air pollution (IAP). The health effects are as diverse as respiratory infections, pulmonary disease, cataracts, blindness, tuberculosis, adverse effects to pregnancy, cancer, and cardiovascular disease (2).

This is not a small problem; it effects three billion people worldwide (3).

The emissions from the burning of fuel used for cooking the family meal are killing the inhabitants of the household. Further troubling is the majority effected by this HAP are mothers and daughters (2), as culturally they have the highest involvement in cooking for the household (4).

These are 3 billion human beings cooking their food with wood, charcoal or kerosene (2) (3), exposing themselves to HAP. Cooking with such materials results in incommunicable diseases resulting in death of four million people each year. These are 4 million humans that are lost to the world due to cooking food each year (5), from what most of us would do without a second thought.

How can cooking, so engrained in our human culture, be responsible for so much misery?

II. Global Stakeholders

Once expected to keep things in check, the market is fractured. There exists little consensus on how to adjust it (6); to accommodate a concept such as climate change.

It is apparent that corporations were not to be the harbingers of change, required to address ecology and the environment (7). Corporations have been seeking profit with the shareholder as the sole stakeholder above all else (8).

Governments take decisions on political agendas, exclusive of scientists, economists, and engineers, or generations of voters not yet born to this planet (9).

More than a single stakeholder should be considered in such decision making (10). It is not always grim. There exist progressive corporations that pursue more than profit alone (11). There exist progressive governments that adopt and embrace technology to address the needs of society (12), or those that allow for professional specialist advice to guide political decision making (13).

Many decisions are still taken to further personal careers or pursue political party dominance. Tax avoidance or tax incentives attract investment and the means for growth of corporations and nations (14) at the expense of climate change and other sustainability objectives. We remain in pursuit of industry, or the exploitation of natural resources, regardless

of need (15) seemingly “indeed, in practice we are all politicians” (16).

Individuals are not necessarily suitable to address such a thing as climate change. They struggle with; long-term vs short term benefits, contemplation of non-linear progression, representational concepts of that which is distant and the valuing the future similarly as we do the present (17).

Specifically with energy, like that required for cooking, individuals believe that access is a right, not something that they feel the need to pay for (18). This leaves others to pick up the tab for new, renewable, or sustainable technologies (19). High income earners adopt new technologies, with abundant inputs in the sun or the wind, along with self-storage (6) unbalancing the grid and placing further burden on technology from a previous era.

Energy supply from outdated power stations is maintained (20) to fill this gap ever reducing justification for future investment, or even maintenance, of such old base load providers. When this outdated infrastructure does not meet requirements of the individual, they are forced to act, creating a vicious cycle (21). In the end it is apparent that those that can ill afford it (22) are those that are left behind. In the end it appears that all on this planet will all pay for it dearly.

III. Existing Solution

The current solution for Clean Cooking and addressing this large problem was developed by a public-private partnership between the United Nations and an Oil & Gas Industry Association as the LP Gas Rural Energy Challenge (23), where the solution of LPG is put forward.

The World Bank assisted providing a breakdown guide to reduce energy poverty and further different countries ventures into the use of LPG (24), concluding that “proper use of LPG can virtually eliminate indoor and outdoor air pollution from fuel combustion”. The World Bank further promoted the opportunity of using LPG as “a global surplus exists” (25). The addressing of this issue clean cooking in a distributed means, as has been done with LPG, with each individual household removes potential opportunity for corruption and predatory government or business where there

is a need for larger infrastructure networks to provide any energy, sustainable or otherwise, in the developing world (26).

Even with the proliferation of the LPG solution (27), and the billions in subsidies paid each year (28) (29), where billions of people now have access to a clean burning fuel; the number, unfortunately, of exposed people without access to clean cooking has not diminished.

Disturbingly, as total number exposed to HAP remains stagnant, it is those most vulnerable, with low income (as defined by the World Bank) on less than \$3 dollars per day, that are unfortunately growing year on year (Figure 1).

IV. Current Predicament

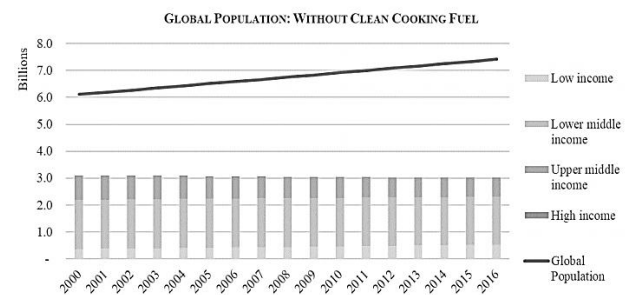


Figure 1 Global population without access to Clean Cooking by Income (37)

Most writing on the topic of Clean Cooking makes loose use of the word sustainable. The LP Gas Rural Energy Challenge (23), where LPG was promoted as the solution stated: “It’s clean” and has a “Lower greenhouse impact”. Such sentiment continues with the classification of LPG as “a ‘five-star’ fossil fuel” (30) and that “LPG’s environmental footprint is negligible” (25).

When one takes into consideration both the combustion of the cooking fuel within the household, along with the rest of the life of the fuel from creation to the disposal of the equipment used; the picture is very different.

Comparisons were made across LPG, Charcoal, Firewood and Hydrogen gas in an environmental assessment of use (31), using the ISO standard (32) covering the environmental life-cycle assessment of these four cooking fuels in compliance with the UN Sustainable Development Goals. The results of such provide new perspective on the subject and the challenge of moving people to Clean

Cooking fuel as a new task, requiring new thinking.

The single perspective of use; LPG is a very clean burning fuel. A conclusion on its sustainability can only be arrived at if you dismiss the amount of CO₂ produced. Increases in CO₂ are normally excluded from some papers altogether (33) as has been done in most literature on promotion of LPG.

The amount of CO₂ that is produced by cooking with LPG is staggering when quantified against the amount proliferated into the market as Clean Cooking since 2003.

Using numbers from the life-cycle analysis and supplementary data (31); the use of LPG is equal to 513kg of CO₂ being produced per household per day. If all three billion people that remain still cooking with unclean fuel are transitioned to LPG, then this would amount to an increase of some 317 million tonnes of CO₂ each, and every year.

To put such a number into context, as individuals we need assistance to fathom such numbers, it has been reported that the bush and forest fires that ravaged Australia and the United States in 2020 did release 184 million tonnes of CO₂ (34) into the atmosphere. In this case when the trees regrow, they would take that amount of CO₂ back out of the atmosphere in the process.

The movement of next three billion people away from firewood, charcoal and kerosene to LPG would produce enough CO₂ as 1.5 times such a fire season each year. This volume of emissions would require the planting of 20 million hectares of eucalyptus trees to absorb this amount of CO₂ from the atmosphere (35). Such a planting exercise is unlikely as 10 million hectares are lost each year (36) due to forest degradation and deforestation.

V. Concluding Remarks

The current solution is clearing the air inside households at expense of the air in the atmosphere, at odds with climate change goals. We must not lose sight of the seven billion, seven hundred and fifty-two million people (37) that exposed to climate change, such as it is “the thorniest challenge facing humankind” (38).

The continuing issue of HAP for 3 billion people causing 4 million deaths each year, most of those who are the most vulnerable, remains to be dealt with. Unless such issues involving poverty are addressed then the task of addressing those in the future as the climate does change will become ever more difficult (38); ignoring it will further those inequalities we seek to address.

Adam Smith believed that the living sparks of endeavor resided only in individuals (39). In this light the Social Entrepreneur can play a great role in enabling developing countries move to sustainable, renewable sources of energy thereby leapfrogging (40) those steps taken by the first world to arrive at where we are today.

Acknowledgement that we cannot continue in such a way is a pivotal step in creating an appropriate vision to address such a problem. The abundance of renewable energy is not disputed (41), the complexity and cost of its storage is of great issue. The opportunity exists to make use of renewable energy with sustainable technologies to assist the poorest people on the planet to live better for themselves and not contribute so greatly to climate change.

‘There is a task for society to reduce misery’ (42); addressing this problem of clean cooking in a sustainable way would reduce a great deal of misery ongoing in the world today.

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STUDY OF EMPLOYEE ATTRITION AND RETENTION OF MID-MANAGEMENT EMPLOYEES AT SELECTED ORGANIZATIONS IN THE BFSI SECTOR

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ABSTRACT

The BFSI division has one of the most noteworthy steady talent loss rates in India. 3 out of the main 5 sub-parts as far as wearing down are from BFSI, particularly from divisions that have considerable field-power with practically 100% steady loss. The reason for this paper is to look at the main considerations that lead to the whittling down of mid-administration workers in the BFSI segment and to structure an activity intend to check the issue. The methodology utilized in this investigation is subjective. The proposed technique includes undertaking inside and out close to home meetings and center gathering conversations of workers in different associations in India of around comparable sizes. A survey was glided over all the mid-administration representatives (Managers, Senior Managers, Chief Managers, Deputy Vice President, Assistant Vice President) of these associations to comprehend the significant explanations behind steady loss of administrators. Considering a survey of existing writing and master board meets, a structure for coordinating ability the executive's techniques zeroed in on the maintenance of mid-administration representatives. The example populace (N) to be considered is 200. The investigation plans to comprehend the variables that lead to the weakening of mid-supervisors and high-expected representatives in the associations and setting up a system to control the issue separated from needing a climb in remuneration. The investigation is restricted to the wearing down and maintenance methodologies for Mid Managers (Manager, Senior Manager, Chief Manager, Assistant Vice President, and Deputy Vice President) in the BFSI area as it were. The existing papers do not zero in on the maintenance of mid-administration level representatives. This examination is unique and would assist associations with holding the best ability they have at the mid-management level.

Keywords: Attrition, Mid-management employees, Retention, high potential employees, Women leadership

I. Introduction

Employee movement is an unavoidable facet of doing business. Attrition of employees is a major signal of dissatisfaction in the workplace. It deciphers a gradual decrease in the staff numbers that occurs when an employee retires, resigns, or is replaced. Changes in the policies, management styles, organization structure, or other operational aspects can lead to employees leaving the organization, eventually resulting in a higher attrition rate. Some factors that can lead to attrition in an organization are as follows- lack of proper growth, lack of well-defined career path, hostile work environment, weak leadership, and lack of appropriate compensation and incentives for the employees. Very often attrition is confused with turnover, it must be noted that vacancies left by attrition are not filled up promptly. This happens because there are a lot of factors affecting the attrition of employee- planned resignations, retirement, etc.

The insurance industry is one of the primary drivers for India's Banking and Financial Sector (BFSI) growth. This has been noted over the last decade that insurance employees are quickly moving from one insurance firm to another. Global authors found various explanations for the attrition. Lack of adequate compensation is one of the key reasons provided by different authors which reduces the morale of insurance agents to stick with the same profile. There is also a strong correlation between peer review and employee engagement in the organization of work and increasing peer review, enhancing job performance.

Abbasi and Hollman (2010) expect to recognize the effect of representative turnover on a foundation and found that over the top worker turnover regularly has extensive outcomes and can, at the extraordinary, risk the endeavors to accomplish the hierarchical objectives.

Siew-PhaikLoke (2008) explored the factors influencing young, well-educated

professionals' intention to switch in. The results indicated that this group of young workers had a strong propensity to move from work. It was prompted by both push factors (work-family-lifestyle balance intervention, etc.) and pull factors (better pay opportunities, more interesting jobs, etc.).

The rationale of the study is to understand the key reasons for the attrition that can lead to retention of mid-management talent in the BFSI sector. Another aspect is to also suggest a primary action plan with initiatives and success matrix to achieve retention and to propose an action plan to mitigate the negative factors that leads to employee attrition in the middle management.

II. Literature Review

Zheng and Lamond (2009) found out that attrition is a significant predictor of training, size, a timeframe of operation, and the nature of the business.

Naqvi and Ramay (2008) revealed that activity fulfilment and hierarchical commitment detrimentally affected turnover goals while saw elective openings for work had a considerable solid relationship with turnover expectations and are the principle determinant related with turnover aim among its experts.

According to Singh and Monga (2012), most insurance workers are under pressure and no one can perform their maximum possible work according to their ability, brought on by stress. Work-related stress disturbs the workplace and personal life of subjects. Stress can negatively affect interactions and customer relationships with friends, relatives, and family members.

Muhammad Rizwan, D Muhammad Qadeer Arshad et al. (2014) in their investigation delineate that the aim to leave or quit is enormously affected by absence of hierarchical duty, stress, and employment fulfilment. This shows the greater part objectives of the issues and the exploration can be accomplished. In any case, there were weaknesses to this examination. The future scientist should accept this overview as a benchmark and decipher it with their own eyes and one with a superior examination of results. Outstanding task at hand control and administrative senior administration connections can limit strain as well as improve worker fulfilment and the

association's dedication. Additionally, regardless of the significance of stopping aims, chiefs must track both the outward and natural wellsprings of occupation fulfilment.

The insurance industry is one of the primary drivers for India's Banking and Financial Sector (BFSI) growth. This has been noted over the last decade that insurance employees are quickly moving from one insurance firm to another. Global authors found various explanations for the attrition. Lack of adequate compensation is one of the key reasons provided by different authors which reduces the morale of insurance agents to stick with the same profile. There is likewise a solid connection between peer survey and representative commitment in the association of work and expanding peer audit, improving occupation execution.

There is also a high association in the workplace environment, between peer review and employee engrossment, and better peer review, better work efficiency. Representative inclusion likewise influences the basic 16 elements of individual achievement, authoritative masses conduct, characterized as individual optional direct that underpins the association and is not explicitly remunerated.

The focal idea driving these endeavors to improve representative support is to incorporate center directors more in dynamic and work measures and to permit those laborers greater adaptability and authority over employment assignments and working strategies (Cappelli and Rogovsky 1994).

Work satisfaction has been portrayed as an indicator of turnover goal and that it is an interceding variable between hierarchical acknowledgment and wearing down (Van Dick et al. 2004).

An association's constituent components are critical to its prosperity, it is its upgraded capacity to draw in and hold the best-quality ability that recognizes it from the others was something which was noted by Bowen and Shuster (1986).

Professional stability is characterized as a person's possibility or probability of keeping his/her work Adebayo and Luck (2012). Employer stability is the key explanation laborers quit the organization (Ashford, Lee, and Bobko 1989).

Birdseye and Hill (1995) acknowledged that the work environment is basic as it is the hugest factor that creates staying or leaving the relationship to the agents.

Further, an examination by Park (2007) uncovers that individuals who work low maintenance (or during a move) and non-desk laborers have a distressing, genuinely requesting work which prompted work disappointment. Robbins (1989) portrayed quality working life as a maintenance component that permits representatives to make their own decisions and cause them to add to the association's work life.

Lazar, Osoian, and Ratiu (2010) inferred that the two laborers and businesses would have the advantage of a fair harmony among work and private life. Over all parts of life, the will to get fruitful cooperation improves the effectiveness of associations and hierarchical results.

Worker adaptability at work which is causally connected to turnover is the most critical factor for working environment fulfillment. Wan (2009), Spence, Day, and Gilin (2009) additionally found that the most factor for work fulfillment was self-rule, which eventually winds up in maintenance.

Work-life agreement, per Ellenbecker (2004), influences the worker's choice whether to remain or not. In the event that the work isn't enough flexible, there would be a uniqueness among work and private life bringing about a distressing workplace and private life. Representatives from the shifted field need to figure deftly without which they are attempting to locate a substitute. Carrying a flexible workplace to attract the laborers is inside the business' hands. to remain inside the association, a genuine working climate is particularly significant for the laborer. Representatives are probably not going to leave the corporate if an endless work-life balance opportunity existed inside the corporate (Markey, Ravenswood, and Webber 2012).

Though Greenhaus, Collins, and Shaw (2003) accepted that interest coordinated how much an individual partakes inside the activity and private life. The time balance between times spent in work and private life and the fulfillment adjusts the degree to which one's work fulfillment and private life are the three

parts of work-life balance that influence maintenance.

As per Ellett et al. (2007), "steady, quality management" and "administration that supports staff" positively affect maintenance. Mignonac and Richebé (2013) have portrayed "steady administration oversight as a contributing element to the maintenance of representatives." Joo (2010) again guaranteed that being overseen decidedly is a supporter of maintenance.

III. Research Methodology

A descriptive study was designed for this paper. The example populace (N) to be considered is 200. A stratified random sampling technique has been adopted for this research. Primary sources were referred to and secondary sources have been used through a structured questionnaire. The survey was structured in such a manner to get impartial data from the respondents from different organizations of the BFSI division and was drifted uniquely among the center supervisors (Managers, Senior Manager, Chief Managers, Deputy Vice President, and Assistant Vice President) who are either working or have as of now left the association. The respondents were focused through different online media destinations like-Linkedin, different graduated class systems, and Facebook. The auxiliary data has been gotten from different organization sites, yearly reports, Insurance diaries, and different articles accessible on the web. The region of study is certain about the Banking and Financial associations of India as it were. The method of factor investigation has been utilized to comprehend the elements answerable for representative steady loss in the Indian Banking, Financial Services, and Insurance area.

IV. Data analysis

The survey questionnaire which was floated amongst employees consisted of questions that revolved around various factors which would lead to the attrition of employees from the organizations in the Banking, Financial Services, and Insurance (BFSI) Sector. The factors were around incentives and perks, workload, work-life balance, working environment, relationship with senior

leadership, career planning, promotions, extra pay for over-time, company rules and regulations, consideration of employee suggestions and grievances, etc. Responses were retrieved and imported into SPSS where factor analysis was performed on the same.

V. Findings

A survey was drifted among the workers of various center administration representatives in the BFSI segment and the accompanying socioeconomics subtleties were framed for the reactions got. 66% of the respondents were discovered to be male and 34% of the respondents were female. 88% of the respondents were hitched and the remaining were discovered to be unmarried. 32% of the respondents have accomplished 0-1 year in the association, 20% have the length of administration of 2-3 years, 27% have gone through 3-5 years in the association, 14% with 6-10 years of involvement with that associations and the rest 5% with over 10 years. 44% of our respondents fall in the age gathering of 20-25 years, 51% fall in the class of 26-35 years, 3% of the respondents are from

the age gathering of 36-45 years and the remaining 2% are of 50 years or more.

Figure 1-KMO and Bartlett’s test analysis

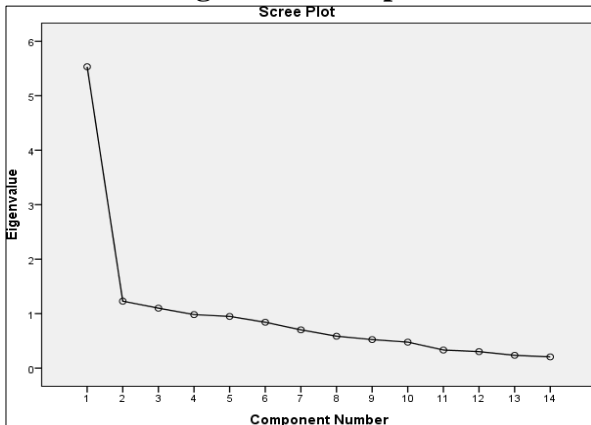
KMO Value	0.845
Bartlett’s Test of Sphericity	1063.686
df	91
Sig.	0.000

Figure 2- Component Matrix

Component	Initial Eigenvalues			Sum of extraction of loadings			Sums of extracted rotated loadings		
	Total	Variance (%)	Cumulative %	Total	Variance (%)	Cumulative %	Total	Variance (%)	Cumulative %
1	5.532	39.516	39.516	5.532	39.51	39.516	3.367	24.049	24.049
2	1.229	8.777	48.294	1.229	8.777	48.294	3.210	22.931	46.980
3	1.100	7.860	56.154	1.100	7.860	56.154	1.284	9.174	56.154
4	.982	7.015	63.169						
5	.949	6.779	69.948						
6	.842	6.016	75.963						
7	.702	5.016	80.979						
8	.586	4.183	85.162						
9	.524	3.744	88.905						
10	.477	3.410	92.315						
11	.332	2.369	94.684						
12	.303	2.164	96.848						
13	.235	1.678	98.526						
14	.206	1.474	100.000						

Figure 3- Rotated component matrix

	Component		
	1	2	3
<i>Does your organization give more consideration to motivators and advantages offered to you?</i>	.587	.252	-.105
<i>You are urged to take an interest in preparing to improve your abilities and capabilities</i>	.590	.180	-.286
<i>Do you think you get the acknowledgment that you merit for your presentation?</i>	.700	.289	-.164
<i>Are over-time salaries paid?</i>	.120	.498	.069
<i>What is your opinion regarding the workload?</i>	-.040	.049	.894
<i>Would you like to stay in this organization if your further career is planned?</i>	-.361	-.342	.386
<i>What do you feel about the workplace?</i>	.288	.729	-.248
<i>What is your sentiment about the organization rules and guidelines?</i>	.168	.778	.051
<i>Interpersonal relationships are encouraged in this organization.</i>	.119	.746	-.061
<i>The job you are performing is satisfactory?</i>	.539	.128	-.055
<i>How is your relationship with the superiors?</i>	.826	.028	.253
<i>Are you treated with respect in the organization?</i>	.659	.431	-.061
<i>Employees suggestions and grievances are considered</i>	.541	.568	-.233
<i>The working environment is open and trustworthy</i>	.462	.668	-.137

Figure 4- Scree plot

VI. Discussions

The KMO value from the analysis is found to be 0.845. A KMO value that is greater than 0.8 indicates that the sampling is acceptable. The significance value (P) from Bartlett's test of sphericity is also 0.00 (less than 0.05) which tells us that it is significant. The cumulative percentage of the factor loadings is found to be 56%.

From the above analysis, we can conclude that employees look for job roles where they get recognized for the performance they exhibit. This is especially key when associations develop or change. It assists representatives with building a feeling that all is well with the world in their incentive to the organization, inspiring them to proceed with incredible work. Agents react insistently when the heads show thankfulness for their incredible work or effort. Agent attestation is the ideal, agreeable, or formal accreditation of an individual's or social affair's conduct, exertion, or business result that underpins the association's objectives and qualities, and which has obviously been past basic needs. To be absolutely beneficial in the working environment at any level, you have to comprehend the psyche investigation of acclaiming others for their phenomenal work, to apply the standards of expert assertion yourself, and to urge others to start it in their working affiliations. Representatives react to appreciation passed on through certification of their phenomenal work since it admits their work is respected by others. Right when specialists and their work are respected, their fulfillment and advantage rise, and they are pushed to keep up or improve their remarkable work.

Gallup examines show worker acknowledgment is the key factor impacting representative commitment and, in this way, hierarchical exhibition. Worker acknowledgment is the rule of social confirmation in real life, a term spearheaded by social brain research teacher Robert Cialdini.

A sound workplace is a second-factor representative search for in an association and is impeccable with respect to keeping up a positive outcome in a troubling atmosphere. There are four perspectives to examine while making a strong workplace condition.

1. Physical condition and occupations wellbeing and security A strong workspace condition furthermore incorporates the state of being of the working environment or workshop and the word related prosperity and security of your agents. Reduce the worry of your delegates by examining the prosperity of the workplace.
2. Health and way of life practice- Representatives will consider the association they are working for if they understand that they are being dealt with. Delegates are the best asset of every affiliation and putting vitality into specialist prosperity can uphold better collaboration, extended effectiveness, and diminishing weakened leave and workplace accidents.
3. Supportive work environment Every representative search for a steady boss. Making such a situation for them is an especially significant factor.

Another factor people look at is flexible rules and regulations in an organization. Concerning drawing in top ability, numerous businesses turn their eyes toward adaptability in the working environment. A strong work-life balance is vital for the two businesses and representatives. Controlling ceaselessly from a customary 9-to-5 work environment structure that directs the whereabouts of a worker, pushing toward a cutting-edge working environment model that improves representative fulfillment and profitability, is perfect in the present occupation atmosphere. Employers must keep in mind that they are recruiting people, not robots. That implies worker commitment ought to be the first concern when you select competitors and

evaluate the general joy of your present representatives. Organizations reluctant to be adaptable are probably going to miss out on the war for ability.

Interpersonal connections suggest a strong relationship among individuals coordinating in a comparable affiliation. Agents collaborating should share an exceptional bond for them to pass on their level best. It is fundamental for individuals to be direct with each other for a strong social relationship and over the long-haul valuable feel at the workplace. An individual spends around eight to nine hours in his affiliation and it is unreasonable for him to work in isolation. People are not machines who can work at a stretch. We need people to analyze various issues, evaluate points of interest and drawbacks, and reach to plans to benefit the laborers just as the relationship all in all. Delegates can conceptualize together and reach to better considerations and frameworks. Frameworks must be inspected on an open stage where everybody can convey his/her points of view. Delegates must be gathered for meetings at any rate once in seven days to propel open correspondence. Coordinated effort all the time is huge for strong connections. Social relationship straightforwardly influences the affiliation culture.

An adequate workload is very essential in the workplace. The excess workload can lead to stress, burnout, discomfort, lack of work-life balance and eventually lead to attrition of employees. Reduced-load work game plans include a decrease in remaining burden or hours with commensurate pay decrease. Managers utilize these plans to hold talent who esteem double commitment in the profession and individual life.

Channelizing a communication system amongst the middle managers and senior leadership can help boost the morale of employees and act as a motivation factor for them and help them define their career path. A lot of employees feel that there is a lack of such a channel in many organizations which eventually leads to quitting the company. Hence, HR managers must make sure that there is a proper communication setup between employees and the senior leadership in a way of a 'CoffeeConnect' so that they do not feel

disconnected from the organization's values and leaders.

We can prepare a priority matrix based on the factors which show the highest significance according to our analysis between 'Urgency to act' VS 'Impact'.

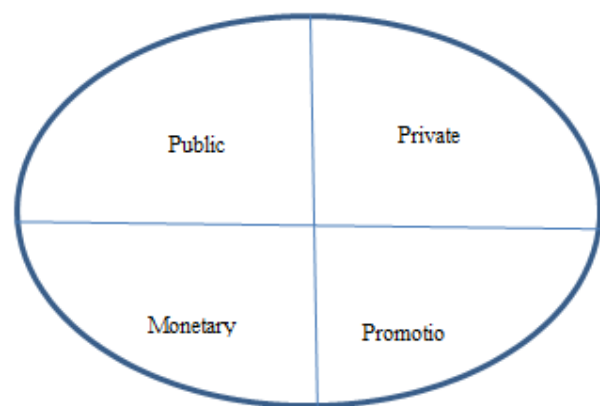
Figure 5- Plot between Urgency to act and Impact

I M P A C T	H I G H	Setup a proper recognition system	Flexible organizational rules and regulations
	L O W	Interpersonal relationships	Workload should be adequate
		LOW	HIGH
		URGENCY TO ACT	

Retention Strategies to mitigate the problem of attrition

Recognition

Figure 6- Types of Recognition



Public Recognition:

- Post a photograph of your representatives via web-based networking media and gloat about their accomplishments.
- Highlight your representatives' examples of overcoming adversity in your organization's bulletin.
- Send a far-reaching complimentary email and acclaim your representatives for an occupation very much done.

Private Recognition

- Send your representatives a written by hand note, or simply leave a clingy note

saying "Thank you" around their work area.

- Call a representative to your office just to state bless your heart. Try not to examine some other issues.

Promotion

- Prize your representative with another, propelled work title.
- Offer your representatives a chance to take a shot at extraordinary activities past their standard obligations.
- Welcome your top entertainer to join your official group meeting.

Monetary Reward

- Show your increase by giving your workers a raise
- Shock your workers with tickets for a gathering, outside affirmation, class, preparing, or other instructive chances.
- Prize your representatives with courtside seats of a game, VIP access to a show that is sold out, or film passes to a debut.

Adequate Workload

Survey results state that employees tend to leave an organization due to its harsh and stringent working hours (especially in the current COVID-19 scenario). Companies can have certain policies so that employees can have a proper mix of work and life. Some initiatives can be (considering the working hours to be 11 am -6 pm):

1. No meeting should be set up before 11 am whatsoever.
2. No meeting must exceed a time limit of 40 minutes
3. Lunch hours must be silent, and no meeting should be scheduled in that time frame.
4. Weekends must be compulsorily off and should be meant for employees to spend time with their loved ones.

Flexible rules and regulations

1. Every employer must try and provide flexible working hours to his/her employees. Employees must be entitled to work from home as they wish, and a proper policy must be set up for the same.

Interpersonal relationships in the workplace

1. Social aptitudes structure a basic bit of your master apparatus compartment. From collaborating on an endeavour with a partner to liaising with a noteworthy

external accomplice, you need the assurance, compassion, and social capacities to gain by every participation.

VII. Conclusion

As the development inclines firm up in work advertise, India is set to observe the most elevated wearing down rate on the planet. Human Resource is the most significant asset and mounting pace of weakening is the greatest test especially in life coverage organizations. Worker turnover has broad negative effects on an association as far as its altruism, competency, benefit, and level of execution. Quality labour and its maintenance are one of the major deciding elements in the association achievement. Along these lines, private protection specialist organizations need to execute powerful representative maintenance systems that can effectively hold the workers for a longer span. Recruiting from one another is a typical practice among insurance agencies. Representatives, particularly in center levels, will in general move among insurance agencies. The high steady loss rate influences the profitability of the association if more individuals are leaving the association, the more it is a channel on the organization's assets like enrolment costs, preparing and direction assets and the time. As high weakening effects the organization's asset contrarily, the associations must give better vocation openings and appropriate workplace to hold the abilities in their association.

From data analysis and interpretation, 4 factors came out from the structured questionnaire. These 4 factors include various major problems which are the root cause of employee attrition of mid-managers in the BFSI sector. By strongly working on these factors, public and private insurance companies can enhance their employee retention rate and minimize employee attrition.

VIII. Limitations and Further Scope of Study

This study is limited to only the mid-management level employees in the BFSI sector and the sample size is confined to 200 members only and few private sector insurance companies are taken into consideration. This study is related to attrition rate in BFSI sector, and this sector has no boundaries, there is lot

potentiality but due to time constraint the researcher has considered only a few companies. In further the researchers can take a greater number of companies and there is a chance to compare attrition rate in public and private insurance companies as well as attrition rate in rural and urban areas.

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PRICE DYNAMICS OF ALUMINIUM METAL MARKETS IN INDIA

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ABSTRACT

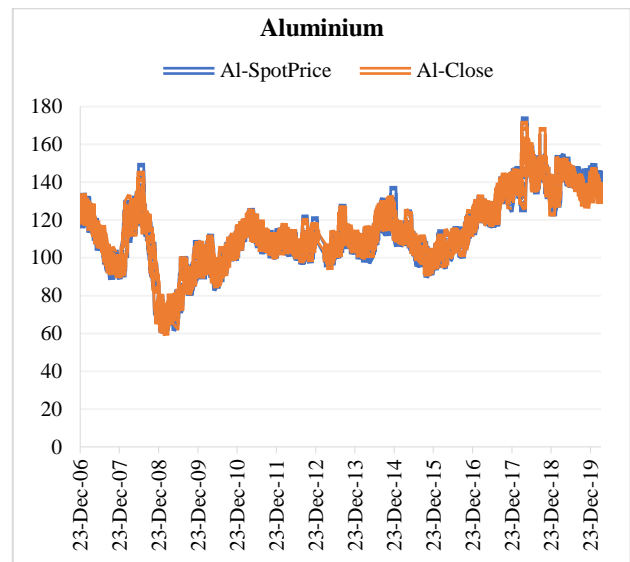
Aluminium is the third most abundant element present in the earth crust. It is a unique metal, which is strong, flexible, and impermeable. The metal is mainly used for electricity, transportation, construction of the building, packing and others. The Indian aluminium price depends on domestic and international markets. The metal commodity derivative trading was established long back in national-level online commodity exchanges, and from then on, it has actively traded in futures contracts. The price dynamics between spot and futures market helps to fulfil the primary function of derivative markets. The current study is to examine the long-term equilibrium relationship between two markets. The study was carried out using the econometric tool for ten years. The daily closing price of the spot and futures market is used for the analysis. It has been found both markets are cointegrated and share a long-run equilibrium relationship.

Keywords: Price dynamics, spot, future, unit root test, cointegration, VECM

I. Introduction

Aluminium is one of the most actively used base metals for transportation, packing, defence and consumer electronic industries. The Aluminium with production at 3615839 MTs during April 2020-March 2021 as compared to 3656130 MTs during April 2019-March 2020 as per data from the ministry of mines. Aluminium in India is dependent on domestic and international spot market prices, exchange rates etc. China (18%), Germany (11%), USA(7%) are the top three exporting and USA(14%), Germany(11%) and China(6%) importing countries in 2020.

The organized future trading in India had a new opportunity in 2003 where national exchanges started trading in commodities such as base metal, precious metals, agricultural commodities. Currently, exchanges are offering both futures and options contracts to its investors. MCX is a leading Exchange in India in terms of volume and value traded.



The aluminium future and spot price reached a maximum in the year 2008. A stable future and spot price in the year 2010-13, which averaged around Rs 109. MCX aluminium January 2015 futures contract prices dropped by about 3% January to close the month at Rs.113.40 per kg. Slowing demand and plentiful supply, in addition to macro-economic concerns over the global economy, especially the Chinese economy, kept aluminium prices down. Aluminium October 2017 Futures Contract prices moved up by 1.2 % in October, closing the month at Rs. 138.60 per kg. Global demand growth, Chinese aluminium capacity cuts and decline in LME aluminium inventory levels helped the rise in aluminium prices. Concerns. MCX Aluminium November Futures Contract

moved down due to the World aluminium market being in surplus in 2019 for the first time in 7 years. Futures trading in base metal been active since 2003 where commodities can be either in the spot market or in forward/Future markets. The primary objective of the future market is to help discover the price and to hedge risk. In this context, the current study attempts to analyze the price dynamics between spot and future for Aluminium in India.

Year	Daily volatility	Returns
2020 (Jan- Dec)	0.71%	5.49%
2019(Jan-Dec)	0.59%	2.00%

II. Review of Literature

Golak Nath, Manoj Dalvi, Vardhana Pawaskar, Sahana Rajaram & Manoel Pacheco (2019)

The effectiveness and price discovery in the Indian gold futures market are investigated in this research. The link between home and international spot prices and gold futures prices is investigated to establish information flow between two variables. The microstructure of the market and the impact of different policy shifts on India's gold market are investigated. The futures and domestic spot markets have a long-run cointegrating connection. According to our findings, the daily price discovery occurs in the futures market, although not in the spot market. Futures are ineffective as a hedge against domestic spot prices. For our analysis, we used the relatively close gold futures contracts offered on the MCX, which are the most liquidity in terms of trading volumes. Trading that lasts longer than a month is considered illiquid and is therefore excluded from the study. The MCX spot price is thought to indicate domestic spot pricing, whereas the WGC spot price is believed to represent global market prices. For the analysis, the natural logarithm of all variables was used. The information was gathered from January 2008 to March 2018. The goal of this research was to investigate the microstructure of the Indian gold market and policy changes. Across numerous political regimes, the study experimentally checks for gold futures efficient markets and determines the direction of the flow of information between the spot and futures markets.

Sanjay Sehgal and Tarunika Jain Agrawal (2019) Since July 1, 2013, the government of India has imposed a 0.01 per cent commodity transaction tax (CTT) on non-agricultural commodity futures trading. The influence of CTT on market liquidity, instability, and government tax collections in the Indian commodities market is examined in this article. We use daily data from May 1 2010, to August 31 2016, for five example commodities: gold, Aluminium, copper, zinc, and crude oil. The application of CTT has damaged the parity of the Indian commodities futures market with international markets, as CTT is not imposed on the COMEX, LME, NYMEX, and other exchanges. Furthermore, a comparison of MCX and foreign businesses can provide signs of trade migration. This viewpoint is further supported by the fact that liquidity has decreased since the CTT was imposed. We use daily closing prices for the spot market, and for the near-month futures contract, we use settling prices. Daily trade volumes and open interest (OI) data are also used in the research. Expanded demand for storage, quality testing labs, shipping, insurance, and other related services will result in more employment and income opportunities because of increased commodities futures trading.

Kirithiga, S. Naresh, G, Thiyagarajan, S (2018) Investing in gold and silver has traditionally been thought to be a safer bet; yet, as risk concerns have increased in recent years, so has an interest in these bullion commodities. The price, return, and volatility criteria are frequently used to choose whether to invest in an asset. The unpredictability of any individual investment determines its risk. Exchange-traded derivatives can efficiently handle high volatility risks, and bullion futures contracts come in various sizes to meet the needs of different bullion investors. The daily spot and futures prices of all available gold and silver arrangements were gathered from the multi-commodity exchange (MCX) over ten years from 2006 to 2015 to investigate the influence of volatility in setting bullion prices. The errors made in modelling returns are measured by volatility, which may be recorded using methods like autoregressive conditional heteroskedasticity (ARCH) and generalized autoregressive conditional heteroskedasticity

(GARCH). In all sizes of contracts for gold and silver, the analysis demonstrates that the previous day's return information affects today's return volatility. As a result, the study suggests that while commodity spot prices collect information from futures prices, volatility data has little impact on the two.

Shashi Gupta, Himanshu Choudhary, D. R. Agarwal (2018) The purpose of this paper is to explore the long-term economic efficiency and price discovery in the Indian commodity futures market experimentally. Two agricultural commodities, two industrial commodities, two precious metals, and two energy commodities were used in the research. The spot and futures market time series are analyzed using advanced statistical approaches such as restricted cointegration and the vector error correction model (VECM). The limited cointegration test indicates that all commodity' near-month futures prices are cointegrated with spot prices but that futures prices are ineffective at predicting future spot prices. The null hypothesis of effectiveness and unbiasedness is rejected for all eight commodity markets in the Indian commodity futures market, evidenced by the low volatility market (Kumar & Pandey, 2013, Journal of Indian Business Research, 5(2), 101–121). This confirms the result of Fortenbery and Zapata. Short-term inefficiencies and bias are established by the statistically significant value of last spot and futures prices. According to the considerable value of the error correction term (ECT) of futures prices, commodity futures are the essential indication of commodity price changes.

Sushmita Bose (2017) Given the large volumes of commodity futures trading and their involvement in the portfolios of a wide range of investors, commodity futures are treated here as a financial product comparable to equities futures. As a result, we look at the patterns in the inter calculated by the two national multi-commodity exchanges. On these exchanges, futures contracts are exchanged electronically. This should be emphasized that Indian commodity/futures indexes are hypothetical indexes; unlike equity/futures indices, they are not (yet) exchange tradable. Each index, therefore, is indicative of price fluctuations in the spot/futures market as a

whole because it is derived using real-time prices of exchange-traded commodities/futures. Our data sample includes the MCX's multi-commodity spot and futures indexes, as well as the NCDEX's agricultural commodities spot and futures indexes and global index values. The sample period is from June 2005 to September 2007. Adjusting the estimation to become robust to heteroscedasticity of the returns data is another type of improvement. Indian commodity/futures indices are notional indices; they should be highlighted. Each index, however, is indicative of price fluctuations in the spot/futures market because it is derived using real-time prices of exchange-traded commodities/futures.

Nidhi Aggarwal, Sargam Jain, Susan Thomas (2015) Trade of commodities markets in India switched from single-commodity regional markets to multi-commodity national exchanges in 2003. The effectiveness of commodity futures price discovery and hedging just after adjustment is examined in this research. A comparable shift in policy has been seen in India, where the government declared the liberalization of commodity derivatives markets in the "National Agricultural Policy" of 2000, after decades of restrictive measures. The study period encompasses the recent period marked by significant price volatility, prompting extensive government and regulatory involvement. Five agricultural commodities and two non-agricultural goods are among the commodities examined. For the period 2003 to 2014, the analysis analyzes daily data from India's two largest national commodities exchanges: the Multi Commodity Exchange (MCX) and the National Commodity and Derivatives Exchange (NCDEX). Non-agricultural commodity trading is dominated by MCX, whereas NCDEX dominates agricultural commodity trading. Daily closing prices on the futures contract as well as the spot market are included in the data. Because the majority of liquidity is focused on the near-month futures market, we limit our analysis to the near-month contract's pricing. Two days before the contract expires, we roll over to the next month's agreement. We conclude that, on average, futures prices discover information relatively quickly, but they are less successful at-risk

management. The study investigates the elements that influence commodities futures' role in wealth creation and hedging efficiency. Carlos Arnade And Linwood Hoffman (2015) Relying on a trying to roll error detection framework, we presented a framework of moment wealth creation. We show that the spot market dominates market pricing in nine products, while the futures market dominates only in six commodity markets. The regular time averages of volume and open interest, which measure the number of futures contracts exchanged and the total number of existing futures contracts owned by market participants, are presented in this table. As a result, our results question the widely held belief in commodity prices that the stock market controls price discovery. We also use a portfolio creation and hedging technique to demonstrate the economic importance of price discovery.

Sinha Pankaj and Mathur Kritika (2015) The Commodities Futures Market is a tool for determining the price of commodities. On July 1, 2013, the Indian government imposed a 0.01 per cent commodity transaction tax on sellers for derivative transactions. This tax is similar to the Securities Transaction Tax, which was set earlier on operations in the securities market. In India, the distinction between the two taxes (STT and CTT) is that STT applies to both purchasers and sellers, whilst CTT applies to non-farm commodity derivatives and is paid by the seller. The purpose of imposing these taxes is to reduce price volatility and boost tax revenue; however, whether it will accomplish these goals is disputed. It is argued since the tax levy hurts the traded volume of contracts. The CTT currently applies to non-farm commodity derivatives exchanged on Indian commodity markets. The present study employs a bootstrap approach to examine commodity transaction taxes' influence on overall commodity exchange trading volume and specific commodity trading volume. The first autocorrelation model is also used to investigate the impact of CTT on commodity portfolio returns and volatility.

Fergal A. O'Connor, Brian M Lucey, Jonathan A. Batten, Dirk G. Baur (2015) We look at the research on gold as an investment. We examine a wide range of sources, including the studies

in this special edition of the International Review of Financial Analysis, for which this survey serves as an editorial introduction. We begin with an overview of how gold markets work, including the little-studied leasing market; we next look at research on physical gold demand and supply, gold mining economics, and finally, investment assessments of gold. Because the trading days for TOCOM and COMEX/NYMEX do not overlap, the authors were able to examine how closing prices on one affect opening prices on the other. Further sections discuss gold market efficiency, gold market bubbles, gold's relationship to inflation and interest rates, and the relatively new literature on gold's behavioural features. The researchers here believe that this is a connection that will end and that gold research will continue to thrive independent of the price's future progression.

Dr Chinmaya Behera (2015) One of the essential economic purposes of the futures market is price discovery, which provides a competitive reference (futures) price from which spot prices are calculated. The paper includes metal and energy futures to look at wealth creation and efficient markets in the Indian futures market. Daily futures and spot closing prices for gold, silver, copper, and crude oil from September 1, 2005, to December 30, 2011, and natural gas from November 1, 2006, to December 30, 2011, are included in the sample data. The study reveals fair price discovery in the futures market using cointegration and error correction mechanisms. According to the survey, price discovery occurs first in the futures market, then in the spot market. The standard deviation ratio is used to examine market efficiency in the futures market. If it is discovered that the gold market is inefficient, it fails to integrate all of the variables of the data currently available on the market.

Carlos Arnade And Linwood Hoffman (2015) From 1992 to 2013, this study examines the relationship between soybean and soybean meal cash and futures prices. The values of both commodities are approximated using error correction techniques. Both simulations include an exogenous measurement of price variability to see if variability accelerates the restoration of cash and futures prices to their long-run

equilibrium relationship. This is used to assess the influence of price fluctuation on efficient markets and the price discovery process in the short run. The findings show that market adjustment rates and the price discovery process are influenced by price fluctuation. This research looks at how price discovery is affected by unexpected information (errors from a long-run model). We examine the function of price fluctuation in determining this reaction and its impact on price discovery weights directly. The long-run relationship among variables and the disequilibrium relation are both embodied in a typical ECM. Other parameters (such as producer demographics) could be incorporated into the model to understand further how the cash and futures markets are shifting their roles in the price discovery process.

Some Coronado Ramírez, Pedro Luis Celso Arellano, Omar Rojas (2015) Using a sample of eight futures contracts, we explore the adaptable market efficiency of the agriculture commodity futures market in this research. The nonlinear serial dependency in the returns series is discovered employing a battery of nonlinear tests. We use the Hinich portmanteau bicorrelation test to find the moment our sample exhibits nonlinear serial dependence and thus adaptive efficient markets. We show how we used a battery of nonlinear tests to detect nonlinear serial dependence and experimentally assess our sample's EMH and AMH. Even while we are primarily interested in demonstrating how nonlinear events exist in specific periods, we use a battery of tests to present a more rigorous study and avoid the risk of underplaying the generality of the results. We employ the McLeod-Li test, Tsay test, ARCH-LM test, BDS test, and Hinich test, described in the introduction. We found that such behaviour happened in non-overlapped time windows ranging from 2.63 per cent of the total number of windows in the case of soybean oil to 9.87 per cent in the case of eggs. As a result, the AMH was exposed to the return of these futures contracts.

Prabina Rajib (2015) Though the agricultural industry significantly contributes to the Indian economy, it is hampered by several barriers: outmoded farm marketing and price discovery rules, which result in low price realization by

Indian farmers. Six national-level exchanges in India offer commodities futures contracts, with several also offering electronic spot exchanges to assist spot commodities trading. Farmers, on the other hand, have been underrepresented in these trades. ITC-ABD, one of India's leading agri-commodity aggregators and exporters, has begun to use these exchange platforms to hedge price risk. Mr S. Sivakumar has over three decades of expertise in the agriculture sector and has a thorough understanding of commodity markets and the demands of Indian farmers. This interview attempts to understand his thoughts on growing farmers' involvement in commodity derivatives trading, as well as ITC-commodity ABD's hedging approach.

III. Research Methodology

Objectives of the Study

1. To understand the market fundamentals of the commodity aluminium of MCX.
2. To study the long-term equilibrium relationship between the spot and futures markets of Aluminium in India.

Data Description

The daily price of spot and futures contract of Aluminium for ten years from 2010-2020 is considered for the study. The secondary data of the prices are collected from Multi commodity exchange.

Econometric Methodology

Descriptive statistics check the normality of data using mean, standard deviation, skewness, kurtosis.

Mean:

Mean is the fundamental of a continuous function of at least one factor over a given range divided by the proportion of the content.

Standard deviation:

The standard deviation is a proportion of the measure of variety or scattering of a set of qualities. A low standard deviation demonstrates that the rates will generally be near the mean of the set, while a high standard deviation shows that the grades are spread out over a wider range.

Skewness:

Skewness is a part of the asymmetry of the probability distribution of a random variable about its mean. The skewness worth can be positive, zero, negative, or unclear.

Kurtosis:

Kurtosis is a proportion of the "tailedness" of the likelihood appropriation of a random variable. Like skewness, kurtosis depicts the state of a probability distribution, and there are various methods of measuring it for a hypothetical distribution and comparing methods of assessing it from a sample from a population.

Jarque-Bera:

Jarque-Bera test is a goodness-of-fit test of whether test information has the skewness and kurtosis coordinating with a normal distribution. The test is named after Carlos Jarque and Anil K. Bera. The test measurement is consistently nonnegative. On the off chance that it is a long way from zero, it flags the information don't have a normal distribution.

Probability:

Probability is the part of arithmetic concerning mathematical descriptions of how likely an event is to happen or how likely it is that a proposition is valid. The probability of an event is a number somewhere in the range of 0 and 1, where, generally talking, 0 demonstrates the event's difficulty and 1 shows certainty. Econometric tools used for the study is unit root test, test for cointegration, VECM. Unit root test: In econometrics, the stationary test is a property where the state value of the variables doesn't change with time. Mean-variance and covariance remain the same at any point in time, which is called mean

revision. There are different types of stationarity tests, one of the best is the Augmented Dickey-Fuller Test. This study adopts ADF as it helps to analyze autocorrelated data and helps to include lag values as per the frequency of data.

$$\Delta X_t = \rho_0 + \rho X_{t-1} + \sum \delta \gamma \Delta X_{t-i} + \epsilon_t \tag{1}$$

JOHANSEN AND JUSELIUS TEST OF COINTEGRATION AND VECTOR ERROR

The research uses Johansen's test for cointegration since it is widely used to test cointegrating relationships for non-stationary time series data.

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum \Gamma \Delta Y_{t-1} + \epsilon_t \tag{2}$$

VECTOR CORRECTION MODEL

The research paper uses the vector correction model as it helps to know the short-run properties of VECM. Nonexistence of cointegration directly roots to Granger Causality test to ascertain causal linkage between variables.

$$R_{st} = \mu_s + \lambda_1 Z_{t-1} + \sum_{i=1}^k \alpha_{s,R_s,t-i} + \sum_{j=1}^l \beta_{s,j} R_{f,t-j} + \epsilon_{s,i} \tag{3}$$

$$R_{ft} = \mu_f + \lambda_2 Z_{t-1} + \sum_{i=1}^k \alpha_{f,R_f,t-i} + \sum_{j=1}^l \beta_{f,j} R_{s,t-j} + \epsilon_{f,i} \tag{4}$$

Z_{t-1} is the error correction term. $\lambda_1 Z_{t-1}$ & $\lambda_2 Z_{t-1}$ speed of adjustment of return towards long-run equilibrium. $\alpha_s, \alpha_f, \beta_s, \beta_f$ measures short-run integration.

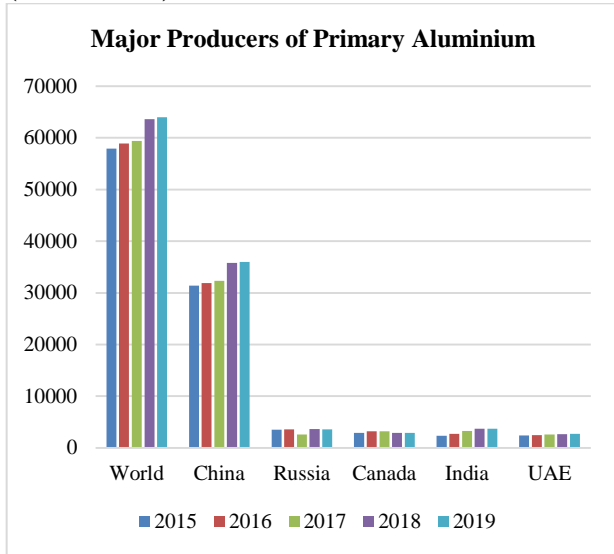
GRANGER CAUSALITY TEST: The research paper uses the Granger causality test to check the lead-lag relationship.

Data Analysis

Market fundamentals of Aluminium of MCX: A summary is presented in Table 1

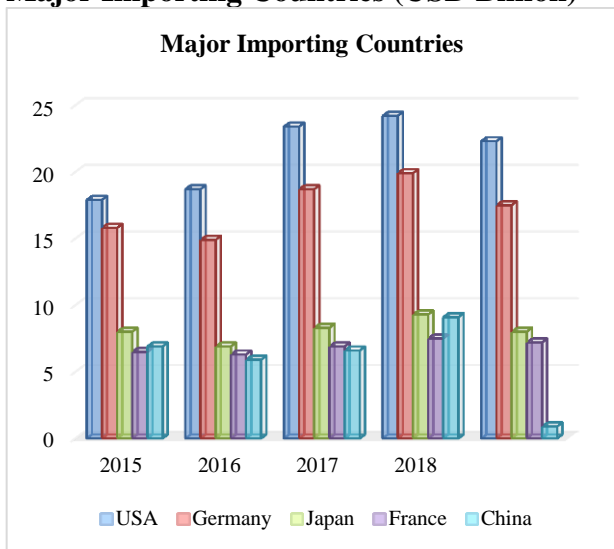
	World scenario (000 tonnes)					Indian Scenario				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Aluminium production – Primary	58456	59890	63404	64336	63697	1815	1746	1843	3694	3656
Production capacity	71200	75500	77800	77000	77900	1671	1751	1958	2318	2152
Aluminium consumption	57722	60922	68700	60524	62270	1153	1547	2012	2338	2371

World Producers of Primary Aluminium (000 tonnes)



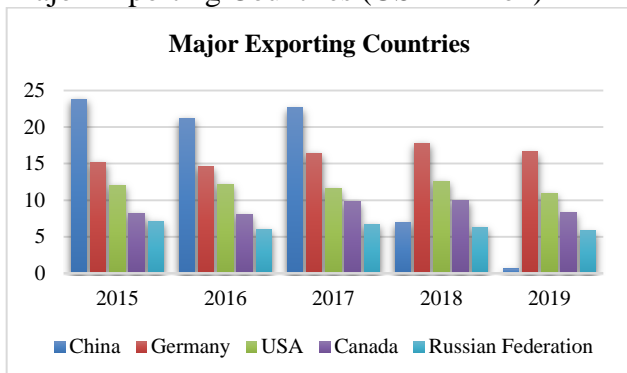
Source MCX

Major Importing Countries (USD Billion)



Source MCX

Major Exporting Countries (USD Billion)



Source MCX

Interpretation :

- Demand and supply :
 - a) Global scenario: In a worldwide system, production is more than consumption in 2015 and 2019, whereas consumption is more than production from 2016-2018. This is due to increased production capacity, which means that the supply is more than demand over the years.
 - b) Indian Scenario: In the Indian scenario, there is an increase in production from 2015 to 2019 from 1815 to 3656 (000 tonnes) respectively. There is an increase in imports from 2015 to 2019 from 1671 to 2152 (000 tonnes). There is an increase in exports from 2015 to 2019 from 1153 to 2371 (000 tonnes) respectively which can be due to the rise in production.
- Major producing countries: The production in the world has been increasing over the year by 4% to 5% year on year. Among all the nations, the major producing country is China, but over time from 2015-2019, the production has been decreasing, similar to Canada's case. At the same time, China has increased their output by 50%-60% every year compared to other countries like Russia, India and UAE.
- Import: The import has been decreasing in the year 2016 and 2019. The highest importing countries are USA and Germany. Whereas other countries such as Japan, France and China also imports to other countries. The rapid decrease in the year 2019 can be due to low production due to the COVID-19 pandemic. The major importing countries to India are China, UAE and UK in the top three positions.
- Export: The export has been decreasing in the year 2016 and 2019. The highest exporting countries are USA and Germany. Whereas other countries such as Canada, Russia and China also exports to other countries. China was one of the top two importing countries in the world in 2015-17 but has rapidly decreased by 50% in 2018 and 2019. The rapid decrease in the year 2019 can be due to low production due to the COVID-19 pandemic. The major exporting countries to India are Korea,

Malaysia and USA in the top three positions.

Descriptive statistics of Aluminium

Table 3

	Future	Spot
Mean	110	108
Standard deviation	13	12.18
Skewness	-0.96	-0.94
Kurtosis	4	4.2
CV	12%	12%

The average daily rate is identical for both the spot and futures markets. The standard deviation is high in future compared to the spot future market. The series are asymmetric with negative skewness. The kurtosis for both the spot and futures market is above 3 indicates a fatter tail.

Test for stationarity:

H₀ The future and spot prices of Aluminium are not stationarity

The test for stationarity is done using Augmented Dickey-Fuller and Philips Perron Test.

Table 4

	SPOT		Future	
	Levels	First Difference	Levels	First Difference
ADF test	-2.723 (0.141)	-56.751 (0.000)	-3.1245 (0.032)	-55.378 (0.000)
PP test	-3.124 (0.070)	-55.721 (0.000)	-3.1012 (0.034)	-55.321 (0.000)

Significant at 1%

The unit root analysis of log value of Aluminium and spot price and future price using augmented and Phillips perron test. The results indicate that future and spot are integrated at first difference. Thus, the null hypothesis is rejected, and the price of Aluminium was found to be stationary.

Cointegration test:

Post stationarity test Johansen's and Juliesus cointegration test is performed

H₀There is no cointegration between future and spot prices of Aluminium

Table 5

Vector	Trace statistics	Maximal Eigenvalue	5% critical value for trace statistics	5% critical value for max Eigen Statistics	Remark
r=0	33.29	30.15	0.000	0.000	Cointegrated
r=1	3.002	3.002	0.051	0.051	

By considering the stationary of spot and future price at the first difference, Johansen's cointegration test has been performed to check the long-run equilibrium relationship between two variables. Using the p-value of trace and Eigenvalue, the null hypothesis has been rejected at 5%level of significance and concluded that long-run equilibrium relationship between two variables.

Vector Error Correction Model:

This analysis is used to check the long-run causality. The VECM is used by incorporating error correction term in case of diequilibrium.The null hypothesis framed as there is no long run causality between futures and spot prices.

Table 6

	Coefficient	P value	Coefficient	P value
ECT	-0.512	0.000	-0.13	0.001
S1	-0.156	0.000	0.052	0.109
S2	-0.051	0.022	0.027	0.176
F1	0.312	0.000	-0.001	0.871
F2	0.131	0.857	0.005	0.600
C	0.018	0.846	0.06	0.875

The above analysis indicates that the coefficient of error correction term is significant and negative for spot equation at-0.512 full future question equation-0.13 of Aluminium. Therefore, it is 51% disequilibrium collected by spot price every day and 13% in the future. from the above

table, the coefficient of error correction Tom siren spot equation than future equation

IV. Conclusion

The study attempts to understand the price dynamics of the spot and future market for Aluminium in India. The study identified both

spot and future market exhibit cointegration relationship, which shows that price move together in the long run and short term causality indicates spot influences future.

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THE IMPLICATIONS OF TIME-DRIVEN ACTIVITY-BASED COSTING**Asif Baig¹, Nabil Ahmed Mareai Senan², Ijaz Ali³, Imran Ahmad Khan⁴**¹ Assistant Professor, Jubail University College, Jubail Industrial City, Jubail, Saudi Arabia² Associate Professor, Department of Accounting, College of Business Administration, Prince Sattam bin Abdul Aziz University, Saudi Arabia, and Administrative Science College, Albaydha University, Yemen³ Assistant Professor, College of Business and Management, Fahad Bin Sultan University, Tabuk, Saudi Arabia⁴ Researcher and Consultant, Creative Heads Consultants, IndiaEmail: ¹baigasif12@gmail.com, ²n.senan@psau.edu.sa, ³iali@fbsu.edu.sa, ⁴imranalig77@gmail.com**ABSTRACT**

Activity-Based Costing (ABC), a costing technique proposed by Cooper and Kaplan in the late 1980s, is probably one of the most notable research topics in the management accounting area over the past two decades. Since the advocacy of Cooper and Kaplan, there have been many studies on ABC. While researchers conducted theoretical research, ABC was also introduced to actual companies. In India, there were not many companies that tried to introduce ABC, but companies in Europe and the United States seemed to be actively trying to do so. In recent years, however, more and more companies in Europe and the U.S. have stopped using ABC, even though they had introduced it, and although ABC attracted a great deal of attention when it was first introduced as an effective tool for business management, its reputation among companies has been declining recently. Based on the current situation, Kaplan and Anderson modified the calculation procedures of conventional ABC and proposed an improved ABC called TDABC (Time-Driven Activity-Based Costing). According to them, TDABC has already been successfully implemented in more than 500 companies. Therefore, in this paper, after pointing out the problems in the calculation technology of the conventional ABC, we will clarify what kind of costing TDABC is and what its significance is..

Keywords: ABC, TDABC, Transaction Costing, Resource Consumption Accounting

I. Introduction

ABC (ActivityBased Costing), a costing technique proposed by Cooper and Kaplan in the late 1980s, is probably one of the most popular research topics in the management accounting field in the past two decades. Since the advocacy of Cooper and Kaplan, there have been numerous studies on ABC. While researchers conducted theoretical research, ABC was also introduced to actual companies. In India, there were not many companies that tried to introduce ABC, but companies in Europe and the United States seemed to be actively trying to do so. In recent years, however, more and more companies in Europe and the U.S. have stopped using ABC, even though they had introduced it, and although ABC attracted a great deal of attention when it was first introduced as an effective tool for business management, its reputation among companies seems to be declining. In fact, in a 2017 survey conducted by a US consulting firm, ABC was ranked low in the ranking of business management tools used by companies. Based on the current situation, Kaplan and Anderson modified the conventional ABC

calculation procedure and proposed an improved ABC called TDABC (Time-Driven Activity-Based Costing). According to them, TDABC has already been successfully introduced in more than 500 companies. Now, we would like to clarify what kind of costing TDABC is and what its significance is. In this paper, we will first confirm what kind of cost accounting technique the conventional ABC was, and then examine the problems in the calculation technique of ABC. Next, we will clarify how TDABC approaches and solves the problems of ABC calculation technology.

II. ABC Calculation Procedure

To discuss the problems in the calculation technique of ABC, we would like to first confirm what the calculation procedure of ABC is. In ABC, costing is based on the basic principle that "products consume activities and activities consume resources." In traditional costing, product cost is calculated through the procedure of cost-by-item calculation, department-by-department calculation, and product-by-product calculation, while in ABC, product cost is calculated through the procedure of cost-by-item calculation, activity-

by-activity calculation, and product-by-product calculation. In ABC, the product cost is calculated through the following procedure. First, let's take a look at the activity-by-activity calculation: In ABC, after the cost-by-item calculation is completed, the costs are aggregated into activities rather than departments. The allocation of costs by activity is done using resource drivers. The resource drivers are the criteria for allocating costs to each activity. For example, when allocating employee salaries, "the percentage of time an employee spends engaged in each activity" would be selected as a resource driver. Note that activities do not correspond to departments. Take the example of a setup activity, whether it is done in the machining department or the assembly department, if the cost is consumed in the activity of setup, it does not matter where it is done, it is considered to be the same activity of setup and is aggregated in the cost pool of setup. The costs aggregated into activities are allocated to each product by activity drivers. An activity driver is an allocation standard for allocating the costs aggregated in an activity to products. For example, in the case of a setup activity, "number of setups" is selected as the activity driver. In ABC, activity drivers are set for each activity, so the costs of activities such as setup activities, where the amount of activity is not proportional to capacity utilization, are assigned to products based on criteria unrelated to capacity utilization. This makes it possible to allocate overhead costs with greater accuracy than in traditional costing, which uses only the capacity utilization criterion. In ABC, activity drivers and resource drivers are sometimes collectively referred to as cost drivers. One important point to note about product-by-product accounting is that the costs of activities performed in auxiliary departments, such as purchasing activities, are also allocated directly from the activities to the products. In traditional costing, auxiliary department costs are assigned to the manufacturing department and then to the product via the manufacturing department, but in ABC, there is no such thing as a transfer of auxiliary department costs to the manufacturing department. In the above, we have looked at the calculation procedure of

ABC, and in the following three characteristics of the ABC calculation procedure are cited.

1. Have activities, not departments, as cost pools.
2. Use criteria other than those related to capacity utilization as criteria for allocating costs to products.
3. Allocate auxiliary department costs directly to products.

By the way, standard costs are better than actual costs in ABC, because ABC focuses on overhead costs, most of which are fixed costs. As a result of the fact that most of the activity costs are fixed costs, the activity driver ratio (the allocation ratio in traditional costing) fluctuates with changes in activity demand, making it impossible to correctly evaluate the profitability of each product. For this reason, Cooper-Kaplan, the developer of ABC, proposed a method of conducting ABC using standard costs. In traditional costing, allocation of overhead costs is also generally done using standard costs. In traditional costing, the overhead budget and standard operating rate for a certain period are set for each department, the standard allocation rate is calculated by dividing the overhead budget by the standard operating rate, and the cost is allocated from the department to the product using this standard allocation rate.

In ABC, the basic concept is the same as in traditional cost accounting. However, in traditional costing, the standard allocation rate is set by the department, while in ABC, the standard activity driver rate is set by activity. Let's take a look at how to set the standard activity driver rate. First, a budget is set for each activity for a certain period. On the other hand, the standard activity volume for a certain period is determined for each activity. Then, the standard activity driver rate is set by dividing the budget for each activity by the standard activity volume. Regarding the setting of the standard activity volume, Cooper-Kaplan states that it should be based on the actual production capacity of each activity. When ABC is conducted using the standard activity driver rate, an unused amount of activity is created when the actual activity volume is less than the standard activity volume. This unused amount of activity is called unused capacity in ABC. By multiplying

this unused capacity by the activity driver rate, the unused capacity cost can be calculated. Unutilized capacity cost is the equivalent of the capacity utilization variance in traditional cost accounting. However, while the capacity utilization variance is calculated on a departmental basis, the unutilized capacity cost is calculated on an activity basis. This unused capacity cost is then not allocated to the product. This makes it possible to correctly assess the profitability of each product. Also, if unused capacity costs are incurred in large amounts, the company must consider some action to deal with them.

III. Need for Departmental ABCs

In the previous section, we have discussed the calculation procedures of ABC, the most important feature of which is that it aggregates costs by activity rather than by department. However, some commentators have pointed out the problem that ABC ignores departments altogether. They argue that the departmental framework used in traditional cost accounting should be incorporated into ABC, and advocate what can be called departmental ABC. There are three reasons for the advocacy of departmental ABC. Let's examine these three reasons. The first reason is from the perspective of responsibility accounting. We will discuss Turney-Stratton's theory in this regard. They argue that when implementing Activity-Based Management (ABM), which is a cost management method using ABC, there is a problem with using activities as a cost pool. This is because most corporate responsibility accounting systems set up departments as units of management responsibility in the organization. In performance management, it is essential to establish an accounting system that corresponds to the authority and scope of responsibility of managers. However, as mentioned earlier, ABC does not take departments into account, which is why the traditional responsibility accounting system does not work well. Therefore, when trying to implement ABM, it is considered necessary to change the traditional responsibility accounting system and reconfigure activities as the unit of management responsibility instead of departments. However, it is not an easy task to change the long-established departmental organization to an activity-based organization

in a company. Therefore, Turney-Stratton proposed that activity costs should be classified and aggregated by division to ensure the successful implementation of ABM. However, when conducting profitability analysis by product, there is no problem in using activities that do not correspond to departments as before, and only when conducting ABM should activity costs be reclassified and aggregated by the department in which the activity was conducted. They called the activities used for product profitability analysis macro activities and the activities that were reclassified and reaggregated by division for use in ABM micro activities. In other words, they proposed that the two types of activities should be used differently according to the purpose of using ABC. The second reason is from the viewpoint of improving the accuracy of product costing. In this regard, we will discuss Keys-Lefevre's theory. Like Turney-Stratton, they also advocated the need to classify and aggregate activity costs by the department for liability accounting issues when implementing ABM, but they differed from Turney-Stratton in that they argued that departmental activities should also be used in product costing to calculate product costs more accurately. In traditional cost accounting, divisional accounting is used because it has the purpose of improving the accuracy of indirect cost allocation in product-based accounting, in addition to the responsibility accounting issue in cost control. Since the nature of work and indirect costs incurred differ from department to department, using a single allocation rate for indirect costs for the entire factory will prevent rational product-by-product calculations. This is also true for ABC. Even if the activities are the same, how they are carried out may differ from department to department, and the costs used in the activities may naturally differ. Therefore, for a more accurate calculation of product cost, it is necessary to divide activities by department, for example, set-up activities in the processing department and set-up activities in the assembly department. The third and final reason is from the perspective of unused capacity cost calculation, and we will discuss Keys-Merwe's theory in this regard. In the previous section, we discussed the calculation of unused capacity cost in ABC, where unused

capacity cost was calculated by activity. Keys-Merwe criticized this method, saying that it is practically difficult to calculate unused capacity costs. So why is it so difficult to calculate? Let's consider a simple example. Suppose we have a resource A, which performs two activities, activity X and activity Y. To set the standard activity driver rate, ABC sets the actual production capacity for each activity. In this case, how should we set the actual productive capacity of activities X and Y? Activity X and activity Y are both performed by resource A. In this case, to set the actual production capacity of activity X and activity Y, the actual production capacity of resource A must be allocated to the two activities. But how should we allocate them? There is no rational way to allocate the resources. Therefore, we have no choice but to allocate the actual productive capacity of resource A to the two activities by some arbitrary allocation method. Even if the actual production capacities of activities X and Y were set up arbitrarily, and the standard activity driver rates of the two activities were somehow calculated, the information obtained would not be useful for managing the unused capacity cost. First of all, the unutilized capacity cost of a resource will be spread over two activities, and we will not know what the true unutilized capacity cost of this resource A is. Furthermore, the unused capacity cost of activity X and activity Y will vary depending on how the actual production capacity of resource A is allocated. This means that ABC, which aggregates costs by activity, has many problems when it is calculated using standard costs. However, when ABC is performed using actual costs, it becomes a major obstacle in analyzing the profitability of products. Therefore, as a solution, Keys-Merwe proposed a method called Resource Consumption Accounting (RCA). If one resource performs only one activity, there is no problem in using ABC. In reality, however, it is common for a single resource to perform multiple activities. Therefore, to understand the unused capacity cost at the resource level rather than the activity level, RCA sets the actual production capacity at the resource level. Therefore, the cost pool of activities is eliminated and costs are directly allocated from resources to products. However, the allocation

of resource costs to products is based on the amount of activity performed by the resource, as opposed to using only the capacity utilization criterion. In practice, resources are not allocated individually but are grouped into several groups. The unit of the group is a department. In other words, in RCA, the procedural flow is the same as in traditional cost accounting: calculation by item, calculation by department, and calculation by product. The unused capacity cost is also calculated by division. The most important feature of the ABC calculation procedure was the aggregation of costs by activity. As a solution, Keys-Merwe came up with a calculation model called RCA, which uses divisional calculation instead of activity-based calculation. However, this would have eliminated the most important feature of the ABC calculation procedure.

IV. Activity Drivers Problems in Setting Activity Drivers

In the previous section, we have discussed the problems with the ABC calculation by activity. Next, in this section, we would like to consider the issues related to the method of setting activity drivers in ABC. Activity drivers are equivalent to the allocation criteria in traditional cost accounting, and what kind of activity drivers are set is a major issue that affects the accuracy of product costs. In this paper, we will examine how activity drivers have been set in the past in implementing ABC and discuss the issues involved. In ABC, costs are assigned in terms of how many transactions have taken place between activities and products. For this reason, ABC was initially called Transaction Costing. Since cost accounting is based on this kind of thinking, most of the time, a measure that indicates the frequency of transactions, such as the number of setups and the number of orders, is used as an activity driver, which is the most easily understood measure to measure the number of transactions. According to Cooper-Kaplan, there are four types of patterns of transaction occurrence, and based on these patterns of transaction occurrence, the activities conducted in a company are classified into four levels as follows.

(1) Unit level activities

Activities in which the amount of activity increases or decreases in proportion to the production volume of the product, such as drilling activities for metal parts.

(2) Batch level activities

Activities in which the amount of activity increases or decreases in proportion to the number of batches, rather than the amount of production, such as setup activities.

(3) Product support activities

These are activities in which the amount of activity increases or decreases in proportion to the type of product, such as design activities.

(4) Facility support activities

Activities that support manufacturing and sales activities, such as factory cleaning, and for which the amount of activity increases or decreases regardless of the increase or decrease in production volume, batch frequency, or product variety. In traditional costing, costs are assigned only based on criteria related to unit-level activities, such as direct labor hours, but ABC improves the accuracy of cost assignment by identifying various patterns of activity generation other than those occurring at the unit level. However, there are some problems with using the frequency of transactions between activities and products as an activity driver. The problem is that when the frequency of activities is used as an activity driver, the cost of each individual activity is calculated to be equal. This phenomenon occurs because the activity driver ratio is calculated by dividing the activity cost by the total number of times the activity is conducted. In the actual field, there are many cases where the time required to carry out an activity and the type of resources used to carry out the activity are different, even for the same activity, due to differences in the product type for which the service is provided. In other words, the unit price of an activity varies depending on the type of product to be used, even if the activity is the same. The problem with the activity driver using the frequency of activity implementation is that it cannot reflect the difference in activity unit price for each product type in the product costing, and this distorts the product cost. To avoid such problems, it is necessary to identify activities with the same content but with

different activity unit costs as different activities. However, if this is done, the number of activities to be set up as cost pools will increase drastically, and the amount of calculation for allocating costs by activity and product will become enormous. The cost of calculating such a large amount of information would exceed the benefit of the ABC information. So, is there any better way than to set activity drivers using the frequency of activity implementation? According to Kaplan-Cooper, there are three types of activity drivers used in ABC: transactional drivers, time drivers, and intensity drivers. Let's examine what each activity driver is based on their theory. First of all, the transaction driver is an activity driver that uses a measure of the number of times an activity is performed, such as the number of setups or inspections, or the frequency with which an activity is performed. In other words, it is the most commonly used activity driver in ABC. As mentioned earlier, when this activity driver is used, it is assumed that the unit cost of each activity is the same regardless of the product type in which it is performed. For example, taking the example of a setup activity, the unit cost of the assigned setup activity will be the same regardless of whether the product has a complex design and requires a long setup time or a simple design and does not require a long setup time. In reality, it is more likely that the cost of a single setup will vary depending on the product type, but this is ignored. In this respect, the transaction driver is a less accurate activity driver, but on the other hand, it has the advantage that it can be operated with less cost and effort. Next is the time driver, which is an activity driver that uses the implementation time of each activity, such as setup time and inspection time, as a measure. The activity driver rate is obtained by dividing the total cost of the activity by the total implementation time of the activity. This activity driver can be used to reflect differences in the time required to perform an activity per time due to differences in product types. For example, suppose we have two products: one is a simple product that takes only 15 minutes per setup, and the other is a complex product that takes 6 hours per setup. Using the time driver, it is possible to allocate the cost according to the actual time

spent. This makes it possible to calculate product costs more accurately than the transaction driver. However, it has the disadvantage that the time required to perform each activity must be measured, which is much more costly and time-consuming than transaction drivers. Finally, let's look at the intensity driver. In the previous section on time drivers, it is assumed that the unit cost per hour is the same, although differences in the time spent on each activity are taken into account. However, the unit price per hour may differ depending on the type of product for which the activity provides a service. For example, in the case of a setup activity, setup for a complex product may require special instruments, equipment, workers, etc. that are not used for a simple product. Therefore, the intensity driver calculates the cost of the resources used for each and every activity and imposes it directly on the product. This activity driver is the best in terms of accuracy, but it has the disadvantage of being too costly and labor-intensive than the time driver. The three types of activity drivers have been discussed above, and the transaction driver has been commonly used in ABC. However, the transaction driver cannot take into account the variation in the unit cost of activities due to differences in product types. Therefore, it is possible to increase the number of activity settings, but this is not realistic considering the processing cost. On the other hand, changing the type of activity driver and using other types of activity drivers, such as time driver and intensity driver, may improve the accuracy of cost calculation, but it is still too costly to operate and difficult to use in practice. As an issue for ABC, it is necessary to think of a way to perform highly accurate calculations at the lowest possible cost.

V. TDABC Calculation Procedure

In the above, we have examined the problems in the calculation technology of ABC. The first issue we have examined is the problem of setting up activities as cost pools instead of departments. By using activities as cost pools, it hindered the implementation of effective cost control, improved accuracy of product costs, and accurate measurement of unused capacity costs. The next activity driver configuration issue examined was how to resolve the trade-

off between the cost of ABC operations and the accuracy of costing. In this section, we will first examine how TDABC addresses the first issue, which is the problem of using activities as cost pools, and for that purpose, we will examine the calculation procedures of TDABC. The major difference between TDABC and traditional ABC is that it does not set activities as the cost pool. Instead of activities, departments are set as cost pools. Let's look at the procedural process of TDABC as presented by Kaplan-Anderson. The procedural process is as follows. In this TDABC, budgetary costs are used instead of actual costs.

- (1) Estimate the cost of all resources that will be generated in a period and aggregate them to the departments where they will be generated. On the other hand, estimate the actual working hours (capacity) of each department for one period. Then, divide the cost aggregated to the department by the capacity of the department for the period to calculate the cost per hour of the department's resources (capacity cost ratio).
- (2) Estimate the processing time per unit for all activities performed in the department, and multiply this by the capacity cost rate to calculate the unit cost per activity (cost driver rate). Then, the activity cost calculated by multiplying this cost driver rate by the amount of activity performed for each product is allocated from the department to the product and other cost objects. In TDABC, costs are aggregated to departments rather than activities and allocated from departments to products. Looking at these procedures, at first glance, the basic calculation procedures seem to be the same as in traditional cost accounting. However, there are major differences, such as the fact that auxiliary departmental costs are basically not transferred to the manufacturing department and are not uniformly allocated from the department to the product based on the capacity-related allocation standard. Since TDABC allocates costs from departments to products and other cost objects using cost driver rates that include non-operational factors, it can be expected to be more accurate than traditional costing. In addition, while traditional cost accounting sets one allocation standard per department, TDABC sets multiple cost driver rates per department, depending on

the type of activities performed in the department. The cost driver rate may also be referred to as the activity driver rate. For the calculation of the cost driver rate, the resource consumption per unit of activity is calculated based on the processing time per unit of activity, hence the name time-driven ABC. However, if it is difficult to measure the resource consumption of an activity in terms of time, measures other than time are also used. Estimating the processing time per unit of activity is determined by the department manager through interviews with employees and direct observation of the work. Estimates of processing time per unit of activity do not need to be very precise; they should be approximately correct. To better understand TDABC, let's look at some examples of figures from the customer service sector as presented by Kaplan-Anderson. Suppose that the total cost incurred by this department every quarter is estimated to be \$560,000, with three activities: "processing customer orders," "handling customer inquiries," and "credit review." There are 28 employees working in this department, and each employee works 8

hours per day (480 minutes), 22 days per month, which equals 31,680 minutes of work per quarter. In addition, it is assumed that 80% of the working hours are actual hours, taking into account breaks, etc., so the total actual hours worked by all 28 employees is about 700,000 minutes (709,632 minutes) per quarter (this is the capacity of the department). Therefore, the cost per minute for this department is \$0.8 (\$560,000 divided by 700,000 minutes), which is the capacity cost rate for this department. Next, the standard processing time per unit for each activity is assumed to be 8 minutes per unit for "customer order processing," 44 minutes per unit for "customer inquiry handling," and 50 minutes per unit for "credit review". As a result, the cost driver ratio for each activity is calculated to be \$6.4 per unit for "customer order processing," \$35.2 per unit for "customer inquiry response," and \$40 per unit for "credit review". The cost report for 51,000 "customer order processing," 1,150 "customer inquiry handling," and 2,700 "credit review" would be as follows.

Table 1: Cost report by TDABC

Activity	Amount of activity (number of cases)	Time required per case (minutes/case)	Total time required (minutes)	Per unit cost of activities (\$)	Total cost (USD)
Order processing	51,000	8	408,000	6.40	326,400
Responding to inquiries	1,150	44	50,600	35.20	40,480
Credit check	2,700	50	135,000	40.00	100,800
Total volume of goods used			593,600		474,880
Input Resources			700,000		560,000
Unused capacity			106,400		85,120

Although this example does not show the procedure for assigning costs to cost objects such as products, it seems to have provided an understanding of how the TDABC calculation procedure is carried out. In section 2, we pointed out the need for departmental ABCs, but TDABC did away with the cost pool of activities and incorporated departments as cost pools. This eliminates the problems of cost control, the accuracy of product costs, and the

measurement of unused capacity costs that have been problematic in ABC.

VI. Use of time equation

The problem of setting up a cost pool of activities was addressed by TDABC by changing the calculation procedure so that departments could be set up as cost pools instead of using activities as cost pools. Next, let's look at how TDABC deals with the problem of setting activity drivers. In ABC, transaction drivers were used as activity

drivers. When using transaction drivers, the calculation assumes that the unit price of each activity is the same if it is the same activity. However, in reality, the unit price of an activity is more likely to change due to differences in the product type in which the activity is conducted. As a result, the accuracy of the calculation using transaction drivers is questionable. TDABC, on the other hand, uses something called time equations to deal with this problem. If we look at the calculation of the cost driver rate for each activity shown in the calculation procedure of TDABC in the previous section, the calculation was done assuming that the unit price for each implementation of the activity is the same as the calculation by the transaction driver of ABC. However, in practice, TDABC uses the time equation to calculate the unit cost of activities, and the unit cost of each activity is modified. Let's examine what the time equation is. In ABC, if the calculation is to reflect differences in the unit cost of activities, the activities must be categorized and set in detail. For this purpose, ABC prepares the following list of activities. As can be seen from the table, each activity is broken down into sub-activities based on factors that change the unit cost of the activity. This decomposition will be broken down to the point where the unit cost of the activity will no longer fluctuate.

VII. Marketing and Sales

4.2 Processing customer orders

4.2.1 Creating a Customer File

4.2.2 Sales Price Estimation

4.2.3 Special Price and Credit Confirmation

4.2.4 Preparation of transport documents

4.2.4.1 Domestic

4.2.4.2 Overseas

4.2.4.2.1 Creating a Customer Form

4.2.4.2.2 Preparation for import and export declaration

4.2.4.2.3 Arranging for customs clearance

4.2.5 Documentation of special services or procedures

4.2.6 Prepare documentation for handling of hazardous materials

This is an example of an activity list where activities related to marketing and sales are summarized. If we look at the activity "processing customer orders" performed by

this department shown in 4.2, this activity is broken down into sub-activities such as 4.2.1 "creating customer files" and "quoting sales prices". In addition, "Preparation of transport documents" in 4.2.4. is further decomposed into 4.2.4.1 "Domestic" and 4.2.4.2 "Overseas", and the overseas one is further decomposed into 4.2.4.2.1 "Preparation of customer forms", etc. In addition, Brimson-Antos lists the following three factors that cause changes in the unit cost of activities, which is the basis for decomposition.

(1) Improper process execution

(2) Product attributes

(3) Customer attributes

(1) Variation in activity unit cost due to inappropriate process execution refers to variation caused by, for example, extra work due to employees' failure to follow the work manual. (2) Variation due to product attributes is the variation caused by the variation in the processing time of individual products due to differences in product design and function. (3) Variation due to customer attributes refers to variation caused by customers' requests for special packaging or delivery methods. In the activity list, activities are broken down based on the product attributes (2) and customer attributes (3) of these three factors. As can be seen from the table, if we try to perform a calculation that reflects the difference in the activity unit cost for "processing customer orders," we will have to set up as many activities as the number of sub-activities that we have broken down. With such a large number of activities, the task of calculating cost allocations becomes a daunting one. Therefore, in TDABC, instead of creating a list of activities like ABC, we create a time equation for each activity to calculate the revised cost-driver ratio. For example, taking the example of 4.2 "Customer Order Processing", the following time equation is set up and a system is created to recalculate the cost driver ratio by modifying the order processing time.

**Order processing time (minutes) = 10 + 5{if new customer}
+2 x number of items
+4 x number of price quotes
+2{if foreign orders}**

(2{if tariff declaration}
+5{if import/export declaration}
+10{if customs clearance}}
+{if special service}
(5{if urgent order}
+10{if credit check is delayed}
+2{if dangerous goods})

The term starting with "if" above indicates that 1 will be entered if the condition is satisfied, and 0 if it is not. Thus, for example, if there is an order for five items from an existing domestic customer who does not require any special service and who has been quoted a price once, then $[10 + (2 \times 5) + (4 \times 1)] = 24$ is calculated, which means that the order processing time is 24 minutes. By using this kind of time equation, we can achieve the same effect as when using the conventional time driver in ABC. When creating the time equation, it is necessary to estimate the processing time per unit for each sub-activity. However, once the estimation is done, the order processing time can be automatically calculated on the computer-based information about the contents of the order and the attributes of the customer, using the data from the ERP (business integration software) of the company. The amount of information processing required for this automatic calculation is much less than the amount of processing required in the conventional case where a huge number of activities are set by ABC and the allocation calculation is performed. By the way, by using the time equation in TDABC, the same effect as using the time driver can be obtained, but the calculation is based on the assumption that the unit cost of resources per hour is the same. Therefore, it is not possible to obtain the same accuracy as using the intensity driver in ABC. For example, suppose that a hospital operating room has equipment that is used only for complex cardiac surgery. In this case, the cost of this special equipment should be excluded from the calculation of the capacity cost rate for non-complex cardiac surgeries. So, for this operating room, two cost rates are set: the capacity cost rate for resources excluding special equipment, and the capacity cost rate for mechanical equipment only. Then, in the case of special cardiac surgery, these two

capacity cost rates are multiplied by the operating time to calculate the two cost driver rates. When the two capacity cost rates are set in this way, the unutilized capacity cost of the operating room is calculated from two groups of resources, one for the resources of normal surgery and the other for the resources of special machinery and equipment. In the RCA proposed by Keys-Merwe, the resources of a department are divided into several groups, such as the human resource group and the machinery and equipment resource group, and the unit cost (capacity cost rate) is set for each resource group. Such grouping not only contributes to the accuracy of product costing but also contributes to capacity management. If the capacity cost rate is set collectively for a department, the department's capacity will be set based on the bottleneck resource when there is a difference in the ability to provide services among individual resources. By grouping the resources of a department, the capacity of each resource group can be clarified, and this information can be used for bottleneck management. In this paper, we have examined how TDABC addresses the problem of setting activity drivers in ABC, by setting the time equation and the capacity cost rate for each resource group. In TDABC, the time equation and the capacity cost rate for each resource group allow the costing accuracy of the strength driver in ABC to be achieved at a lower cost than ABC.

VIII. Conclusion

In this paper, we have pointed out the problems in the calculation technology of conventional ABC and discussed how TDABC approaches and solves these problems. There are two technical problems with ABC that we have identified in this paper: the first is the problem of setting up activities as cost pools. ABC uses activities rather than departments as cost pools. This has hindered the implementation of effective cost control, improved accuracy of product costs, and accurate measurement of unused capacity costs. To solve this problem, TDABC stopped using activities as cost pools and changed to a calculation model that uses departments as cost pools, as in traditional cost accounting. Another problem is the problem of setting the activity drivers for ABC. In conventional ABC, the transaction driver with

the lowest accuracy among the activity drivers is generally adopted as the activity driver. If time drivers and intensity drivers are used as activity drivers, the accuracy of cost accounting can be improved, but this requires a large amount of money. TDABC has succeeded in improving the accuracy of costing without cost by using the time equation method. ABC eliminates the cost pool of departments used in traditional costing and establishes a new cost pool of activities. ABC

aimed for more accurate costing by fundamentally changing the traditional costing procedures. However, it was difficult to adapt such a drastically changed ABC calculation procedure to actual practice. Therefore, rather than fundamentally changing the traditional cost accounting procedures, TDABC took the approach of improving the procedures to improve the accuracy of cost accounting while following the traditional methods.

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ANADAPTIVE JOB STRESS SCALE SPECIALIZED FOR PANDEMIC INDUCED STRESS FACTORS IN IT ORGANIZATIONS

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ABSTRACT

Work from home has become a norm to support business continuity during pandemic. COVID 19 has forced many businesses to shift to remote working. Though remote working brings many comforts to employees in terms of being available close to family, discomfort and time wastage of travelling, it break the barriers of work timings introducing work life imbalance. This in-addition to other factors like safety perception, contagion risk, social alienation, job loss fears, and work coordination failures due to technological glitches etc pandemic brought a increase in psychological stress and depression for employees. The effect is more pronounced in Information Technology (IT) sectors. Human resource management in IT sectors needed a better means to quantize stress and reduce the stress induced attritions. Towards this need, this work proposes a novel job stress scale for pandemic created stressors to quantize the stress level of employees. The job stress scale is designed based on factors identified through analysis on questionnaire responses from employees. The job stress scale is very adaptive to gender, employment level etc. The effectiveness of the proposed job stress scale is tested as case study in a corporate company and the results were found to highly correlate to the most standard PSS-10 stress results.

Keywords: Job stressor, pandemic, Job stress scale, Work life imbalance

VII.Introduction

COVID-19 pandemic has changed the traditional way of work and introduced new norms like work from home. These norms were adopted by many organizations to support business continuity during lock downs, social isolation and fear of pandemic spread. Businesses without these new norms like work from home came to a grinding halt during pandemic times. Their revenue and sales took a severe hit. Many companies reevaluated their operations and enhanced their operations with more digital channels for ensuing business continuity. "Work from home" has become a new order of working in many IT organizations.

Though "Work from home" has facilitated much convenience to employees in terms of being close to family, avoiding travel discomforts, avoid time wastage in office travel, attending to personal chores etc, it break the regular work hour barriers. Employees need to stretch out their working hours due to glitches in coordination, technical failures, and resource availability. Frequent team coordination has to be done with video

conferencing to avoid silos in working. These break into employees work life balance. Work lifeimbalance, role expectation and co-worker/manager support create psychological stress and depression for employees. The stress is further aggravated with additional stressors like job loss fears, risk of contagion etc. Stress induced health problems has increased the attrition levels in organizations. Human resource departments in many companies find it challenging to quantize the stress level among employees in this teleworking environment and adopt suitable stress management practices to facilitate a stress free working environment for the employees. A reliable stress scale to quantize the stress level of employees considering the new stressors created from pandemic situation is needed to roll in various organization plans which can foster positive attitude, reduce stress and adapt employees to the teleworking environment. The objective of this work is to design a reliable job stress scale considering the new job stressors created by pandemic and test the effectiveness of the designed job stress scale in teleworking environment.

VIII. Related works

Nixon et al (2011) studied the correlation between eight physical symptoms and the organizational stressors. Rosenthal approach was used to analyze the mental impact due to workload, working hour conflict on the stress level of the employees. Elahi et al (2012) analyzed the role stress on employees in banking sector. The questionnaire responses collected from 100 employees were analyzed using ANOVA model to understand the correlation between role conflicts and job stress. Shukla et al (2016) proposed a stress scale based on working hours specific to Indian working environment. The scale is derived using existing theoretical job stress models. Factor and correlation analysis was used to validate the job stress scale. Frantz et al (2019) modeled work stress in terms of physical sickness leave opted by the employees. The reliability of the model was tested using test-retest analysis on questionnaire responses from the employees. Holmgren et al (2009) proposed a stress assessment model for employees based on various work related and personal factors. Questionnaire responses from employees were tested using test-retest analysis to check the validity and consistency of the stress assessment model. Niedhammer et al (2006) studied the impact of major organizational changes on the stress level of the employees. Factors of job strains, over commitment, support from colleagues and effort reward imbalance were considered in stress assessment. Streiner et al (2015) proposed a mental health assessment model. It is based on the response options of employees to various organizational challenges. Test-retest analysis was used to check the reliability and validity of the model. Stanton et al (2001) used exploratory factor analysis for identification of factors inducing stress on employees. Methods like oblique rotation and maximum likelihood are used for factor analysis. Inoue et al (2016) proposed a new job stress scale combining various stressors used in organizations. Correlation coefficient analysis on various job stress scale resulted in a 23 item questionnaire. Test-retest analysis was used for testing the validity of questionnaire items. Foroutan et al (2015) devised a occupational stress assessment model for Tehran municipality

using Osipow questionnaire .The most influential factors in the questionnaire items was found using correlation analysis. Job burnout factors were found to have more influence of occupational stress compared to other factors. Spector et al (1998) proposed three occupational job stress scale based on conflicts, organizational constraints and work load. Correlation between job scale and other variables is found using meta analysis. Spector (2016) analyzed the correlation between stress and control on employees. The study inferred that stress is directly correlated to level of control of the employees. Bjerkeli et al (2020) proposed a stress scale correlating stress to sickness absence. Through questionnaire response analysis on 271 health care workers, study found a higher correlation between stress level and sickness leave. Wännström et al (2009) studied the correlation between psychological and social factors at work to the Psychometric properties in General Nordic Questionnaire. Out of 26 scales, 24 scales in General Nordic questionnaire were found to be good indicator of stress at workplaces. Duchaine et al (2020) studied the correlation between job stressors and mental disorder. Meta analysis on various data acquired from MEDLINE found a strong correlation between job stress and mental health. Among many factors, effort reward imbalance was found to be most important factors contributing to the job stress. Ouimet et al (2020) proposed a stress model in terms of objective measurement of mental health. Cox regression analysis on questionnaire responses from white collar workers in Canada proved a stronger association between mental health and job stressors and the relation is more strong in women compared to men. Nielsen et al (2019) correlated the workspace bullying and absence due to medical sickness using regression analysis. The study found that longer sickness absence is strongly correlated to work space bullying. Indregard et al (2017) proposed a stress assessment model based on medical sickness. The study found role conflict as a dominant factor in inducing work related stress.

Gap:

From the survey, it could be seen that the existing job stress scales does not incorporate

the newly induced stressors due to COVID-19 like safety, risk to life, Quarantine, work life imbalances due to teleworking, financial loss and job insecurity etc. But this is necessary as these factors will be prevalent in most of companies as most are adopting “work from home” for a major percentage of their workforce. This research gap has motivated us to study these novel factors and propose a new job stress scale to quantize stress level of employees.

IX. Materials and Methods

3.1. Rationale of the Study

“Work from home” has become the new order of work during pandemic. Many companies are investing on IT infrastructures to facilitate remote working and business sustainability in wake of lockdowns. Though “Work from home” brings many benefits, it also witnessing various new stress factors to the employee. This has become more challenging to HR to quantize stress due to “Work from home” induced factors and other pandemic induced factors.

Aim:

- The aim of this work is to analyze the impact of “Work from home” and pandemic induced factors on stress level of employees.

Scope:

- Though the work can be applied for any industries, this research restricts its scope to the IT industries as “Work from home” can be adopted for larger percentage of work force in IT industries and there is already higher stress level in IT sector, with new pandemic factors, the stress is even more aggravated.

Objectives:

- To propose a new scale for job stress assessment
- To analyze the relevance and validity of new job stress scale across employment level and gender across the company

3.2. Methodology

The new job stress scale consider stressors in following categories during pandemic

1. Work environment anxiety
2. Conflict in teams
3. Work life imbalance

Teleworking from home introduces various challenges like tools un-availability, support un-availability and network connectivity glitches in needy times. This creates anxiety stress on the employees as they have to spend times exceeding their normal working hours to meet their deadlines.

In this situation of struggling to meet deadline, various conflicts occurs in team in terms of roles, responsibilities and who should take the blame for schedule slippage and quality deterioration. Since employees are new to remote team coordination, conflicts escalates and create more stress for employees. It is also observed that team conflicts can result in getting support from co-worker or manger, depriving the employee of support from fellow staffs in needy situations. This increases the stress level for employees.

Teleworking breaks the normal working hours and affects the work life balance for employees. An abnormal stretch in working hours to late night, disturbances from family members cause even more stress to employees. Each of the factors has multiple questions scored on a likert 5 point scale as shown in Table 1.

Table 1 Job stress scale

Factors	Questions
Work environment anxiety (5)	What is the level of overload? Are you in pressure of schedule slippage? Are you in pressure of quality deterioration? Are you nervous to face job challenges? Are you feeling heavy at work?
Conflict in teams (5)	Are you finding it difficult to satisfy conflicting demands from my team? Are you burdened by different expectation from team and clients? Are you getting enough assistance

		from my team?
		Are you getting enough feedback about your work?
		Are you getting enough support from your team?
		Are you satisfied with work life balance?
Work	life	Are you satisfied with time allocated for personal work?
imbalance(5)		Is work over stretched?
		How often do you have late meeting beyond working hours?
		How often do you have late support beyond working hours?

The job stress score is calculated as

$$JS = \frac{\sum_{i=1}^k \Phi_{r,f}(i) * R_i}{k} \quad (1)$$

Where k is the number of question items, R_i is the response for the question item i. Φ_{r,f} is the ranking function of factor f containing the question i. The ranking function Φ_{r,f} is calculated as average of importance given to the factor by the employees in different employment levels.

$$\Phi_{r,f} = W_{f,0} + \sum_{q=1}^P W_{f,q,f,r,q} \quad (2)$$

Where p is the number of question items in the factor f. W_{f,q,f,r,q} is the relevancy of question item in factor f to the job stress. It is calculated in terms of Gaussian approximation function as

$$W_{f,q,f,r,q} = \prod_{q=1}^P G(f_{r,q}, D_{e,q}, \sigma_{e,q}) \quad (3)$$

Where f is the feature, D is the median value of the feature and σ_{e,q} is the deviation from the median.

$$\sigma_{e,q} = \frac{1}{N_e} \sum_{r=1}^{N_e} (f_{r,q} - D_{e,q})^2 \quad (4)$$

$$G(f_{r,q}, D_{e,q}, \sigma_{e,q}) = e^{-\frac{(f_{r,q} - D_{e,q})^2}{\sigma_{e,q}^2}} \quad (5)$$

The reliability of the job stress scale given in Equation 1 is tested using: internal consistency test, Test-retest analysis and Intra class coefficient analysis. The new job stress scale is tested across 100 employees in a leading IT company located in Bengaluru. The 15-item questionnaire is distributed to 100 employees in three different employee levels of Developer, Senior Developer and Manager and in two categories of male and female. Psychometric test – (PSS-10) is also conducted for the 100 employees. The correlation between the proposed job stress scale and PSS-10 scores is analyzed for different employment levels and gender to prove the reliability of the proposed job stress scale.

X. Results

Convenience random sampling is adopted in this work. The sampling distribution is as below

Table 2 Sampling population

Employment levels	Developer	50
	Senior Developer	30
	Manager	20
Gender	Male	65
	Female	35

The mean and standard deviation for the 15 questionnaire items in three categories of work environment anxiety, conflict in teams and work life imbalances are given below

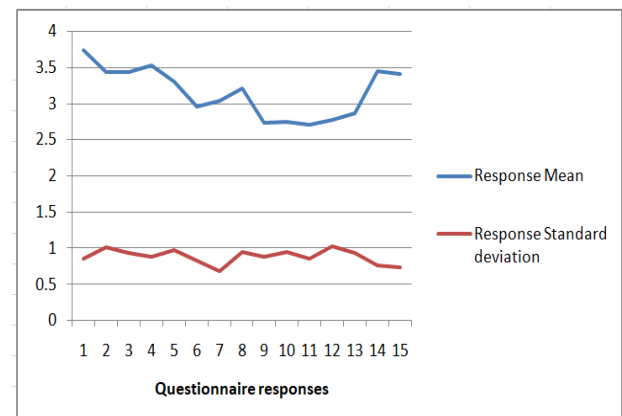


Figure 1 Mean and SD of responses

Test-retest was done with cronbach’s alpha and Pearson correlation coefficients for each of the three factors and the result is given below

Table 3 Reliability of scale

Factors	Cronbach's alpha coefficient	Pearson correlation coefficient
Work anxiety	0.78	0.91
Conflict in teams	0.83	0.92
Work life imbalance	0.82	0.93

The Cronbach's alpha coefficient for all factors are above threshold of 0.75 and Pearson correlation coefficient value for all factors are above threshold of 0.9 indicating a higher reliability and validity of questionnaire items of the factors.

The correlation between PSS-10 score and the proposed job scale is measured for all three employment levels using linear regression and the result is given below

Table 4 Regression results for Employment levels

Employment levels	Rcoeff	R square	Adjusted R square	Std error of estimate
Developer	0.760	0.5776	0.559	5.69
Senior Developer	0.761	0.5791	0.562	5.71
Manager	0.781	0.6099	0.610	5.31

The R coeff value is above 0.75 indicating strong association between the PSS-10 score and the proposed job stress scale. The association is strong for Manager compared to developer and senior developer. This is because the role of manger has become even more difficult with "work from home". He or

she might face the schedule slippage and quality distortion.

The correlation between PSS-10 score and the proposed job scale is measured for all male and female employees using linear regression and the result is given below

Table 5 Regression results for Genders

Employment levels	Rcoeff	R square	Adjusted R square	Std error of estimate
Male	0.726	0.527	0.53	5.69
Female	0.773	0.597	0.59	5.46

The R coeff value is above 0.70 for both male and female employees indicating a strong association between the PSS-10 score and the proposed job stress scale. . The association is strong for female compared to male employees. This is because most female employees need more time for their personal chores compared to male and they find it difficult to do work life balances because of job stretch resulting from "Work from home".

XI. Conclusion

A new job stress scale is proposed in this work to analyze the impact of pandemic and work from home induced stress factors for IT

employees. The job scale is modelled as fuzzy function based on 15 item questionnaire response in three categories of work anxiety, conflict in teams and work life imbalances. Reliability of the scale is proved using Test-retest analysis The correlation of new job stress scale with PSS-10 scores prove a stronger association between the proposed job stress scale and PSS-10 scores. Also the association was stronger for employment levels of manager and female employees. Testing the effectiveness of the scale for larger population and across different industries is in scope of future work.

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COMPARATIVE ANALYSIS OF OWNERSHIP CHARACTERISTICS BETWEEN ACQUIRING AND TARGET COMPANIES DURING MERGERS & ACQUISITIONS IN THE UNITED STATES

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ABSTRACT

From the data base about 3968 companies of America, we have defined two types of samples that are acquiring companies and the target companies during the total operation between acquisitions and mergers. Moreover, the results have allowed us for defining both the types of organization under several aspects like control structure, size, and ownership structure. However, we have found out that the total target having the ownership that is concentrated about 32% and in several cases in which the owner of the family is involved. However, it is marked out than within 22% cases the total cases belong to the member who is the main head for the direction. Moreover, we have also noticed the total existence of the pyramid structure within the ownership structure and the institutional investor comes in the second phase as the ultimate owners. However, for the acquires, we have noticed the structure less ownership that is concentrated for the targets. Moreover, in most of the cases the main owner is the family within the place or in the institute of finance within the second place. On the other hand, the percentage of the families as the main owners is not higher for the acquires as it is for the targets and the opposite is happening when we are considering the total financial institutions as the ultimate owners. We have also noticed the total existence of the total structure of pyramid within the ownership of the acquirer. Moreover, the test of the mean difference is shown that the acquires are significantly less and larger concentrated than the targets. Finally, we have founded the positive significant relationship between the probabilities that is acquired, and the total ownership is concentrated within the firms.

Keywords: mergers, acquisitions, ownership structure, pyramid structure of ownership, family control

I. Introduction

The composition of a company's shareholders and its degree of atomization influences the strategic and financial orientations that it is led to choose. The first study about this was introduced by Berle & Means (1932). This study was the first research in a field that has continued to evolve, and which has given rise to influx often contradictory empirical results. According to the theory of the agency that is introduced by Jensen & Meckling (1976), the leaders of companies are the representatives or agents of shareholders who are in a position of principal or principal. This situation leads to a possible divergence of goals between these managers and shareholders, which translate into policy choices that may correspond more to the objectives of the leaders than to those of the shareholders. These then try to reduce the costs induced by this discrepancy (agency costs) by exercising control over the directors, through the board of directors, by an incentive or other remuneration system. The financial performance of the company being linked to value creation, it varies inversely with agency costs (Harris & Raviv 1988). Thus, depending

on the degree of control incentive, these costs will either subsist or disappear and in both cases will have effects on decision-making within the firm. In this context, acquisitions, and mergers (A&M) can be seen as a means minimization of agency costs through the replacement of non-executive competent authorities and modification of the control structure (Mane 1965, Dodd & Warner 1983, Shleifer & Vishny 1986). Another school of thought states that the phenomenon of F&A is just one manifestation of agency costs.

The defenders of this theory argue that in order to maximize their control and compensation, leaders will opt for F&A even if they do not present a beneficial strategy for the firm (Mueller 1969, Roll 1986). As part of this work, we will do an overview of the literature dealing with F&A, agency costs and concentration. We will present some empirical evidence that was found to be relevant. Our empirical work will first attempt to characterize the ownership structure, the control structure as well as the size of the target us companies and buyers during the f & a. For this purpose, we will base ourselves on two samples taken from an

American database for the year 1996. Secondly, we will try to make a comparison between these two groups at the level of these three major characteristics in order to be able to draw empirical evidence. Finally, we run a multivariate analysis by advancing a prediction model for targets of F&A according to three key variables, namely concentration, size and profitability.

II. Literature Review:

1. Agency costs

Alchain & Demsetz (1972) introduced the first studies on the contract approach as an organizing principle within firms. This approach translates into a system of delegations between parties. Subsequently, it was 1976's turn that Jensen & Meckling showed the implications of this system by studying the agency relationship, source main conflict of interest and agency costs. These costs represent financial, legal and other charges which are assumed by companies for protecting the rights of shareholders, managers and bondholders. The more the conflicts between these parties increase, the more these costs increase.

Since the appearance of the first works on this subject and until today, we have witnessed a wave of studies dealing with this subject: Fama (1980), Harris & Raviv (1985). According to these studies, an agency relationship is established either formally or informally between two agents each time one of them gives a mandate (principal) to the other (agent) to act on its behalf. Aside from the existing relationship between owners and managers, several other relationships exist within firms or between firms and external persons or bodies. Examples are the relationships between employers and employees, lenders and borrowers, principals, and subcontractors. These agency relationships generate implicitly conflicts of interest between the different parties, either because of their divergent claims, either because of information asymmetries or uncertainty of one or more parties.

The sources of these conflicts can be summarized as follows:

- **Relationship of opposing interests:** It is the interest of each of the parties acting as

agent that prevails. If they cannot enrich themselves more at the expense of the others, they act at least to safeguard their gains without worrying about the interests of the other parts.

- **Moral risk:** This is the risk faced by insurers when they are unable to follow the actions of policyholders. Once insured, they are inclined to increase the risk of their assets.
- **Adverse risk:** The principal and the agent each have a different attitude towards risk. A risk may be high for the shareholder while it is minimal for the manager.
- **Adverse selection:** refers to a situation for which insurers are unable to distinguish the good insured from the bad. Thus, they rationalize the insurance amounts and set their rates under an intermediate category risk. The bad agent then has an advantage over the good agent.

Conflicts of interest in agency relationships thus generate agency costs essential to guard themselves against bad intentions and deeds opportunism.

2. Concentration and agency costs

Holderness (2001) and Barclay & Holderness (1989) argue that effective control of managers would be likely to substantially reduce agency costs between these last and shareholders. Once this control is achieved, the need for other means of minimization of agency costs will be significantly reduced.

Shleifer & Vishny (1986) developed a model for this that examines the role possible of a large shareholder in the firm. They listed some mechanisms available to it to improve the management quality of managers. Indeed, the large shareholder can make a cash takeover bid with a view to replace incompetent manager. It may also encourage certain investors to take control through an acquisition and thus reform the management team. In other cases, there may only be informal negotiations between the latter and the managers with a view to instituting changes in order to maximize the shareholders wealth

Zeckhauser & Pound (1990) emphasized the role of large external shareholders as long-term controllers. The authors believe that if the control they exercise is effective, it will prevent

managers from making decisions that go to against the interests of shareholders. Empirically, they test the hypothesis according to which the presence of the large shareholder who is associated within the variations in expectations of growth in earnings, dividend payment and debt ratios. They associate higher expected earnings growth with the presence of wholesale shareholders in firms operating in industries where control is accessible.

This result shows that the control carried out by these shareholders leads to a better performance of the firm. Tosi & Gomez-Mejia (1994) tried to test the same hypothesis as Zeckhauser & Pound (1990) through an analysis of questionnaires. They wanted to check if the presence of large external shareholders leads to effective control of managers and, therefore, consequently the improvement within the performance of the total firm. These authors consider the control as a behavioral process that would be best evaluated by questioning those informed about what is effectively controlled in the firm and to what degree. They obtained results which confirm the hypothesis that the level of control is higher in firms where there are large shareholders. However, if control serves to bring together the interests of the managers and those of the total shareholders, is it fair to say that a concentrated ownership structure would have the positive impact within the value inside the firm or simply that the market better values a firm with a concentrated structure.

3. The concentration and value of the firm

Berle & Means (1932) and Jensen & Meckling (1976) showing the distribution of ownership between external and internal shareholders can influence the value of the firm. The important thing here is therefore to distinguish between ownership held by interns (managers, employees, etc.) And that held by external parties (investors institutional, state ...). Indeed, we realize that the influence of these two types of shareholders can be different and even sometimes opposite.

Shleifer & Vishny (1986) in their study come to the conclusion that the pressure of external shareholders and institutional investors can lead to the maximization of the value of firms. They predict all things in equal manner that the

holders of a large fraction of the ownership will have the total positive effect within the market value inside the firm.

Pound (1988) proposes mainly three hypotheses of the relationship between the institutional investors and the market value of the firm:

H1: the control of efficient hypothesis that stipulates that the total institutional investors are having a better expertise in which they can control managers at a lower cost unlike small shareholders. This predicts a positive relationship between ownership of the firm owned by institutional investors and the value within the firm.

H2: the conflict of the interest hypothesis assumes that because of the business relationship institutional investors will be aligned with the managers.

H3: the strategic alignment hypothesis which is similar to the previous one and which stipulates that the institutional investors and executives find mutual advantages to cooperate together.

Thus, the last two hypotheses anticipate a negative relationship of the ownership of the institution and the accurate value regarding the firm.

The total emphasis of the fraction of ownership owned by managers and predicts a nonlinear relationship of the internal ownership and the total value within the firm (Morck, Shleifer & Vishny, 1988). They argue that the tendency of managers to allocate resources of the firm in their own interest for the detriment of the total shareholders that will have a negative effect on the value of the firm. However, increasing their share of ownership will converge their interests and those of shareholders and will have the positive impact within the firm value.

Bolton & Von Thadden (1998) adopt the same line of thought as Shleifer & Vishny (1986) and assert that firms with a concentrated ownership structure undergo greater control and the result is an improvement of the value within the firm. Given these different aspects, the relationship of the total value within the firm and the ownership structure can only be determined through empirical studies.

Stulz (1988) obtains rather moderate results taking into account only ownership owned by managers. It focuses on the significance of the

disciplinary role control of takeovers. His model anticipates that the premium to be paid for a hostile takeover increases with the total percentage of ownership owned by the managers, but that the probability is that it takeover will be effective decreases. His results show that at a proportion of 50% of the shareholding held by managers, the probability within the takeover is zero.

Moreover, the reasoning is giving the rise to the curvilinear relation that is between the total value within the firm and with the total fraction of the ownership owned by the managers. However, the value of the overall firm increases and then it decreases with the total increase in the fraction held by managers. When the ownership shares of managers reach 50%, this is the thesis of the entrenchment of managers that wins out. In this case the managers do not respond more to the influence of external shareholders.

Unlike previous authors, who focus only on ownership owned by the managers or that of the external shareholders, Mc Connell & Servaes(1990) examine two groups of stockholders: internal and external. Regarding internal ownership, they get a curvilinear relation which means that the value of total firm increases within the internal ownership to a level between 40 and 50% and then decreases with a subsequent increase in this ownership. This confirms the thesis of the convergence of interests up to 50% of the ownership held by the managers and, beyond this percentage, that of the entrenchment of managers who is having the effect for reducing the total value within the firm. As for the ownership held by external shareholders, the authors find the significant and positive relationship between this and the market value of the firm. This result has been confirmed by several authors such as Barclay & Holderness (1991 and 1992), Mikkelson & Ruback (1985) who find an abnormal positive return around the announcement date of the acquisition of a large fraction of the shares by the investor external. In the same context, Bennett (1997) wanted to know whether the market better values transactions involving firms with a concentrated structure. He tests the hypothesis according to which the increase in market value around the given date of the

announcement within the transaction will be higher for firms with concentrated ownership than for those with diffuse ownership. His results show that transactions between two firms with concentrated ownership structures are valued more than transactions between two firms with diffuse ownership structures. When one of the firms involved in the transaction has a concentrated structure and the other diffuse ownership, the shareholders of the firm of concentrated ownership structure see themselves better rewarded. This study therefore provides empirical evidence that investors value better firms with concentrated ownership structures. However, other studies reveal the contrary.

Berle & Means (1932) assert the overall structure of diffused ownership decreases the link between control and ownership therefore undermines the role of maximizing value as an asset allocation guide. This dissemination makes the shareholders powerless in the face of managers, which implies a positive relationship of performance and concentration.

Demsetz & Lehn (1985) examines the relationship between performance and ownership structure of the firm. Their approach is to highlight the advantages and disadvantages of a very diffuse ownership structure within a firm. They find first that the degree of instability defined by systematic risk, standard deviation of returns and the accounting rate of profit is positively correlated with concentration of the ownership. They then test the thesis of Berle & Means (1932) who argues the diffuse structure of the ownership affects negative performance of the calculated firm as the accounting rate of profit. However, the authors did not find any of the important relationship between concentration and the accounting rate of profit; they thus reject the hypothesis of Berle & Means (1932). Their results support the hypothesis of neutrality of the ownership structure advanced by Demsetz (1983) according to which the capital holding structure constitutes an endogenous response to the profit maximization process which is a function of operating characteristics of the firm and pressures exerted by the external environment.

In other words, all structures are equivalent according to him, this result, which does not

conform to predictions, may however be linked to the use of the accounting rates of profit as a measure of the performance. With more adequate measures, we might get different results.

An important criticism can be related to the fact that they often considered only north american companies. The question would be whether the results obtained by the authors do not meet the specific characteristics of the economic environment, political, social and cultural of these countries?

Chan, Suk Hun Lee & Suk (1999) took a different approach to try to generalize their results. Unlike authors who use Tobin's q ratio for measuring overall performances, they took the return on owners' equity and its components namely: sales efficiency, sales profitability and financial leverage. Their tests did not reveal a positive relationship within the total concentration of ownership of managers and the value within the firms for all measures of performance considered.

These results go against the hypothesis of convergence of interests and the conclusions of Jensen & Meckling (1976) and thus conform to the hypothesis rooting in manager ownership proposed by Morck, Shleifer & Vishny (1988). These contradictory results have led some authors including Chartreux (1997) to issue certain criticisms, the most relevant of which refers to the problem of the choice of performance which in most cases is linked to purely accounting criteria. The most recent research on this subject argues that focus could mean better control of managers and thus minimization of conflicts of interest and therefore the agency costs. We will thus have a better performance and appreciation of the value of the firm by the inverse relationship of agency costs and firm value defined by Harris & Raviv (1985).

In addition, there are several authors including Holderness (2001) have emphasized several benefits of block holders that represent a manifestation of a concentrated structure. He argues that the existence of such block holders will result in the creation of profits they shared as private benefits targeting entrenchment.

According to him, the more the control blocks grow, the more they will have management

power and guidance and the more they will have an interest in increasing the value of the firm. This augmentation being a benefit shared with small shareholders. Moreover and because of their privileged positions, they will have the opportunity to benefit from and consume the exclusive corporate advantages, usually named as "on the job consumption". These present the private benefits of insiders referred by Holderness (2001).

To date, the results of studies on this subject have always advanced contradictory results; many of them opt for the theory that the structure of ownership improves the value of the firm, others, on the other hand, do not find a direct link between them.

4. Empirical evidence

Berle & Means (1932) found that the ownership structure of us was diffuse and that the capital of the firms was held by several small investors. None of the latter held a significant proportion of the capital and thus was only entitled to minimal control (voting rights). This picture of the ownership structure was later criticized by several researchers who tried to test the validity of these results. Holderness & Sheehan (1988) showed the existence of a few hundred firms in us with majority shareholder. Holderness, Kroszner & Sheehan (1998) have showed that the ownership of rulers in the us was higher than that described by

Berle & Means (1932). Several empirical studies have shown that the model of Berle & Means (1932) was not real. They found that this was only applicable to the us market at that time. Among these studies, we will cite those of Morck, Shleifer & Vishny (1988); Shleifer & Vishny (1986 & 1997); Holderness & al (1999). La Porta, Lopez-de-Silanes & Shleifer (1999) carried out a study which aimed to identify the ultimate owners who controlled the 20 largest firms in 27 countries. The study also looked at 10 medium-sized firms in each and every country. They have showed that the overall ownership tended more towards concentration than towards dispersion and that the majority of the ultimate owners were families. This study also made it possible to focus on the importance of multi-class actions and pyramid structures as means used to achieve or maximize control over these companies. Myers

(1914) found that in Canada less than around 50 people controlled mostly one-third of the wealth of the country. Also a study made by the “royal commission on price spreads” in 1935 confirmed that the ownership structure was concentrated in Canada.

Gadhoun (1995, 1999 and 2000) identified some aspects of Canadian firms following this scheme (see appendix 1). He has showed the total majority of these were directly and indirectly controlled by majority shareholder that holds more than about 50% of the voting rights and about 20% of the total shares are held by internal persons. In addition, the author has shown that this ownership structure had some similarities with those of large groups Japanese (keiretsu), characterized by a controlled complex inter-firm link exclusively by some of the individuals belonging to same family. Several researches have been done in the European context, Bloch & Kremp (1998) for the French companies; “Crespi-Cladera & Garcia-Cestona (1998) for Spanish companies; Bianchi & Enriques (1998) and Barca (1995) for companies Italian; Jong & al (1998), Gorton & Schmid (1996) and Franks & Mayer (1994) Forgerman companies; Georgen & Renneboog (1998) for UK companies”.

Faccio & Lang (2000) studied the overall ownership structure that is around 3,740 firms within five countries Europeans namely France, Italy, Germany, Spain and Great Britain. They found that the ownership structure in Europe was concentrated and that 43.9% of the control was exercised by a limited number of families. The leader was himself in the majority of cases the ultimate owner or was related to the family owner. Likewise, for east Asia, Classens & al (2000) tried to identify the ultimate shareholder for a sample of 2980 companies. Their study showed that more than 2/3 of firms were controlled by an ultimate owner that turns out to be the family. The pyramidal structures are frequently observed unlike multiple classes of actions that are less used. They found that in Philippines and Indonesia, the ten largest families are being controlled for more than half of the corporate assets. It is the same in the other countries in question except for the case of Japan where the concentration of ownership is less. In short, we note that according to most of the empirical

results, the diffusion of ownership appears to be the least common characteristic. Apart from that, the overall concentration of control and ownership within the hands of families seems to be the major trend. The concentration of control turns out to be greater than that of ownership of stocks due to the fact that control can be established directly by holding shares or indirect holders through the pyramidal structures and multiple classes of actions they use.

III. Empirical study

1. Research Objective

The objective of this research is to first characterize the structure of ownership, size of target and, structure of control and acquiring companies during mergers and acquisitions. Secondly, we will rely on the results obtained to try to make a comparison between these two types of companies at the level of these three major characteristics. Finally, we will try to perform a multivariate analysis by testing a prediction model of M&A in which the probability of acquisition is expected to depend on three key variables, namely: size, concentration and profitability.

2. Methods and Materials

Originally, our data of 3,969 American firms are collected from a database "worldscop 1996". This database was processed as part of the work of research characterizing the American and Canadian shareholding developed by (Gadhoun, 2016). Information relating to the characteristics of the shareholding was taken from sec website and the “world’s cop global 1996” database disclaimer. From these sources, we have selected companies that have carried out mergers or acquisitions during the year in question (1996). We then separated them into two groups: buyers/acquirers and targets.

We have in the end 184 firms in the acquiring group and 90 firms in the target group from a total of 3969 companies. The information was collected in two stages: identifying the owners first and then identify their holdings of voting rights and ownership rights. We excluded from our samples affiliated firms with foreign firms and companies with the anonymous shareholders since it is very difficult to trace

back the chain of control and ownership structure in these cases.

At the chain of ownership level, we kept only those shareholders who hold more than 5% within the voting rights within the firm. In many cases the owner is the entity (financial institution, firms etc.); in this case we identify his ownership and go further on until we get to an individual or a broadly owned entity called the ultimate shareholder. Note that an ultimate shareholder is not necessarily the majority shareholder since apart of the control is indirect. When the main shareholder is the unlisted firm, it is considered as a family, the exception of firms controlled by unlisted financial institutions, in this case it is considered to be a financial institution. In addition, we do not distinguish between family and individual in our study. The definition of control and ownership is related to the rights to

voting rights and cash flows respectively. In the definition of ultimate shareholders, there are two types of levels with the control. A shareholder is the finalized owner at 10% as he holds more than 10% of the rights of voting. If the firm has two ultimate shareholders, one which holds 17% of the voting rights and the other holds 26%, we say that the firm has two ultimate shareholders at 10% and one ultimate shareholder at 20%. On the other hand, there are no shareholders who hold more than about 10% (20%) of the voting rights; we say it has 10% (20%) diffuse ownership. Ultimately, we will have two categories of firms, those which have a diffuse ownership and those which have at least one ultimate shareholder.

Below, table 1 introduces each of the variables used in the work as well as their respective definitions.

Table 1: List and Definitions of Variables

Variables	Definitions
BLC1, BLC2, BLC3, BLC4 et BLC5	This is the direct share within the rights of voting that is organized by the 1st, 2nd, 3rd, 4th and 5th block respectively.
PDF10 et PDF20	Ownership diffusion at 10% and 20% respectively. A firm has diffuse ownership if it does not own any shareholder who is holding most of 10% (20%) of the rights of voting. These are binary variables that are taking the value of variable 1 if the ownership of the firm is diffuse, 0 otherwise.
PCO10 et PCO20	Ownership concentrated at 10% and 20% respectively. A firm has concentrated ownership while it is having at least one of the ultimate shareholders (at 10%, 20%). These are binary variables that take the overall value of 1 if the firm's ownership is concentrated, 0 otherwise.
FAM10 et FAM20	=1 if the ultimate shareholder (at 10% and 20% respectively) is an individual (family), 0 otherwise.

This is the direct share of the voting rights held by the 1st, 2nd, 3rd, 4th and 5th block respectively. This is the direct share of the voting rights held by the 1st, 2nd, 3rd, 4th and 5th block respectively. GOV10 et GOV20	=1 if the ultimate shareholder (at 10% and 20% respectively) is a provincial, federal or municipal authority, 0 otherwise.
FIN10 et FIN20	=1 if the ultimate shareholder (at 10% and 20% respectively) is a diffusely owned financial institution, 0 otherwise.
FRM10 et FRM20	=1 if the ultimate shareholder (at 10% and 20% respectively) is a privately owned firm, 0 otherwise.
DIV10 et DIV20	=1 if the ultimate shareholder (at 10% and 20% respectively) does not belong to the categories already listed, 0 otherwise. Example: coopérative
FRETR	=1 if the finalized shareholder is the foreign firm, 0 otherwise. A firm is considered foreign if more than 50% of the voting rights that are totally controlling by the shareholders of the foreign country.
CMV	=1 if the firm uses multiple voting shares, 0 otherwise.
ANV	=1 if the firm uses non-voting shares, 0 otherwise.
ROV	This ratio measures the minimum proportion of the ownership that provides 20% of the voting rights. The ratio is totally equal to 20% if the firm does not use the multiple classes of voting or non-voting shares.
SUO10 et SUO20	=1 if there are at least 2 ultimate shareholders (10% and 20% respectively) who control the firm, 0 otherwise
O1 et O2	This is the share of the ownership of the 1st and 2nd ultimate shareholder of the firm (respectively).
Variables	Definitions
C1 et C2	This is the share of control of the 1st and 2nd ultimate shareholder of firm (respectively).
PYR	=1 if the finalized shareholder is controlling the firm using a pyramid structure, 0 otherwise.
CHOL	=1 if the main shareholder controls the firm using cross-ownership, 0 otherwise
RHOL	=1 if the main shareholder controls the firm by reciprocal ownership, 0 otherwise
MFCF10 et MFCF20	=1 if the family that controls the company (10% and 20% respectively) appoints one of its members to the management, 0

IINV	This is the share of direct and indirect control held by financial institutions.
NACT	This is the number of shares of the firm.
CAPB	This is the market capitalization of the firm
CONC	This is the sum of the direct shares of the voting rights held by the first five blocks of control of the firm.

3. Univariate Analysis:

First, we started with a descriptive statistical analysis of the two groups: buyers and targets. We calculated for each of the groups and for each of the variables: [referred to table 1-3].

- the number of the valid observations: n
- the average
- the median
- the standard deviation (STD DEV)
- the maximum value: Max
- the minimum value: Min

These results are presented in tables 2 (targets) and 3 (acquirers).

Table 2: Descriptive statistics of target enterprises

Targets	N	Median	Mean	STD DEV	Max	Min
BLC1	77	12,40	22,88	26,32	99,82	0,00
BLC2	77	5,50	5,47	5,51	26,30	0,00
BLC3	77	0,00	2,92	3,83	15,70	0,00
BLC4	77	0,00	1,19	2,46	8,33	0,00
BLC5	77	0,00	0,29	1,26	6,20	0,00
PDF10	77	0,00	0,36	0,48	1,00	0,00
PDF20	77	1,00	0,68	0,47	1,00	0,00
PCO10	77	1,00	0,64	0,48	1,00	0,00
PCO20	77	0,00	0,31	0,47	1,00	0,00
FAM10	77	0,00	0,35	0,48	1,00	0,00
FAM20	77	0,00	0,17	0,38	1,00	0,00
GOV10	77	0,00	0,01	0,11	1,00	0,00
GOV20	77	0,00	0,01	0,11	1,00	0,00
FIN10	77	0,00	0,19	0,40	1,00	0,00
FIN20	77	0,00	0,01	0,11	1,00	0,00
FRM10	77	0,00	0,06	0,25	1,00	0,00
FRM20	77	0,00	0,03	0,16	1,00	0,00
DIV10	77	0,00	0,03	0,16	1,00	0,00
DIV20	77	0,00	0,01	0,11	1,00	0,00
FRETR	77	0,00	0,01	0,11	1,00	0,00

Targets	N	Median	Mean	STD DEV	Max	Min
CMV	73	0,00	0,04	0,20	1,00	0,00
ANV	73	0,00	0,01	0,12	1,00	0,00
ROV	73	0,20	0,19	0,03	0,20	0,00
SUO10	77	0,00	0,18	0,39	1,00	0,00
SUO20	77	11,10	0,08	0,27	1,00	0,00
O1	77	11,40	1,81	20,44	99,82	0,00
C1	77	0,00	1,15	22,63	99,82	0,00
O2	77	0,00	1,94	5,05	26,30	0,00
C2	77	0,00	2,10	5,61	26,30	0,00
PYR	77	0,12	0,12	0,32	1,00	0,00
CHOL	77	0,00	0,00	0,00	0,00	0,00
RHOL	77	0,00	0,00	0,00	0,00	0,00
MFCF10	77	0,00	0,22	0,42	1,00	0,00
MFCF20	77	0,00	0,14	0,35	1,00	0,00
IINV	77	7,18	12,37	17,23	88,10	0,00
NACT	90	531796	4470356	16429070	11403800	1278
CAPB	86	344488	1971072	5233089	39303298	435
CONC	77	26,20	32,76	28,15	100,00	0,00

Findings:

- **BLC1 variable:**
The median value and the mean value of the variable blc1 are much higher than blc2, 3, 4 and 5. This means that the direct part of the voting rights held by the first control block is far higher than that of the 2nd, 3rd, 4th and 5th blocks of control. This leads us to think that the control within the targets is on average largely held by the first block which, by itself, directly holds an average of 22.88% of voting rights.
- **PDF10, PDF20, PCO10 and PCO20 variables:**
The hypothesis of diffuse ownership at the 10% level (PDF10) is validated in 36% of cases while in the case of 20% level (PDF20) it is observed in 68% of cases. The results of these two hypotheses should be interpreted together with those of the other two relating to

ownership concentrated at the 10% (PCO10) and 20% (PCO20) levels. Those last two shows us that the ownership concentrated at the 10% level is validated in 64% of cases while ownership concentrated at the 20% level is concentrated in 31% of the data used.

At this point the most relevant result is that the ownership concentrated at the 10% level is validated in 64% of cases, which suggests that the targets have a structure of concentrated ownership. This result is more relevant than that of the hypothesis of diffuse ownership at the 20% level, despite being validated in 68% of cases. Indeed, since the PDF20 variable is binary and only takes into account shareholders holding more than 20% within the rights of voting, while the largest block of shareholder, namely BLC1, holds on average a little more than 20% (22.88%) and that the median of BLC1 is far below 20% (12.4%), so PDF20 will take the value 0 in more than 50% of cases since in most cases there is no shareholder is holding more than around 20% of the rights of voting. Moreover, this explains why the PDF20 hypothesis is validated in 68% of cases and its median is equal to 1. Ultimately, we must retain the fact that the hypothesis of the concentrated ownership of targets at the 10% level is validated in the vast majority of cases and that the median of this variable PCO10 is equal to 1. We thus conclude that the targets have a concentrated ownership in the vast majority of observations studied.

□ FAM10 and FIN10 variables:

The ultimate shareholder in the targets group is in most cases in the hands of a family. This is shown clearly that at the level of the binary variable FAM10 which is verified in 35% of cases. We also noticed another relevant result at this level and which relates to financial institutions. Thus, in 19% of cases, the ultimate shareholder at the level of 10% is a financial institution. ultimately, the ultimate shareholder in terms of targets is first and foremost a family and secondly, a financial institution.

□ SUO10 variable:

The SUO10 variable is on average equal to 18%. This means that in 18% of cases there is a second ultimate shareholder at the 10% level in the targets. Although relatively small, this

percentage (18%) remains high and leads us to believe on the existence of a second ultimate shareholder in the target ownership structure.

□ Variables O1, C1 and PYR:

The variables O1 and C1 respectively define the ownership and the control for the first finalized shareholder. The first finalized shareholder holds an average of 13.81% of stocks ownership and 16.15% of controlling shares, which gives it a privileged position within the target firm. The difference between these two parts can be explained by the use of means of separation between cash-flow rights and voting rights, namely: shares with cross holding, reciprocal holding and multiple rights of voting, pyramidal structure.

At this level we notice that the most dominant means of separation is that of the pyramidal structure (PYR). Thus, we notice that this is verified in 12% of cases and that the other structures are either non-existent (cross structures and reciprocal ones) or insignificant (multiple voting rights, non-voting shares).

□ Variable MFCF10:

The binary variable MFCF10 is validated if the family that controls the target firm at the level of 10% appoints one of its members to the management of the company. We notice that in 22% of cases the variable is validated. This demonstrates the goal of these families that is trying to increase and consolidate their majority control in target firms.

□ IINV variable:

The share of direct and indirect control of institutional investors (financial institutions) in the targets group is quite significant (12.37%). However, this part remains still smaller than that of the first ultimate shareholder who is holding on average 16.15% of the rights of voting and which is in the majority of cases (35%) a family ownership.

□ CONC variable:

The concentration at the targets is quite high (32.76%). This concentration is defined as the sum of the first five control blocks.

The table below summarizes the findings that have been made at the target level.

Findings at the target firm level

Variables	Constatations
BLC1	Control within the targets is on average largely held by the first bloc which, alone, directly holding the average 22.88% of the total rights of voting.
PCO10	The concentrated ownership of targets at the 10% level is validated in 64% of cases, suggesting that the targets have a concentrated ownership structure.
FAM10 et FIN10	The ultimate shareholder in terms of targets is first and foremost a family (35%) and secondly a financial institution (19%).
SUO10	It is believed that there is a second ultimate shareholder in the ownership structure of the targets (18% of cases).
O1 et C1	The first ultimate shareholder holds on average 13.81% ownership shares and 16.15% control shares in the target.
PYR	The pyramidal structure is the most dominant means of separation between control and ownership within targets. This structure is verified in 12% of cases.
MFCF10	In 22% of cases, the family that controls the target firm at the level of 10% appoints one of its members to the management of the company.
IINV	The share of direct and indirect control of institutional investors in the targets is on average equal to 12.37%.
CONC	The concentration at the target level is on average equal to 32.76%.

In what follows, we will analyze the results obtained at the level of the group of acquiring firms.

Table 3: Descriptive Statistics of Acquirers

Acquirer	N	Mean	Median	STD DEV	Min	Max
BLC1	176	16,33	10,10	20,36	0,00	99,82
BLC2	176	5,07	5,57	5,73	0,00	37,30
BLC3	176	2,42	0,00	3,64	0,00	16,98
BLC4	176	1,32	0,00	2,79	0,00	10,40
BLC5	176	0,48	0,00	1,73	0,00	9,90
PDF10	176	0,45	0,00	0,50	0,00	1,00
PDF20	176	0,75	1,00	0,43	0,00	1,00
PCO10	176	0,55	1,00	0,50	0,00	1,00
PCO20	176	0,24	0,00	0,43	0,00	1,00
FAM10	176	0,27	0,00	0,45	0,00	1,00
FAM20	176	0,13	0,00	0,34	0,00	1,00
GOV10	176	0,01	0,00	0,11	0,00	1,00
GOV20	176	0,01	0,00	0,11	0,00	1,00
FIN10	176	0,22	0,00	0,42	0,00	1,00
FIN20	176	0,02	0,00	0,15	0,00	1,00
FRM10	175	0,03	0,00	0,18	0,00	1,00
FRM20	175	0,02	0,00	0,15	0,00	1,00
DIV10	176	0,02	0,00	0,15	0,00	1,00
DIV20	176	0,01	0,00	0,11	0,00	1,00
FRETR	176	0,01	0,00	0,11	0,00	1,00

Acquirer	N	Mean	Median	STD DEV	Min	Max
CMV	172	0,08	0,00	0,27	0,00	1,00
ANV	173	0,01	0,00	0,11	0,00	1,00
ROV	170	0,19	0,20	0,03	0,00	0,20
SUO10	176	0,17	0,00	0,38	0,00	1,00
SUO20	176	0,06	0,00	0,24	0,00	1,00
O1	176	11,91	6,47	18,17	0,00	99,82
C1	176	12,98	10,10	19,71	0,00	99,82
O2	176	1,72	0,00	5,23	0,00	37,30
C2	176	1,94	0,00	5,44	0,00	37,30
PYR	176	0,10	0,00	0,30	0,00	1,00
CHOL	175	0,01	0,00	0,08	0,00	1,00
RHOL	175	0,00	0,00	0,00	0,00	0,00
MFCF10	175	0,17	0,00	0,38	0,00	1,00
MFCF20	175	0,10	0,00	0,30	0,00	1,00
IINV	175	12,99	9,90	15,96	0,00	92,60
NACT	184	5 541	1 140 106	13 286 565	1 278	114 038 000
CAPB	172	5 514	1 205 784	12 074 644	435	96 075 712
CONC	176	25,62	20,05	24,65	0,00	99,82

Findings:

□ BLC1 variable:
The median value and the mean value of the variable BLC1 are much higher than BLC 2, 3, 4 and 5. This means that the direct part of the rights of voting held by the first control block

is far higher than those of the 2nd, 3rd, 4th and 5th blocks of control. This indicates to us that the control within the acquirers is, on average, largely held by the first block which, on its own, directly owns an average of 16.33% of voting rights. That being said, this share of ownership is lower than that at the target level. However, we will not be able to draw a conclusion on this subject until we have carried out a mean difference test between the two groups.

□ PDF10, PDF20, PCO10 and PCO20 variables:

The hypothesis of diffuse ownership at the 10% level (PDF10) is validated in 45% of cases while that at the 20% level (PDF20) is in 75% of cases. The results of these two hypotheses should be interpreted together with those of the other two variables relating to the ownership concentrated at the levels of 10% (PCO10) and 20% (PCO20). Those last two figures show us that the ownership concentrated at the 10% level is validated in 55% of cases, while ownership concentrated at the 20% level is validated at only 25% of cases. With these findings, we will not be able to comment on the ownership structure of the acquirers. However, we notice that ownership at the 10% level is more concentrated despite the difference between these two characteristics being small (10%). At the 20% level, the ownership is more diffuse than concentrated levels and the gap between these two characteristics is higher than before (50%). These two results do not allow us to draw a conclusion on the ownership at the level of the buyers especially that at two levels (10% and 20%) the conclusions are contradictory. However, and in the same logic of reasoning advanced at the level of targets, we should consider the result obtained at the 10% level instead. The average of PCO10 being equal to 55% and its median being equal to 1, we could consider that the ownership at the buyer level is in the majority of cases more concentrated than diffuse, except that the difference between these two characteristics remains relatively small (10%).

□ FAM10 and FIN10 variables:

The ultimate shareholder in acquiring firms is in most cases a family. This is clearly seen at the level of the binary variable FAM10, which is verified in 27% of cases. We can also notice another relevant result at this level and which relates to financial institutions. Thus, in 22% of cases the ultimate shareholder at the level of 10% is a financial institution. Ultimately, the ultimate shareholder at the level of the acquirers is first and foremost a family and secondly a financial institution. In addition, it should be noted that on average the share of families is lower among buyers than among targets (27% vs. 35%). The opposite is happening at the level of financial institutions. Among buyers, they have more shares than among targets (22% vs. 19%). However, it should be remembered that we are still at the level of descriptive statistics of the data and not at the level of conclusions. Difference tests of average will be able to draw further conclusion in this direction.

□ SUO10 variable:

The SUO10 variable is on average equal to 17%. This means that in 17% of cases, there is a second ultimate shareholder at the 10% level among the buyers. Though relatively small, this percentage (17%) remains high and leads us to believe on the second existing shareholder within the ownership structure of acquirers.

□ Variables O1, C1 and PYR:

The variables O1 and C1 respectively define the controlling of the first finalized shareholder and ownership. The first ultimate shareholder holds an average of 11.91% of shares in ownership and 12.98% of controlling shares which gives it a privileged position within the acquiring firms. The difference between these two parts can be explained by the use of intelligent means of separation between ownership and control. At this level, we notice the most dominant way of separation can be the use of pyramidal structure (PYR). Thus, we notice that this is verified in 10% of cases and that the other structures are either non-existent (reciprocal structures) or not significant (multiple voting rights, non-voting shares and cross structuring of ownership).

□ Variable MFCF10:

The binary variable MFCF10 is validated if the family that controls the acquiring firm at 10% level appoints one of its members to the management of the company. We note that in 17% of cases the variable is validated statistically. This once again demonstrates the objective of these families to try to increase and consolidate their majority control of votes within acquiring firms.

□ IINV variable:

The share of direct and indirect control of institutional investors (financial institutions) among buyers is quite significant (12.99%). They are far from equal control with the first ultimate shareholder who owns on average 12.98% of the controlling shares and which is in the majority of cases (27%) a family. The contrary is happening at the targets pool. Thus, the controlling share of the first ultimate

shareholder, which in the majority of cases is a family, is higher than that of financial institutions

(FIN10). This does present a difference between the two groups, but at this stage we are still not able to draw conclusions on this subject since we have not yet carried out mean difference tests.

□ CONC variable:

The concentration among buyers is quite high (25.62%). This concentration is defined as the sum of the first five control blocks. Finally, note that this concentration is higher in the targets than in the acquirers. A conclusion on this subject will be made based on the results of the tests of mean difference that we will present later.

In the table below summarizes the findings made at the level of buyers.

Findings at the acquirer level

Variables	Findings
BLC1	Control within the acquirers is on average largely held by the first block which, on its own, directly holds within the average 16.33% of their rights in voting process.
PCO10	The concentrated ownership of the acquirers at the 10% level is validated in 55% of cases. Ownership at the level of the acquirers is in the majority of cases more concentrated than diffuse.
FAM10 et FIN10	The ultimate shareholder at the level of the acquirers is first and foremost a family (27%) and secondly a financial institution (22%).
SUO10	It is believed that there is a second ultimate shareholder in the ownership structure of the acquirers (17% of cases).
O1 et C1	The first ultimate shareholder holds on average 11.91% ownership shares and 12.98% control shares in the acquiring firm.
PYR	The pyramidal structure is the most dominant means of separation between control and ownership among the acquirers. This structure is verified in 10% of cases.
MFCF10	In 17% of cases, the family that controls the acquiring firm at the level of 10% appoints one of its members to the management of the company.
IINV	The share of direct and indirect control of institutional investors in the acquirers is on average equal to 12.99%.
CONC	The concentration at the level of the acquirers is on average equal to 25.62%.

Below, table 4 summarizes the parametric tests in finding out the difference in value of mean that is between two groups for each of the variables and at confidence levels of 99, 95 and 90%.

Table 4: Parametric Tests of Mean Differences

Acquirer	N	Mean	Median	STD DEV	Min
BLC1	16,33	22,88	0,054	0,054	0,054
BLC2	5,07	5,47	0,599	0,599	0,599
BLC3	2,42	2,92	0,322	0,322	0,322
BLC4	1,32	1,19	0,725	0,725	0,725
BLC5	0,48	0,29	0,402	0,402	0,343
PDF10	0,45	0,36	0,204	0,204	0,204
PDF20	0,75	0,68	0,221	0,237	0,237
PCO10	0,55	0,64	0,204	0,204	0,204
PCO20	0,24	0,31	0,225	0,242	0,242
FAM10	0,27	0,35	0,213	0,227	0,227
FAM20	0,13	0,17	0,426	0,426	0,426
GOV10	0,01	0,01	0,913	0,913	0,913
GOV20	0,01	0,01	0,913	0,913	0,913
FIN10	0,22	0,19	0,634	0,634	0,634
FIN20	0,02	0,01	0,610	0,610	0,610
FRM10	0,03	0,06	0,274	0,332	0,332
FRM20	0,02	0,03	0,882	0,882	0,882
DIV10	0,02	0,03	0,877	0,877	0,877
DIV20	0,01	0,01	0,913	0,913	0,913
FRETR	0,01	0,01	0,913	0,913	0,913

Variables	Acquirer	Targets	Pr. at 99%	Pr. at 95%	Pr. at 90%
CMV	0,08	0,04	0,320	0,266	0,266
ANV	0,01	0,01	0,890	0,890	0,890
ROV	0,19	0,19	0,830	0,830	0,830
SUO10	0,17	0,18	0,827	0,827	0,827
SUO20	0,06	0,08	0,654	0,654	0,654
O1	11,91	13,81	0,463	0,463	0,463
C1	12,98	16,15	0,263	0,263	0,263
O2	1,72	1,94	0,759	0,759	0,759
C2	1,94	2,10	0,831	0,831	0,831
PYR	0,10	0,12	0,730	0,730	0,730
CHOL	0,01	0,00	0,508	0,508	0,508
RHOL	0,00	0,00	S.O.	S.O.	S.O.
MFCF10	0,17	0,22	0,356	0,356	0,375
MFCF20	0,10	0,14	0,361	0,361	0,389
IINV	12,99	12,37	0,781	0,781	0,781
NACT	5 541 834	4 470 356	0,563	0,563	0,563
CAPB	5 514 409	1 971 072	0,001	0,001	0,001
CONC	25,62	32,76	0,044	0,044	0,044

Findings:

By analyzing the test results we noticed only the three significant differences of means between two groups. These differences are observed in the following variables: BLC1, CAPB and CONC.

□ BLC1 variable

This variable designates the direct part of the voting rights held by the 1st controlling block holder.

We find that the shares of this block are on average significantly higher in the sample of targets (22.88%) than that of the buyers (16.33%). Moreover, the overall difference within the mean value is at the confidence level of 90%, this can be interpreted this way: the first controlling block holder has more power to control the decisions in targets' pool than in buyers' pool.

□ CAPB variable

This variable designates the market capitalization of the firm and represents a relevant measure of the firm the size. We are watching that the important difference within the value of mean between the two groups at the variable level of this value and this at the three thresholds of significance 1%, 5%, and 10%).this can be interpreted quite simply by the fact that the targets are smaller than the acquirers. We can see that the size of the buyers is on average 2.8 times the size of the targets, which represents a large size ratio. This is probably not surprising given that in general it is the large firms that absorb the small ones and not the contrary.

□ CONC variable

This variable designates the sum of the direct shares of the voting rights held by the five first blocks of control. It impacts the concentration since it determines whether the firm has a concentrated or diffuse ownership structure. That being said, we note that the average of the voting rights shares of the five

Largest block of control is significantly larger (at two levels of confidence) at the level of targets than at the level of buyers, 32.75% compared to 25.61%. This leads us to say that M&A targets have an ownership structure more concentrated than in the case of the buyers. Moreover, like the parametric statistical tests of difference of means place very severe restrictions on certain data characteristics, the observations which are non-following definition of our data selection could easily skew our results. A very severe restriction for the validity of our tests consists in the normality of the data that we have tested

by calculating the skewness and kurtosis of each data series. We have concluded that none of the variables in the two groups followed the normal distribution. as a remedy to this problem, we used the mean difference test: the test of nonparametric Wilcoxon-Mann-Whitney U which does not include any condition relating to the data normality unlike the previous test. This kind of test we call nonparametric does not rely on the parameters of the frequency distributions unlike conventional difference-of-means tests. Moreover, it is ideal in cases involving very small samples. Such samples are too small to allow a correct estimation of frequencies, which in general prevents them from being submit to parametric tests. in our case, this test will allow us to remedy the constraints relating to data characteristics and confirm or reject the results of the difference tests of “the average difference test” already found.

Below, table 5 summarizes the results of the non-mean difference parametric test of Wilcoxon-Mann-Whitney U.

Table 5: Wilcoxon-Mann-Whitney U mean difference tests

Variables	Statistic Z	Probability at 95%
BLC1	-2,277	,023
BLC2	-1,061	,288
BLC3	-1,503	,133
BLC4	-.202	,840
BLC5	-.512	,609
PDF10	-1,461	,144
PDF20	-1,315	,189
PCO10	-1,374	,169
PCO20	-1,308	,191
FAM10	-1,323	,186
FAM20	-.925	,355
GOV10	-.106	,916
GOV20	-.106	,916
FIN10	-.336	,737
FIN20	-.516	,606
FRM10	-.923	,356
FRM20	-.151	,880
DIV10	-.151	,880
DIV20	-.106	,916
FRETR	-.106	,916

Variables	Statistic Z	Probability at 95%
CMV	-.600	,549
ANV	-.663	,507
ROV	-.572	,567
SUO10	-.417	,677
SUO20	-.442	,658
O1	-1,173	,241
C1	-1,376	,169
O2	-.425	,671
C2	-.384	,701
PYR	-.628	,530
CHOL	,000	1,000
RHOL	,000	1,000
MFCF10	-.928	,353
MFCF20	-.782	,434
IINV	-.072	,942
NACT	-3,745	,000
CAPB	-4,136	,000
CONC	-2,535	,011

Findings:

We note that the differences in means that we found significant using the parametric test remain significant by applying the non-parametric test. In addition, we have observed the emergence of a significant difference in the mean that was revealed by this new test. Indeed, at the level of the variables blc1, capb and conc, we confirmed by using the test of “Wilcoxon-Mann-Whitney U” and this test is having the importance regarding the total difference within the mean value and between two groups studied, both targets and acquirers. This leads us to say that:

1. The first block of control has more direct control power in targets than among buyers.
2. The target firms are smaller than the acquiring firms considering the market capitalization as a measure of size.
3. f & a targets have a more concentrated ownership structure than that of acquirers.

In addition, thanks to this last test, we revealed a new difference of several value of mean variable between other two groups for the variable Nact. This same difference in mean was not significant using the parametric test introduced previously in table 4. the variable Nact being defined as the number of shares of the firm, we conclude that the number of target

actions is on average significantly lower than that of the buyers. This last result confirms the results found the capitalization level within the overall stock market of the firm. It is noteworthy to recall that both variables define the size of firms.

This therefore leads us to say that:

4. The target firms are smaller than the acquiring firms considering the number of shares as it is fully measured in size.

Results 2 and 4 allow us to conclude that the targets are significantly smaller than the buyers.

Discussion

4. Multivariate analysis

Finally, we carried out a multivariate analysis by putting forward a F&A target prediction model. Thus, we have already studied about the overall relationship of probability (Y) that a firm is acquired and three explanatory variables namely: concentration (CONC), market capitalization(CAPB) and performance measured by the Tobin’s Q ratio (QTOBINS). To this end, we have collected information relating to these three variables for our two samples, namely targets and acquirers. We then used a binary variable where Y is equal 1 when it comes to target firms and 0 otherwise.

Our model can be presented as follow:

$$Y = \alpha + \beta_1 \times CONC + \beta_2 \times CAPB + \beta_3 \times QTOBINS$$

Logit model:

The fact that our dependent variable Y is binary (value 1 is taken if there is acquired firm otherwise the value is 0) can cause us some estimation problems. Indeed, instead of estimating Y, the objective is to estimate P (Y = 1) with p is a probability and ranges in the interval between 0 and 1. consequently, this measure is bounded on the right and on the left. It is moreover necessary for finding the total way for removing these limits.

By dividing P by (1-P) the bound on the left is non-existing because when the value of P tends to 1, P / (1-P) that tends towards the infinity. If P tends to 0 then P / (1-P) also tends to zero. We apply then a second transformation of logarithmic type, so that when p tends to the value of 0, the transformation tends to negative

infinity. Hence, this double transformation we called the logit of P.

The logit model is then written as follows:

$$\text{Logit}_Y = \log\left(\frac{Y}{1-Y}\right) = \alpha + \beta_1 \times CONC + \beta_2 \times CAPB + \beta_3 \times QTOBINS$$

By manipulating the model in an adequate way, we obtain a model which expresses Y in Function of our independent variables. So, we get:

$$Y = \frac{\exp(\alpha + \beta_1 \times CONC + \beta_2 \times CAPB + \beta_3 \times QTOBINS)}{1 + \exp(\alpha + \beta_1 \times CONC + \beta_2 \times CAPB + \beta_3 \times QTOBINS)}$$

Findings:

To test the logit model we used SPSS software which gives us the result with the greatest caution because ultimately our model cannot predict targets, which is our original goal of this multivariate analysis.

This proposed possibility of manipulating the logit regression; it allows us to use it directly without having to manipulate data beforehand.

The results obtained are summarized in the tables below:

Table 6: Significance of the Model

	Chi Square	DF ⁶⁰	Sig ⁶¹
Modèle	7,982	3	0,046

Table 7: Logit Regression Results

Variables	Regression coefficient	Std Dev	Test of Wald	DF	Sig
QTOBINS	-0,003	0,012	0,079	1	0,778
CONC	0,011	0,006	2,810	1	0,094
CAPB	0,000	0,000	1,878	1	0,171
Constante	-1,448	0,306	22,401	1	0,000

Table 8: Prediction Level of the Model

Observés ⁶²	Prediction of the model		
	Non target	Targeted	% of prediction
Merger/Acquisition	Non Target	157	100%
	Target	43	0%
Global %			78,50%

⁶⁰ It represents the degree of freedom

⁶¹ Statistic sig following Chi carré (to compare with 0.01, 0.05 or 0.1 according to the degree of freedom needed)

Results analysis:

The first result that we will highlight is that our model is globally significant at 95% confidence level. We can see this through table 6 in which we can see that the value of the statistic $\text{sig} = 0.046$ is less than 0.05 (for a level 95%). the second result, the most relevant, is that only the variable CONC is significant in our model at a confidence level of 90% ($\text{sig} = 0.094$), the others variables (CAPB and QTOBINS) being insignificant at all levels of confidence (99%, 95% and 90%)

The result is based on one of the Logit regression (table 7), our model would be written under this form:

$$\text{Logit}_Y = \log\left(\frac{Y}{1-Y}\right) = -1.448 + 0.011 \times \text{CONC} + 0.000 \times \text{CAPB} - 0.003 \times \text{QTOBINS}$$

The only result that can be drawn from this equation is that the probability of being a target positively depending upon the overall degree of concentration within the ownership. In other words, the more the firm has a concentrated ownership structure, the more likely it is to be a M&A target.

According to Shleifer & Vishny (1986) and Bolton & Von Thadden (1998), this result is consistent with many other advanced research findings on this subject. The last relevant result to add is that our model manages to predict 100% the non-targets but cannot predict any targets. Theoretically the model has an overall prediction percentage of 78.5%. Note that we must interpret this result with prudence.

IV. Conclusion

Our empirical study made it possible to characterize in certain aspects the targets and Buyers during the M&A. we found that on average M&A targets have a shareholding concentrated structure is at 32% and that in the majority of cases, the finalized shareholder is within the family that

Is within the 22% of cases is designated to a member to the head of the management. At the level of the acquirers, we observed a less concentrated than the targets (25%). In the majority of cases, the finalized shareholder is in the first position of the family. Secondly, the ultimate shareholder is a financial institution. The percentage of families as the ultimate shareholder is lower among buyers than among targets, and the opposite is happening at the level of financial institutions. In addition, we note also the existence of the pyramidal structure at the level of the shareholding of targets. Our mean difference tests have enabled us to suggest that the buyers are

Less concentrated and they are mostly larger than all the targets. Finally, it would be safe to say that our results cannot be generalized to other countries. Each country has its own corporate culture and a generalization could not be done than in its territorial context. Another major criticism we can make to this study would be related to the size of our samples. At this level, we should remember the difficulty of collecting data. Thus, by having larger samples we could have obtained even more relevant and conclusive results. This leaves the door open for other future research with a larger quantitative data base.

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