RELATIONSHIP ANALYSIS BETWEEN QUALITY OF WORK LIFE (QWL) AND LABOURS ORGANIZATIONAL COMMITMENT (LOC): A STUDY OF LARGE SCALE MANUFACTURING INDUSTRIES OF PUNE DISTRICT

P. V. Yadav[1], D. T. Pisal[2], S.A. Giiramkar[3]
[1]Anekant Education Society, Anekant Institute of Management Studies, Baramati (AIMS).
[2]SVPM's Institute of Management, Malegaon BK.
[3]Parikrama College of management Shrigonda
[1]praveen26dec@gmail.com [2]pisaldt@gmail.com

ABSTRACT

Quality of Work Life and Labours Organizational Commitment serve as a foundation for all commercial operations inside the company and hence the researcher has considered the Quality of Work Life and Labours Organizational Commitment being the most essential reason for which this research is being conducted. The objective of the present study was to find the relationship between Quality of Work Life (QWL) and Labours Organizational Commitment (LOC) of the large-scale manufacturing industries of Pune district. Data were collected from 390 respondents. Three independent structured close ended schedules were used as instruments for collecting primary data from respondents. Simple Linear Regression & Multiple Linear Regression was used to find the impact of Quality of Work Life and Labours Organizational Commitment. Pearson Correlation Coefficient (r) test was used for analysis of relationship.

Keywords: *Quality of Work Life, Labours Organizational Commitment and large-scale manufacturing industries.*

Introduction

Employees are the organization's most valuable resource and its core strength. Organizations frequently place a greater emphasis on technology and systems than on personnel. It is not well recognised that employees are the ones who drive an organization's technologies and systems. Employees are not individuals working in the organisation; they are social creatures who belong to a specific social structure, family life style, and culture. The relevance of "Quality of Work Life" (QWL) in an organisation is not effectively taken care of due to a lack of knowledge among employers and employees. Absence of QWL results in job discontent, greater absenteeism, a lack of motivation and morale, higher accident rates, and worse productivity, among other things. These are the primary causes of an organization's poor performance, outnumbering all other factors. In organisations, QWL is critical to the proper operation of the business. It also aids in attracting and maintaining efficient and productive people for the appropriate job profile, which leads to the success of both employees and companies. To ensure that all employees are working at their maximum ability while remaining stress-free, the Work-Life Balance must be carefully maintained. Employee dedication can come in a variety of shapes and sizes. As a result, it's frequently regarded as a difficult-to-define HR variable. When it comes to the context, direction, and growth of commitment, as well as the extent to which commitment drives behaviour, there can be confusion and debate. The bond that employees have with their organisation defines their devotion to it. Employees who are committed to their company have a sense of belonging, a sense of knowledge of the company's goals, and a sense of belonging in general. Because they are more engaged to their work, more productive, and more aggressive in delivering aid, such employees have a higher added value. Employee commitment is critical because high levels of

commitment result in a number of positive organisational outcomes. It demonstrates how dedicated employees are to the organization's aims and how much they identify with it. In today's competitive business world, every company faces the challenge of attracting and maintaining qualified employees. To counteract this, all firms must maintain a high level of Workplace Quality of Life. According to the literature, QWL is a movement that is a continuous process that has an impact on employee performance. Employee morale, commitment, efficiency, and effectiveness all suffer when the level of QWL falls. As a result, when developing QWL for employees, companies must consider issues like as morale, employee dedication, and so on. Every employee's Quality of Work Life (QWL) should be enjoyable; else, that individual would feel uncomfortable and demotivated in the organisation. This type of setting, on the other hand, has a direct impact on job satisfaction, performance, and productivity, as well as their general contentment at work. It can be concluded from the preceding analysis that there is a strong correlation between "Quality of Work Life" (QWL) and Labours Organizational Commitment (LOC). Thus, QWL is no longer just for show; it has become a necessity for employers, as its implementation has resulted in attracting better employees and lowering turnover, as well as enhanced job satisfaction, retention, devotion, loyalty, attention, and performance.

Quality of Work Life (QWL):

The concept "Quality of Work Life" first appeared in study journals and the press in the United States in the 1970s. The term "quality of work life" was coined by Louis Davis. The inaugural International Quality of Work Life Conference was held in Toronto in 1972, and the next year, the International Council for "Quality of Work Life" was established. [i].

The basic concept of QWL is moved around its eight criteria of employment i.e. characteristics of the individual's work experience or work environment[ii]. Richard E. Walton QWL is explained in terms of eight general conditions which consist of "Adequate and fair compensation", "Safe and healthy working conditions", "Opportunity to use and develop human capacities", "Opportunity for continued career growth and security", "Social integration in work place", "Constitutionalism in the work organization", "Balanced role of work in total life space" and "Social relevance of work"[iii].

Organizational Commitment (OC):

Organisational commitment is describe in a variety of ways throughout the last few years (e.g. Meyer & Allen, 1991; J. P. Meyer, D. J. Stanley, L. Herscovitch, L. Topolnytsky, 2002, I. R. Gellatly, J. P. Meyer, A. A. Luchak, 2006, Mowday et al., 1979). Organisational commitment is thus made up of the following three components:

1) "one's strong belief in and acceptance of the organisation's goals and values",
2) "one's willingness to make considerable effort on behalf of the organisation",
3) "one's strong desire to maintain membership in the organisation".

The following are major aspects of organisational commitment:

1. **Affective commitment:** "refers to the employee's positive emotional attachment to the organization. The affective component means emotional commitment of an employee to the organization and identification with it. The persons with strong affective commitment continue their employment in the organization because they want to do so. The choice of the notion – affective commitment –

was conditioned by a belief that all factors involved in the development of this component are accompanied by strong positive feeling, and this is probably the most essential aspect of this form of commitment" [iv].

2. **Continuance commitment:** "refers to an employee's commitment to an organization due to the fact that he calculates how high the costs of losing one's organizational membership are. Such considerations might include economic costs (for instance, pension accruals) and social costs (relationships/friendships with colleagues might cease to exist) too". Individuals feel that they "have to" commit to the organization. "The awareness of the costs associated with leaving the company is a component of the continuity component. Employees whose basic relationship to the company is based on the need to keep working there stay as long as they need to." [v].

3. **Normative commitment:** "refers to an individual's commitment an organization because of feelings of obligation. Such feelings might derive from the fact, for example, that the organization invested a certain amount of resources when employing the person (trainings, courses, etc.), which makes the employee feeling obliged to put considerable effort into the job and stay with the organization until repaying the debt. Furthermore, such feelings can also stem from personal reasons, triggered by some socialization processes, or one wishes to remain loyal to his family or any other person." Therefore, the employee stays with the organization because he "ought to" do so. "These feelings arise out of a sense of duty or obligation. This particular component is affected largely by one's personal experience, cultural background, and socialization. There are cultures, for example, that of the Japanese, which are characterized by normative commitment, whereas affective commitment is typical of the Americans (János, 2005)" [vi].

The goal of this research was to find out more about large scale manufacturing companies of the Pune district. The existence of QWL programs in large scale manufacturing companies was essential in order to retain valuable employees as it also influenced their organizational commitment (OC). As a result, in order to establish the relationship between the two, "Quality of Work Life" (QWL) programs and "Labours Organizational Commitment" (LOC), the following questions is used:

Research Hypothesis:

H_0 : "There is no significant relationship between **Quality of Work Life (QWL)** and **Organizational Commitment (OC)**".

H_1 : "There is significant relationship between **Quality of Work Life (QWL)** and **Labours Organizational Commitment (OC)**".

Research Methodology

A. Research Design:

The present research is Diagnostic in nature as it is an in-depth study directed by hypotheses. Diagnostic inferential research design is used since, it focuses on relationship and association between variables such as QWL and OC. The Primary data has been collected in the form of feedback from sample blue collar labours to cogitate the impact of QWL on OC. Three independent structured close ended schedules were

used as instruments for collecting primary data from respondents.

B. Sample and Sampling Technique:
Labours working in the large-scale manufacturing industries of Pune district taken as samples. Simple random sampling method was used for sample selection since sample universe is large and researcher wants to obtain representative samples from each company. Samples of every company were approached in person to record the responses. There are 677 large scale manufacturing companies situated in Pune district out of which 114 companies were selected where the total employment is more than 500. The sample universe of this research was 1,36,036. Researcher has used standard formula to calculate proposed sample size. Each company's samples added together to calculate actual sample size. The actual sample size of this research is **390 samples**.

C. Measurement:
The reliability analysis for final data of Schedule I, II & III was done by Cronbach's Alpha using of SPSS. Simple Linear Regression & Multiple Linear Regression has used to find the impact of impact of QWL on OC. Hypothesis was tested using Pearson Correlation Coefficient (r) test has used to find out relationship between QWL & OC.

Result and Discussion:

Table 1.1. Demographic Distribution of Samples

(n=390)

Sr. No.	Demographic Variables		Gender		Total	Gender		Total
			Male	Female		Male	Female	
			Frequency	Frequency		%	%	
1	Marital Status	Single	39	18	57	10.0	4.6	14.6
		Married	274	59	333	70.3	15.1	85.4
		Separated	-	-	-	-	-	-
		Widowed	-	-	-	-	-	-
		Divorced	-	-	-	-	-	-
		Total	313	77	390	80.3	19.7	100.0
2	Education	Illiterate	-	-	-	-	-	-
		School: Up to 4 years	61	0	61	15.6	0	15.6
		School 5-9 years	54	0	54	13.8	0	13.8
		SSC	94	42	136	24.1	10.8	34.9
		HSC	13	21	34	3.3	5.4	8.7
		ITI	91	14	105	23.3	3.6	26.9
		UG	-	-	-	-	-	-
		PG	-	-	-	-	-	-
		Other	-	-	-	-	-	-
		Total	313	77	390	80.3	19.7	100.0
3		Up to 5000	-	-	-	-	-	-

	Income (Monthly)	6000 to 10,000	-	-	-	-	-	-
		11,000 to 15,000	20	0	20	5.1	0.0	5.1
		16,000 to 20,000	65	43	108	16.7	11.0	27.7
		Above 20,000	228	34	262	54.5	8.7	67.2
		Total	313	77	390	80.3	19.7	100.0
4	Employment Status	35-40 Hours Per Week	81	48	129	20.8	12.3	33.1
		41-45 Hours Per Week	2	12	14	0.5	3.1	3.6
		More than 45 Hours Per Week	230	17	247	59.0	4.4	63.3
		Any Other	-	-	-	-	-	-
		Total	313	77	390	80.3	19.7	100.0
5	Job Title/Occupation/ Designation	Carpenter	-	-	-	-	-	-
		Electrician	81	0	81	20.8	0.0	20.8
		Fitter	17	0	17	4.4	0.0	4.4
		Operator	72	0	72	18.5	0.0	18.5
		Gardening, Landscaping, etc	-	-	-	-	-	-
		Maintenance	53	0	53	13.6	0.0	13.6
		Line Leader	27	23	50	6.9	5.9	12.8
		Quality Checker	13	48	61	3.3	12.3	15.6
		Mechanical	8	0	8	2.1	0.0	2.1
		Painter	-	-	-	-	-	-
		Plumber	-	-	-	-	-	-
		Driver	-	-	-	-	-	-
		Welder	10	0	10	2.6	0.0	2.6
		Skilled Technician	16	0	16	4.1	0.0	4.1
		Packaging	16	6	22	4.1	1.5	5.6
		Any other	-	-	-	-	-	-
		Total	313	77	390	80.3	19.7	100.0

(Source: Field Data)

The impact of Quality of Work Life (QWL) factors on Labours Organizational Commitment (LOC)

Table 1.2.

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
(Constant)		1.635	.084		19.446	.000
Adequate and fair compensation	X1	.053	.011	.136	4.788	.000
Safe and healthy environment	X2	.066	.009	.207	7.506	.000
Development of human capacities	X3	.116	.010	.271	11.331	.000
Growth and security	X4	.089	.009	.241	9.909	.000
Social integration	X5	.075	.009	.214	8.773	.000
Constitutionalism	X6	.081	.010	.224	8.480	.000
The total life space	X7	.070	.011	.190	6.660	.000
Social relevance	X8	.124	.014	.224	8.947	.000
Dependent Variable: Labours Organizational Commitment (LOC)						

(Source: Compiled by researcher)

In the above table a multiple regression calculated to predict Labours Organizational Commitment (LOC) based on Quality of Work Life (QWL) factors. Researcher has framed multiple regression equation to study the impact of eight Quality of Work Life factors (independent variable) on Labours Organizational Commitment (dependent variable).

LOC= 1.635+0.053*X1+
0.066*X2+0.116*X3+0.089*X4+0.075*X5
+0.081*X6+0.070*X7+0.124*X8

From above table it is clear that, Development of human capacities has more significant impact on Labours Organizational Commitment (LOC) with Beta value of 0.271 followed by Growth and security Social relevance & Constitutionalism with beta values 0.241, 0.224 & 0.224 respectively.

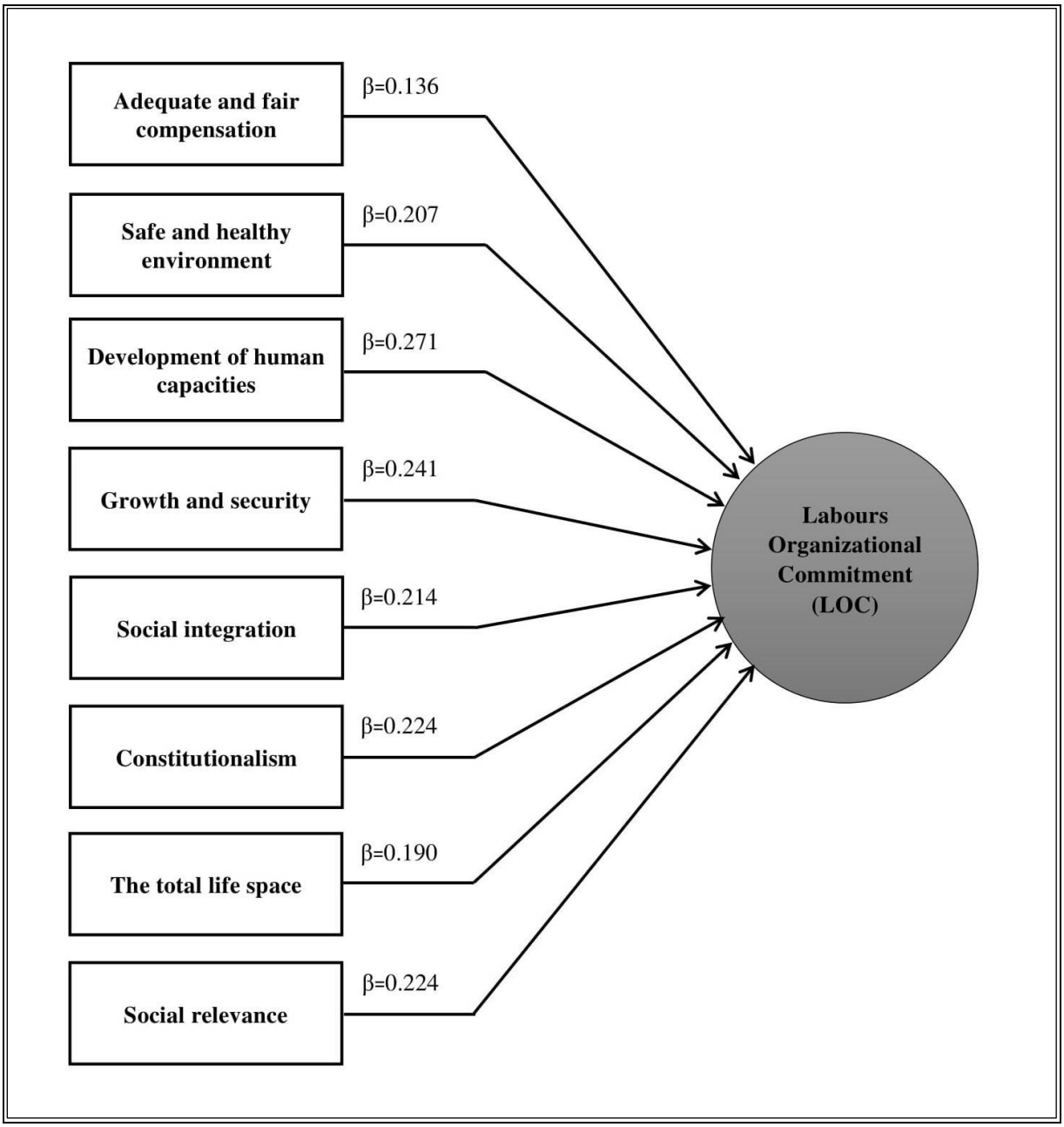


Fig: 1.1 The impact of Quality of Work Life (QWL) factors on Labours Organizational Commitment (LOC)

Table 1.3. The Correlation between Quality of Work Life (QWL) and Labours Organizational Commitment (LOC).

Correlations			
		QWL	LOC
QWL	Pearson Correlation	1	.948**
	Sig. (2-tailed)		.000
	N	390	390
LOC	Pearson Correlation	.948**	1

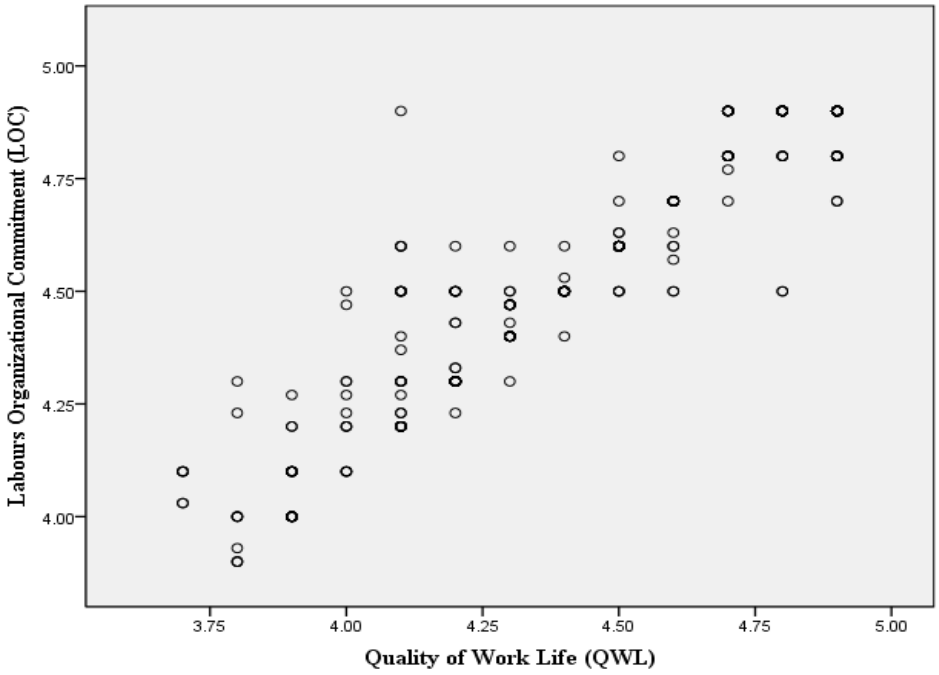
	Sig. (2-tailed)	.000	
	N	390	390
**. Correlation is significant at the 0.01 level (2-tailed).			

(Source: Compiled by Researcher)

Table No. 1.3 depicts the Pearson's r states correlation between the Quality of Work Life (QWL) and Labours Organizational Commitment (LOC) which is 0.948. The Pearson's r is 0.948 and this value is very much close to 1. However, it is revealed that there is a strong and positive relationship between Quality of Work Life (QWL) and Labours Organizational Commitment (LOC).

The Sig. (2-Tailed) value is 0.000. Thus 'P' value is 0.000 and this is less than 0.05 hence, null hypothesis is rejected and the alternative hypothesis i.e. there is significant relationship between Quality of Work Life (QWL) and Labours Organizational Commitment (LOC) is accepted.

Graph 1.1



The above graph states trend line slopes upward from zero therefore; positive correlation between **Quality of Work Life (QWL)** and **Labours Organizational Commitment (LOC)**. Increases in first variable are correlated with increases in second variable. Also decreases in first variable are correlated with decreases in second variable.

Conclusion:

As the industrial sector becomes more essential to the economies of developed countries, organisations claim that their most precious asset is their personnel. Employees are more likely to report higher levels of performance and dedication if they believe a company provides them with high-quality work in exchange for their participation. Employees' sense of commitment will

improve if they have strong relationships and are cohesive in the company. QWL and OC are multidimensional constructs that are the result of a workplace examination. Employee commitment enables superior performance as well as greater attraction and retention of the best personnel, boosting the organization's ability to provide higher-quality services. Workplace satisfaction and organisational commitment are linked. Workplace satisfaction has been found to have a major impact on organisational commitment. This suggests that employees who have a good quality of life at work are more devoted and have great commitment towards organization in all dimensions with their employers than those who have a bad quality of life at work.

References

1. Jain Bindu and Swami Yashika (2014). 'Quality of Work Life with Special Reference to Academic Sector', Research Journal of Management Sciences, 14-17
2. http://www.isca.in/IJMS/Archive/v3/i1/4.ISCA-RJMS-2013-111.pdf
3. Rao Subba P. (2006) Human Resource Management and Industrial Relation, Himalaya Publishing House, Mumbai, P. 659.
4. Ibid
5. Agata Wołowska (2014). "Determinants of Organizational Commitment", Human Resources Management & Ergonomics Volume VIII pp 129-146.
6. Ibid
7. http://www.jgypk.hu/tamop13e/tananyag_html/sportkultura_eng/the_concept_of_organisational_commitment.html

A STUDY OF FINANCIAL PERFORMANCE INDICATORS FOR ENGINEERING INDUSTRY: A REVIEW

S. V. Umbardand
Arts, Science and Commerce College, Indapur.
svu2020@gmail.com

ABSTRACT

The Current paper focuses on the study (review) of the nature of engineering industry and the financial indicators that can examine and evaluate the financial performance of the engineering companies. The main focus is on the study of financial tools and techniques that will be suitable for understanding the financial performance of Engineering Industry. The Researcher has made an attempt to understand the scope and nature of the engineering units and thereafter studied the analytical tools to be used for assessing the financial efficiency, profitability, solvency and financial position of the engineering units. The researcher has reviewed previously published work of financial performance analysis of companies belonging to other industries. The researcher concludes that Comparative statements, common size statement analysis, ratio analysis and trend analysis are more suitable for measuring the financial performance of selected engineering industrial units.

***Keywords**: Engineering Industry, Financial Performance, Financial Tools, Financial Techniques, Financial Indicators.*

Introduction

The Evolution of Industry in India is very ancient. Indian artisans and craftsmen have been engaging themselves in manufacturing many products using small tools and manual skills. Weaving and handicrafts were the basic occupation along with agriculture in Indian villages. Slowly Cotton Textile industry started growing in India. Till the Industrial Revolution took place in Europe, Steel Industry, Silk Industry, Carving, Pottery, Metal works, Dyeing and Printing Industries developed in India. After the Industrial Revolution mechanization and modern factories started developing in India. The first large scale Iron industry (using Charcoal as fuel) was set up in the year 1830 in Tamilnadu. However it shut down by 1866.Therefore the large scale mechanized Cotton Textile industry set up in Mumbai in 1854 can be considered the first big factory in India. East India Company developed Jute, woolen, paper, breweries, war equipment Industries. The demand for cotton, jute, paper, cement, metals, sugar, explosives and arms and ammunitions rose during the Ist and IInd World War which further gave impetus to the development of the Industries in India.In 1941 chemical, aircraft, metal fabrications industries were set up. Since 1941 many engineering industries to manufacture tools and machinery required for other industries were set up in India. During the first five year plan (1951-1956) the focus was on increasing the capacity of existing industries. New Industry policy framed during the second five year plan (1956-1961) gave emphasize on development of basic and heavy industries. In the third five year plan the need for improving and developing the basic industries arouse. Since then the Heavy and Basic Engineering Industries have been constantly developing, producing industrial tools, machinery, defense equipment, railway engines, electrical machinery, capital goods etc.In 1991 various industrial reforms like, liberalization, privatization, foreign direct investments further strengthened and developed the engineering industries in India. Currently steps are taken to create India as a global manufacturing hub. Many incentives to attract manufacturers from

other Countries under Make In India campaign have been announced.

Engineering Industries will play a major role in manufacturing Machines, Tools, Designs, Formulas, Electric Equipment, and Power saving devices required for the production of various goods by different manufacturing industries. The demand for engineering industries will keep growing due to rising demand of power, mining, oil and gas, refinery, automotive, construction equipment etc.

Engineering Industry can be considered as the largest industry in India, mainly because of its diversification. Engineering Industry in India is basically divided into two segments: Heavy and Light Engineering.

Table1: Segments of Heavy Engineering Companies

Heavy Engineering Companies		
.Automotive	Heavy Electrical	Heavy Engineering and Machine Tools
Passenger Vehicles	Boilers	Machine Tools.
Auto Components	Turbines	Textile Machinery.
Agriculture Machinery	Transformers	Cement Machinery.
Tractors.	Switchgear	Material handling equipment.
Utility Vehicles	Control gear	Plastic processing machinery.
	Power transmission	Dies, moulds and tools industry
	Power distribution.	Process plant equipment.
		Transport equipment.
		Capital goods.
		Earth moving construction equipments
		Earth moving mining equipments.

Source: Secondary Data Report of IBEF

Table2: Classification of Light Engineering Companies

Light Engineering Companies	
Low Technology products.	High Technology Products
Casting	Surgical Equipment.
Forging.	Medical Equipment.
Industrial Fasteners.	Sophisticated microprocessor based equipment.

Source: Secondary Data Report of IBEF

Diversified growth and development of engineering industry is quite visible from the above classification. The current paper is focusing to study the financial indicators required to study the financial performance of fast growing engineering industry.

Literature Review

Subramanyan K R (2014) in his book, "Financial Statement Analysis", has divided the book into three main areas: Financial Analysis, Accounting Analysis and Analysis Overview. First two chapters cover the overview of role of financial statements in equity analysis, credit analysis and business statement analysis. Next four chapters cover the procedure and clues for the analysis and adjustment of financial statements slit into financing, investing and operating activities. The last five chapters discuss the tools , methods, procedures and techniques to be used for financial analysis by various users for different objectives.

Singla (2013) in the research paper has made a comparative study of financial performance between two steel manufacturing companies. He concluded that the financial performance of Tata Steel Ltd was better than Steel authority of India Ltd.

Vanitha S &Selvam M (2011) examined the financial performance of companies restructured through takeovers and amalgamations. The concluded that the financial performance of the companies which were taken over by the companies which had better management, the financial performance of those companies also improved after the restructuring and takeovers.

Martin S Fridson and Fernando Alvarez (2011) in their book titled, "Financial Statement Analysis: A Practitioner's Guide", have explained the components of financial statements and the implication of such components to assess the financial performance. Credit analysis, equity analysis and forecasting of financial performance through the historical financial data has been discussed in few chapters. The authors have also explained the assessment of companies having mergers and acquisitions in addition to the

reliability on disclosures and audited reports of financial statements.

Charles Gibson (2009) in his book, "Financial Report & Analysis" 11th edition has covered the financial reporting statements and the basis of analysis. The book has covered the financial statement analysis procedure to be followed for the financial reports prepared by some special industries like banks, insurance, oil and gas, real estate, transportation, government, nonprofit entities.

Sury M M (2008) in his book," India's Five year plans" has covered the process and procedure of economic planning in India The book mainly focuses on the planning and transfer of resources for development of various sectors for all round growth and development of the Nation. It covers the Strategy, priority, and allocation of resources for the development of industries and sectors in each five year plan.

Narasimha Chary S (2007) in his book, "Industrial Development in India" has explained the pre Independence and Post-Independence gradual growth and development of various sectors and industries in India.

Many studies have been conducted on evaluating the financial performance of companies from various sectors having mergers, acquisitions, amalgamations, take overs etc. Researcher therefore makes an attempt to review the financial tools and techniques to review randomly selected two engineering companies.

Objectives of Research

1. To review financial tools and techniques those can be used for evaluating the overall financial progress of engineering industry.
2. To study the financial analysis tools to be used to assess the profitability of engineering firms.
3. To study the Financial analysis tools to be used to find the financial position of the engineering firms.

Source of Data

Financial Statements:
These are summarized financial reports of an organizations transactions and business taken place in a stipulated period of time. They may be annual, quarterly or half yearly statements. These are prepared to provide valuable information to the investors, suppliers, creditors, Government and Regulatory Departments, and any other user. These include:

1. Earning Statement or Income Statement or Profit & Loss AccountUses:
   I. To find the earnings of the organization for the stipulated period of time.
   II. To decide on how much of the profits can be withdrawn or distributed to owners.
   III. To decide how much of the net profits can be retained in the organization.
   IV. To calculate the income tax liability.
   V. To make investment decisions.
2. Balance Sheet Uses:
   I. To find the financial position and financial status of the organization as on a specific date.
   II. Assess the net worth of the organization on a specific date.
   III. Compare total assets with total liabilities.
   IV. Compare current assets with current liabilities.
   V. Compare owned capital and borrowed debts
   VI. To identify the composition of various assets and liabilities.
3. Cash Flow Statement Uses:
   I. Evaluate the cash position of the firm.
   II. Project future cash flows.
   III. Compare historical and projected cash flows.
   IV. Assess short term liquidity of the firm.

V. Helps in planning repayment of debts and borrowings.
VI. Facilitate in purchase of fixed assets in future.
VII. Find the proportion of net cash flows from operating, investing and financial activities in the accounting period.

4. Fund Flow statement Uses:
I. Identify sources of funds and application of funds in the reporting period.
II. Calculate cost of capital from the sources of funds.
III. Suggests ways to improve working capital position of the company.
IV. Helps management to formulate and modify financial policy.
V. Asses the credit worthiness of the business unit.
VI. Decide future long term investment decisions.

Financial statements reveal and disclose the summary of transactions for the specific period of time, but to have a thorough financial performance these statements need to be further analyzed.Further analysis can be done by the following tools and techniques.

Tools and Techniques of Financial Analysis

1. Common Size Statements
I. These are used to build commonness in terms of structure and size of different companies.
II. The data in the financial statement is converted into percentage to facilitate comparison of different accounting periods and other firms with different size and structure.
III. Common size balance sheet discloses each asset and liability as a percentage of the total asset or liability.
IV. Common size Income statement shows every expense as a percentage of sales turnovers.
V. Common size cash flow statements show every cash inflow or outflow as a percentage of the total cash.

2. Comparative statements:
I. These statements can be used for inter and intra firm comparison.
II. Comparative balance sheet is used to compare each asset and liability increase or decrease in absolute value and in percentage.
III. They form the basis for trend analysis.
IV. Comparative income statement gives the increase or decrease in every expense and income in absolute value and in percentage.
V. Helps in measuring financial performance for different accounting periods.
VI. Locate any sizeable change in any item in different accounting periods.

3. Trend Analysis:
I. It is a tool used to forecast future financial performance based on the historical financial data..
II. Can be expressed graphically to enhance the impact of financial performance for a longer period of time.
III. Facilitates in making future decisions.
IV. Helps in making future inference based on the previous data.
V. Facilitates in measuring solvency and liquidity positions.
VI. Facilitates in measuring profitability positions.
VII. Useful to compare many components simultaneously.

4. Ratio Analysis:
These are quantitative relations between two financial items giving a comparative relationship.

4.1 Profitability ratios:
I. Gross Profit Ratios: Measures the absolute profitability of production or purchase.
II. Net Profit Ratios: Measures the profitability after deducting all expenses and taxes.
III. Operating Profit Ratio: Measures the profitability out of core business activities excluding financial cost and

taxes. It measures the operating margin of profit and operating efficiency of the firm.

IV. Return on Capital Employed: Measures the proportion of profit on total capital employed.

V. Return on Assets: Measures the profit margin in proportion to the total assets employed.

a) Return on Net worth: Measures the profit margin in proportion to the capital belonging to the owners.

b) Earnings Per Share: Measures the share of net profits belonging to one equity share.

4.2 Solvency Ratios:

I. Debt Equity Ratio: Measures the proportion of total borrowed funds to the owned funds.

II. Equity Ratio: Measures the proportion of total assets belonging to the owners.

III. Debt Ratio: Measures the proportion of total liabilities to the total assets.

IV. Solvency Ratio: Measures the ability of the firm to pay back its short term and long term liabilities

4.3 Liquidity Ratios:

I. Current Ratio: Measures a company's ability to pay the short term liability.

II. Quick Ratio: Measures the company's ability to pay the short term liability with most liquid assets.

III. Cash Ratio: Measures the company's cash proportion to the short term liability.

IV. Inventory Turnover Ratios: Measures the efficiency of the company to liquidate the inventory.

V. Interest Coverage Ratio: Measures the efficiency of the company to pay interest on the borrowed funds.

4.4 Efficiency Ratios:

I. Sales to Total Assets Ratio: Measures overall investment efficiency.

II. Sales to Fixed Assets: Measures efficiency of long term investments.

III. Sales to Current Assets Ratio: Measures efficiency of short term investments.

4.5 Valuation Ratios:

I. Price Earnings Ratio: Measures the demand value of a company's share to its profitability.

II. Price to Book value Ratio: Measures the demand value of a company's share to its Net worth value.

III. Price to Sales Ratio: Measures the demand value of a company's share to its sales turnover.

Data Analysis and Interpretation

Though there are many tools which are used for analysis of financial performance of companies, for the current study intercompany comparative statements and common size statement toolshave been used. Two engineering companies which are situated in Pune and Listed on National Stock Exchange are randomly selected for the current study.

Table3:Common Size Income statement of Thermax Ltd for the Period 2015-2019 (See Appendix)

Financial performance of Thermax Ltd for the Accounting Period 2015 to 2019

1. The average operating profit margin for the period 2015 to 2019 is around 9%.
2. The average Profit before tax for the accounting period 2015 to 2019 is around 9%.
3. The average profit after tax for the accounting period 2015 to 2019 is around 6%

Table4:Common Size Income Statement of Thermax Ltd for the Period 2010-2014 (See Appendix)

Financial performance of Thermax Ltd for the Accounting Period 2010 to 2014

1. The average operating profit margin for the accounting period 2010 to 2014 is around 10%.

2. The average Profit before tax for the accounting period 2010 to 2014 is around 11%.
3. The average profit after tax for the accounting period 2010 to 2014 is around 7%

Table5: Common Size Income Statement of Cummins Ltd for the period 2015-2019 (See Appendix)

Financial performance of Cummins Ltd for the Accounting Period 2015 to 2019

1. The average operating profit margin for the accounting period 2015 to 2019 is around 15%.
2. The average Profit before tax for the accounting period 2015 to 2019 is around 18%.
3. The average profit after tax for the accounting period 2015 to 2019 is around 14%

Table 6: Common Size Income Statement of Cummins Ltd for the Period 2010-2014 (See Appendix)

Financial Performance of Cummins Ltd for the Accounting Period 2010 to 2014

1. The average operating profit margin for the accounting period 2010 to 2014 is around 17%.
2. The average Profit before tax for the accounting period 2010 to 2014 is around 20%.
3. The average profit after tax for the accounting period 2010 to 2014 is around 15%

Table7: Comparison of Common Size Income Statement of Engineering Companies 2010-2019 (See Appendix)

Comparative Financial performance of Thermax Ltd and Cummins Ltd for the Accounting Period 2010 to 2019

1. The average operating profit margin of Thermax Ltd from 2010 to 2019 is around 9.5% , whereas, the operating profit margin of Cummins Ltd from 2010 to 2019 is around 16%
2. The average net profit before tax of Thermax Ltd from 2010 to 2019 is around 10% , whereas, the net profit before tax of Cummins Ltd from 2010 to 2019 is around 19%
3. The average net profit after tax of Thermax Ltd from 2010 to 2019 is around 6% , whereas, the net profit after tax of Cummins Ltd from 2010 to 2019 is around 15%

Table 8: Shows the common size Balance Sheet of Thermax Ltd for the period 2015-2019 (See Appendix)

Financial Performance of Thermax Ltd for the Accounting Period 2015 to 2019

1. The average current assets are around 68% and current liabilities 50% for the accounting period 2015 to 2019
2. The average Long term debts are around 1% whereas shareholders' funds are around 48% for the accounting period 2015 to 2019.

Table 9: Shows the common size Balance Sheet of Thermax Ltd for the period 2010-2014 (See Appendix)

Financial performance of Thermax Ltd for the Accounting Period 2010 to 2014

1. The average current assets are around 72% and current liabilities 59% for the accounting period 2015 to 2019
2. The average Long term debts are around 2% whereas shareholders' funds are around 39% for the accounting period 2015 to 2019

Table10: Shows the common size Balance Sheet of Cummins Ltd for the period 2015-2019 (See Appendix)

Financial Performance of Cummins Ltd for the Accounting period 2015 to 2019

1. The average current assets are around 55% and current liabilities 25% for the accounting period 2015 to 2019
2. The average Long term debts are around 3% whereas shareholders' funds are around 72% for the accounting period 2015 to 2019.

Table11: Shows the common size Balance Sheet of Cummins Ltd for the period 2010-2014 (See Appendix)
Financial performance of Cummins Ltd for the accounting period 2015 to 2019

1. The average current assets are around 64% and current liabilities 31% for the accounting period 2015 to 2019
2. The average Long term debts are around 4% whereas shareholders' funds are around 65% for the accounting period 2015 to 2019.

Table 12: Comparison of Common Size Balance Sheets of Engineering Companies 2010-2019(See Appendix)
Comparative Financial performance of Thermax Ltd and Cummins Ltd for the Accounting Period 2010 to 2019

1. The average Long term debts of Thermax Ltd are around 1% and shareholders' funds are around 43%, whereas the average long term debts of Cummins Ltd are around 3% and shareholders' funds are around 69%, for the accounting period 2010 to 2019.
2. The average current assets of Thermax Ltd are 70% and current liabilities are 55%, whereas the currents assets of Cummins Ltd are 60% and current liabilities are 28% for the accounting period 2010 to 2019.

Suggestions

Engineering companies can be considered for investment by prospective investors as the financial performance indicates strong financial position and profitability.Shareholders' funds are higher than the borrowed debts by the engineering companies and hence the finance cost is very low. Other Companies may be suggested to follow profit retention policy to improve profitability and reduce finance cost.

Conclusion

Operating profits, net profits before tax and profits after tax of both the engineering companies are indicating good financial performance of engineering industry.The average operating profit margins are around 17%among the engineering companies. The average net profits after tax are around 10%, among the engineering companies.The composition of external debts and the owner's funds indicate a favorable financial position.The composition of current assets and current liabilities are also favorable among the engineering companies.

References

1. Charles Gibson , "Financial Report & Analysis" 2009 , published by *South-Western Cengage Learning.* 11th edition
2. Cornett, Marcia Million, Saunders, Anthony, "Financial Institutions Management: A risk management approach", 2003, *McGraw-Hill/Irwin*
3. Fridson S Martin, Fernando Alvarez, "Financial Statement Analysis: A Practitioner's Guide"2011, Wiley Publications.
4. Narasimha Chary S , "Industrial Development in India" 2007, published by Anmol Publisher.
5. Subramanyan K R,"Financial Statement Anlysis" 2014 *McGraw Hill Publications* 11th edition.
6. Sury M M, ," India's Five year plans"2008, Published by New Century Publications.
7. http://www.mospi.gov.in/statistical-year-book-india/2018/176
8. https://archive.india.gov.in/business/Industry_services/heavy_industries.php

9. https://testbook.com/blog/planning-commission-gk-notes-pdf/

10. https://www.ibef.org/download/Engineering-and-Capital-Goods-July-2017.pdf

Appendix

Table 3: Common Size Income statement of Thermax Ltd for the Period 2015-2019

Particulars / Year	Mar 19	Mar-18	Mar-17	Mar-16	Mar-15	Average
Total Revenue	3,663.90	3,971.85	3,866.30	4,461.63	4,808.22	**4,154.38**
Other Income	122.80	103.98	102.65	109.85	110.81	**110.02**
Total Operating Revenues	3,541.10	3,867.87	3,763.65	4,351.78	4,697.41	**4,044.36**
Total Operatiing Expenses	3290.38	3496.5	3389.86	3963.21	4227.37	**3,673.46**
% of Operating Expenses	89.81	88.03	87.68	88.83	87.92	**88.45**
Operating Profit	250.72	371.37	373.79	388.57	470.04	**370.90**
% of operating profit	6.84	9.35	9.67	8.71	9.78	**8.87**
Finance Costs	5.26	8.04	3.59	0.61	19.69	**7.44**
% of finance cost	0.14	0.20	0.09	0.01	0.41	**0.17**
Depreciation	50.13	64.2	65.43	60.9	64.12	**60.96**
% of Depreciation	1.37	1.62	1.69	1.36	1.33	**1.48**
Other exceptional items	-47.85	-25	-132.84	0	0	**-41.14**
Profit before tax	270.28	378.11	274.58	436.91	497.04	**371.38**
% of profit before tax	7.38	9.52	7.10	9.79	10.34	**8.83**
Total Tax Expenses	109.26	139.86	129.75	131.39	161.1	**134.27**
% of tax expenses	2.98	3.52	3.36	2.94	3.35	**3.23**
Profit after tax	161.02	238.25	144.83	305.52	335.94	**237.11**
% of profit after tax	4.39	6.00	3.75	6.85	6.99	**5.59**

Source: Secondary Data Annual reports of Thermax Ltd

Table 4: Common Size Income Statement of Thermax Ltd for the Period 2010-2014

Particulars / Year	Mar 14	Mar-13	Mar-12	Mar-11	Mar-10	Average
Total Revenue	4,366.46	4,763.88	5,374.55	4,935.49	3,193.07	**4,526.69**
Other Income	64.3	73.01	70.49	83.13	131.04	**84.39**
Total Operating Revenue	4,302.16	4,690.87	5,304.06	4,852.36	3,062.03	**4,442.30**
Total Operating expenses	3892.95	4183.74	4720.15	4317.28	2759.19	**3,974.66**
% of Operating Expenses	89.16	87.82	87.82	87.47	86.41	**87.74**
Operating Profit	409.21	507.13	583.91	535.08	302.84	**467.63**
% of operating profit	9.37	10.65	10.86	10.84	9.48	**10.24**
Finance Costs	8.85	9.65	6.55	2.18	1.52	**5.75**
% of finance cost	0.20	0.20	0.12	0.04	0.05	**0.12**
Depreciation	57.77	54.86	46.95	43.33	40.42	**48.67**
% of Depreciation	1.32	1.15	0.87	0.88	1.27	**1.10**
Other exceptional items	0	0	0	0	0	**0.00**
Profit before tax	406.89	515.63	600.90	572.70	391.94	**497.61**
% of profit before tax	9.32	10.82	11.18	11.60	12.27	**11.04**
Total Tax Expenses	153.92	165.67	194.04	190.28	135.64	**167.91**
% of tax expenses	3.53	3.48	3.61	3.86	4.25	**3.74**
Profit after tax	252.97	349.96	406.86	382.42	256.3	**329.70**
% of profit after tax	5.79	7.35	7.57	7.75	8.03	**7.30**

Source: Secondary Data Annual reports of Thermax Ltd

Table 5: Common Size Income Statement of Cummins Ltd for the period 2015-2019

Particulars / Year	Mar 19	Mar-18	Mar-17	Mar-16	Mar-15	Average
Total Revenue	5,951.77	5,310.97	5,285.32	4,934.68	4,692.38	**5,235.02**
Other Income	292.77	228.47	207.98	225.86	286.58	**248.33**
Total Operating Revenues	5,659.00	5,082.50	5,077.34	4,708.82	4,405.80	**4,986.69**
Total Operatiing Expenses	4,794.90	4,350.05	4,275.52	3,933.71	3,670.75	**4,204.99**
% of Operating Expenses	80.56	81.91	80.89	79.72	78.23	**80.26**
Operating Profit	864.10	732.45	801.82	775.11	735.05	**781.71**
% of operating profit	14.52	13.79	15.17	15.71	15.66	**14.97**
Finance Costs	16.2	14.83	16.78	9.58	4.52	**12.38**
% of finance cost	0.27	0.28	0.32	0.19	0.10	**0.23**
Depreciation	110.32	93.79	84.78	81.01	79.72	**89.92**
% of Depreciation	1.85	1.77	1.60	1.64	1.70	**1.71**
Other exceptional items	0	56.12	0	0	0	**11.22**
Profit before tax	1,030.35	908.42	908.24	910.38	937.39	**938.96**
% of profit before tax	17.31	17.10	17.18	18.45	19.98	**18.01**
Total Tax Expenses	307.78	199.95	173.61	156.08	151.54	**197.79**
% of tax expenses	5.17	3.76	3.28	3.16	3.23	**3.72**
Profit after tax	722.57	708.47	734.63	754.30	785.85	**741.16**
% of profit after tax	12.14	13.34	13.90	15.29	16.75	**14.28**

Source: Secondary Data Annual reports of Cummins Ltd

Table 6: Common Size Income Statement of Cummins Ltd for the Period 2010-2014

Particulars / Year	Mar 14	Mar-13	Mar-12	Mar-11	Mar-10	Average
Total Revenue	4,154.38	4,796.10	4,240.55	4,122.90	2,966.07	**4,056.00**
Other Income	177.71	206.72	123.33	80.37	115.15	**140.66**
Total Operating Revenue	3,976.67	4,589.38	4,117.22	4,042.53	2,850.92	**3,915.34**
Total Operating expenses	3279.94	3754.5	3419.97	3279.14	2317.02	**3,210.11**
% of Operating Expenses	78.95	78.28	80.65	79.53	78.12	**79.11**
Operating Profit	696.73	834.88	697.25	763.39	533.90	**705.23**
% of operating profit	16.77	17.41	16.44	18.52	18.00	**17.43**
Finance Costs	4.18	4.61	5.41	4.75	2.05	**4.20**
% of finance cost	0.10	0.10	0.13	0.12	0.07	**0.10**
Depreciation	52.75	47.25	41.98	36.64	36.08	**42.94**
% of Depreciation	1.27	0.99	0.99	0.89	1.22	**1.07**
Other exceptional items	0	61.59	51.44	0	0	**22.61**
Profit before tax	817.51	1,051.33	824.63	802.37	610.92	**821.35**
% of profit before tax	19.68	21.92	19.45	19.46	20.60	**20.22**
Total Tax Expenses	217.49	287.22	233.36	211.38	160.5	**221.99**
% of tax expenses	5.24	5.99	5.50	5.13	5.41	**5.45**
Profit after tax	600.02	764.11	591.27	590.99	450.42	**599.36**
% of profit after tax	14.44	15.93	13.94	14.33	15.19	**14.77**

Source: Secondary Data Annual reports of Cummins Ltd

Table7: Comparison of Common Size Income Statement of Engineering Companies 2010-2019

Engineering Company	Thermax Ltd			Cummins Ltd		
Year	2015-19	2010-14	2010-19	2015-19	2010-14	2010-19
Particulars	Average	Average	Average	Average	Average	Average
Total Revenue	4,154.38	4,526.69	**4,340.54**	5,235.02	4,056.00	**4,645.51**
Other Income	110.02	84.39	**97.21**	248.33	140.66	**194.49**
Total Operating Revenue	4,044.36	4,442.30	**4,243.33**	4,986.69	3,915.34	**4,451.02**
Total Operating expenses	3,673.46	3,974.66	**3,824.06**	4,204.99	3,210.11	**3,707.55**
% of Operating Expenses	88.45	87.74	**88.10**	80.26	79.11	**79.68**
Operating Profit	370.90	467.63	**419.27**	781.71	705.23	**743.47**
% of operating profit	8.87	10.24	**9.56**	14.97	17.43	**16.20**
Finance Costs	7.44	5.75	**6.59**	12.38	4.20	**8.29**
% of finance cost	0.17	0.12	**0.15**	0.23	0.10	**0.17**
Depreciation	60.96	48.67	**54.81**	89.92	42.94	**66.43**
% of Depreciation	1.48	1.10	**1.29**	1.71	1.07	**1.39**
Other exceptional items	-41.14	0.00	**-20.57**	11.22	22.61	**16.92**
Profit before tax	371.38	497.61	**434.50**	938.96	821.35	**880.15**
% of profit before tax	8.83	11.04	**9.93**	18.01	20.22	**19.11**
Total Tax Expenses	134.27	167.91	**151.09**	197.79	221.99	**209.89**
% of tax expenses	3.23	3.74	**3.49**	3.72	5.45	**4.59**
Profit after tax	237.11	329.70	**283.41**	741.16	599.36	**670.26**
% of profit after tax	5.59	7.30	**6.45**	14.28	14.77	**14.53**

Source: Secondary Data Annual reports of Cummins Ltd

Table 8: Shows the common size Balance Sheet of Thermax Ltd for the period 2015-2019

Liabilities / year	Mar 19	Mar-18	Mar-17	Mar-16	Mar-15	Average
Equity Share Capital	23.83	23.83	23.83	23.83	23.83	**23.83**
% of Equity Shares to Total Assets	0.39	0.44	0.52	0.48	0.49	**0.46**
Reserves and Surplus	2,712.02	2,541.73	2,385.93	2,463.29	2,242.99	**2,469.19**
% of Reserves to Total Assets	44.18	47.29	51.92	49.67	46.22	**47.86**
Total Shareholders Funds	2,735.85	2,565.56	2,409.76	2,487.12	2,266.82	**2,493.02**
% of shareholders funds to Total Assets	44.57	47.73	52.44	50.15	46.71	**48.32**
Total Non-Current Liabilities	58.6	70.26	69.21	66.14	46.88	**62.22**
% of fixed liabilities to Total Assets	0.95	1.31	1.51	1.33	0.97	**1.21**
Total Current Liabilities	3,344.40	2,739.31	2,116.63	2,405.89	2,538.94	**2,629.03**
% of Current Liabilities to Total Assets	54.48	50.96	46.06	48.51	52.32	**50.47**
Total Capital And Liabilities	6,138.85	5,375.13	4,595.60	4,959.15	4,852.64	**5,184.27**
Assets / year	Mar 19	Mar-18	Mar-17	Mar-16	Mar-15	Average
Fixed Assets	742.05	763.81	683.74	644.52	648.48	**696.52**
% of Fixed Assets to Total Assets	12.09	14.21	14.88	13.00	13.36	**13.51**
Non-Current Investments	767.48	639.29	639.73	667.18	474.19	**637.57**
% of Non Current Investments to Total Assets	12.50	11.89	13.92	13.45	9.77	**12.31**
Other Non-Current Assets	1,044.35	1,164.41	1,095.64	980.22	886.68	**1,034.26**
% of Other Non-Current Assets to Total Assets	17.01	21.66	23.84	19.77	18.27	**20.11**
Total Non-Current Assets	1,811.83	1,803.70	1,735.37	1,647.40	1,360.87	**1,671.83**
% of Total Non-Current Assets to Total Assets	29.51	33.56	37.76	33.22	28.04	**32.42**
Total Current Assets	4,327.02	3,571.43	2,860.23	3,311.75	3,491.77	**3,512.44**
% of Total Current Assets to Total Assets	70.49	66.44	62.24	66.78	71.96	**67.58**
Total Assets	**6,138.85**	**5,375.13**	**4,595.60**	**4,959.15**	**4,852.64**	**5,184.27**

Source: Secondary Data Annual reports of Thermax Ltd

Table 9: Shows the common size Balance Sheet of Thermax Ltd for the period 2010-2014

Liabilities /year	Mar 14	Mar-13	Mar-12	Mar-11	Mar-10	Average
Equity Share Capital	23.83	23.83	23.83	23.83	23.83	**23.83**
% of Equity Shares to Total Assets	0.49	0.58	0.60	0.66	0.76	**0.62**
Reserves and Surplus	2,001.16	1,845.44	1,577.35	1,268.51	1,026.96	**1,543.88**
% of Reserves to Total Assets	41.23	44.97	39.73	34.94	32.72	**38.72**
Total Shareholders Funds	2,024.99	1,869.27	1,601.18	1,292.34	1,050.79	**1,567.71**
% of shareholders funds to Total Assets	41.72	45.55	40.33	35.60	33.48	**39.34**
Total Non-Current Liabilities	173.56	67.04	45.02	31.28	43.63	**72.11**
% of fixed liabilities to Total Assets	3.58	1.63	1.13	0.86	1.39	**1.72**
Total Current Liabilities	2,655.30	2,167.83	2,323.53	2,306.90	2,044.24	**2,299.56**
% of Current Liabilities to Total Assets	54.71	52.82	58.53	63.54	65.13	**58.95**
Total Capital And Liabilities	4,853.85	4,104.14	3,969.73	3,630.52	3,138.66	**3,939.38**
Assets /year	**Mar 14**	**Mar-13**	**Mar-12**	**Mar-11**	**Mar-10**	**Average**
Fixed Assets	663.92	645.51	573.59	516.34	507.69	**581.41**
% of Fixed Assets to Total Assets	13.68	15.73	14.45	14.22	16.18	**14.85**
Non-Current Investments	462.08	393.69	350.97	260.91	378.16	**369.16**
% of Non Current Investments to Total Assets	9.52	9.59	8.84	7.19	12.05	**9.44**
Other Non-Current Assets	857.94	869.98	705.74	711.75	534.11	**735.90**
% of Other Non-Current Assets to Total Assets	17.68	21.20	17.78	19.60	17.02	**18.65**
Total Non-Current Assets	1,320.02	1,263.67	1,056.71	972.66	912.27	**1,105.07**
% of Total Non-Current Assets to Total Assets	27.20	30.79	26.62	26.79	29.07	**28.09**
Total Current Assets	3,533.83	2,840.47	2,913.02	2,657.86	2,226.39	**2,834.31**
% of Total Current Assets to Total Assets	72.80	69.21	73.38	73.21	70.93	**71.91**
Total Assets	**4,853.85**	**4,104.14**	**3,969.73**	**3,630.52**	**3,138.66**	**3,939.38**

Source: Secondary Data Annual reports of Thermax Ltd

Table10: Shows the common size Balance Sheet of Cummins Ltd for the period 2015-2019

Liabilities /year	Mar 19	Mar-18	Mar-17	Mar-16	Mar-15	Average
Equity Share Capital	55.44	55.44	55.44	55.44	55.44	**55.44**
% of Equity Shares to Total Assets	0.95	1.00	1.10	1.23	1.28	**1.11**
Reserves and Surplus	4,075.01	3,930.63	3,686.73	3,425.86	2,831.08	**3,589.86**
% of Reserves to Total Assets	69.62	71.06	73.14	76.29	65.51	**71.12**
Total Shareholders Funds	4,130.45	3,986.07	3,742.17	3,481.30	2,886.52	**3,645.30**
% of shareholders funds to Total Assets	70.56	72.06	74.24	77.53	66.79	**72.24**
Total Non-Current Liabilities	200.26	103.31	91.12	114.86	207.89	**143.49**
% of fixed liabilities to Total Assets	3.42	1.87	1.81	2.56	4.81	**2.89**
Total Current Liabilities	1,522.86	1,441.85	1,207.59	894.31	1,227.33	**1,258.79**
% of Current Liabilities to Total Assets	26.02	26.07	23.96	19.92	28.40	**24.87**
Total Capital And Liabilities	5,853.57	5,531.23	5,040.88	4,490.47	4,321.74	**5,047.58**
Assets /year	**Mar 19**	**Mar-18**	**Mar-17**	**Mar-16**	**Mar-15**	**Average**
Fixed Assets	2,171.28	2,057.20	1,963.24	1,808.60	1,404.57	**1,880.98**
% of Fixed Assets to Total Assets	37.09	37.19	38.95	40.28	32.50	**37.20**
Non-Current Investments	42.57	42.68	44.16	49.48	45.72	**44.92**
% of Non Current Investments to Total Assets	0.73	0.77	0.88	1.10	1.06	**0.91**
Other Non-Current Assets	2,402.90	2,279.05	2,325.42	2,165.25	1,867.93	**2,208.11**
% of Other Non-Current Assets to Total Assets	41.05	41.20	46.13	48.22	43.22	**43.97**
Total Non-Current Assets	2,445.47	2,321.73	2,369.58	2,214.73	1,913.65	**2,253.03**
% of Total Non-Current Assets to Total Assets	41.78	41.97	47.01	49.32	44.28	**44.87**
Total Current Assets	3,408.10	3,209.50	2,671.30	2,238.17	2,408.09	**2,787.03**
% of Total Current Assets to Total Assets	58.22	58.03	52.99	49.84	55.72	**54.96**
Total Assets	**5,853.57**	**5,531.23**	**5,040.88**	**4,490.47**	**4,321.74**	**5,047.58**

Source: Secondary Data Annual reports of Cummins Ltd

Table11: Shows the common size Balance Sheet of Cummins Ltd for the period 2010-2014

Liabilities /year	Mar 14	Mar-13	Mar-12	Mar-11	Mar-10	Average
Equity Share Capital	55.44	55.44	55.44	39.6	39.6	**49.10**
% of Equity Shares to Total Assets	1.47	1.51	1.79	1.38	1.66	**1.56**
Reserves and Surplus	2,509.71	2,331.29	1,987.71	1,766.67	1,521.40	**2,023.36**
% of Reserves to Total Assets	66.52	63.53	64.08	61.65	63.82	**63.92**
Total Shareholders Funds	2,565.15	2,386.73	2,043.15	1,806.27	1,561.00	**2,072.46**
% of shareholders funds to Total Assets	67.99	65.04	65.87	63.03	65.48	**65.48**
Total Non-Current Liabilities	183.79	177.17	113.4	120.27	32.97	**125.52**
% of fixed liabilities to Total Assets	4.87	4.83	3.66	4.20	1.38	**3.79**
Total Current Liabilities	1,023.79	1,105.72	945.14	939.12	789.82	**960.72**
% of Current Liabilities to Total Assets	27.14	30.13	30.47	32.77	33.13	**30.73**
Total Capital And Liabilities	3,772.73	3,669.62	3,101.69	2,865.66	2,383.78	**3,158.70**
Assets /year	**Mar 14**	**Mar-13**	**Mar-12**	**Mar-11**	**Mar-10**	**Average**
Fixed Assets	1,014.91	614.22	514.58	421.04	333.66	**579.68**
% of Fixed Assets to Total Assets	26.90	16.74	16.59	14.69	14.00	**17.78**
Non-Current Investments	53.39	53.39	75.51	58.65	732.92	**194.77**
% of Non Current Investments to Total Assets	1.42	1.45	2.43	2.05	30.75	**7.62**
Other Non-Current Assets	1,702.86	1,086.85	864.47	629.65	383.60	**933.49**
% of Other Non-Current Assets to Total Assets	45.14	29.62	27.87	21.97	16.09	**28.14**
Total Non-Current Assets	1,756.25	1,140.24	939.98	688.3	1,116.52	**1,128.26**
% of Total Non-Current Assets to Total Assets	46.55	31.07	30.31	24.02	46.84	**35.76**
Total Current Assets	2,016.48	2,529.38	2,161.71	2,177.36	1,267.26	**2,030.44**
% of Total Current Assets to Total Assets	53.45	68.93	69.69	75.98	53.16	**64.24**
Total Assets	**3,772.73**	**3,669.62**	**3,101.69**	**2,865.66**	**2,383.78**	**3,158.70**

Source: Secondary Data Annual reports of Cummins Ltd

Table 12: Comparison of Common Size Balance Sheets of Engineering Companies 2010-2019

Engineering Company	Thermax Ltd			Cummins Ltd		
Particulars	Average	Average	Average	Average	Average	Average
Liabilities /year	2015-19	2010-14	2010-19	2015-19	2010-14	2010-19
Equity Share Capital	23.83	23.83	**23.83**	55.44	49.10	**52.27**
% of Equity Shares to Total Assets	0.46	0.62	**0.54**	1.11	1.56	**1.34**
Reserves and Surplus	2,469.19	1,543.88	**2,006.54**	3,589.86	2,023.36	**2,806.61**
% of Reserves to Total Assets	47.86	38.72	**43.29**	71.12	63.92	**67.52**
Total Shareholders Funds	2,493.02	1,567.71	**2,030.37**	3,645.30	2,072.46	**2,858.88**
% of shareholders funds to Total Assets	48.32	39.34	**43.83**	72.24	65.48	**68.86**
Total Non-Current Liabilities	62.22	72.11	**67.16**	143.49	125.52	**134.50**
% of fixed liabilities to Total Assets	1.21	1.72	**1.47**	2.89	3.79	**3.34**
Total Current Liabilities	2,629.03	2,299.56	**2,464.30**	1,258.79	960.72	**1,109.75**
% of Current Liabilities to Total Assets	50.47	58.95	**54.71**	24.87	30.73	**27.80**
Total Capital And Liabilities	5,184.27	3,939.38	**4,561.83**	5,047.58	3,158.70	**4,103.14**
Assets /year	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
Fixed Assets	696.52	581.41	**638.97**	1,880.98	579.68	**1,230.33**
% of Fixed Assets to Total Assets	13.51	14.85	**14.18**	37.20	17.78	**27.49**
Non-Current Investments	637.57	369.16	**503.37**	44.92	194.77	**119.85**
% of Non Current Investments to Total Assets	12.31	9.44	**10.87**	0.91	7.62	**4.26**
Other Non-Current Assets	1,034.26	735.90	**885.08**	2,208.11	933.49	**1,570.80**
% of Other Non-Current Assets to Total Assets	20.11	18.65	**19.38**	43.97	28.14	**36.05**
Total Non-Current Assets	1,671.83	1,105.07	**1,388.45**	2,253.03	1,128.26	**1,690.65**
% of Total Non-Current Assets to Total Assets	32.42	28.09	**30.26**	44.87	35.76	**40.31**
Total Current Assets	3,512.44	2,834.31	**3,173.38**	2,787.03	2,030.44	**2,408.74**
% of Total Current Assets to Total Assets	67.58	71.91	**69.74**	54.96	64.24	**59.60**
Total Assets	**5,184.27**	**3,939.38**	**4,561.83**	**5,047.58**	**3,158.70**	**4,103.14**

Source: Primary Data Annual Reports of Thermax Ltd and Cummins Ltd.

ddINDIAN SHOPPING MALLS – A BLEND OF RETAIL AND RECREATION

A. S. Chhawchharia[1], Dipak Bhamare[2]
[1,2] Savitribai Phule Pune University.
[1]chhawchharia@gmail.com, [2]dr.dipakbhamare@gmail.com

ABSTRACT

Shopping malls in India existed for ages in different forms. Historically shopping activities happened in open-air markets along with public functions and festivals. What we see today is the modern form of shopping malls. The organized form of retail went through a plethora of changes to attain the stature that it has now. The era of mall culture in India slowly began in 2000 and gradually started multiplying in the metro cities. Shopping malls are large organized retail developments owned by the private sector. The modern shopping malls are an amalgamation of product, entertainment, and service, all under a single roof and it provides a range of variety to customers with an ideal shopping experience. India has acquired great heights in the retail sector and the credit of this to a great extent goes to the 'Mall Culture'.

The result of this research paper shows that shopping malls are not just shopping destinations. Shopping malls are a blend of shopping, relaxation, and recreation. Malls are the one-stop hub that serves as community centers for shopping, hanging out with family and friends, window shopping, movies, dining and entertainment, and recreational activities all under one roof and that too with an excellent ambiance and a wonderful experience.

Keywords: *Shopping, blend, relaxation, recreation, experience, ambiance.*

Introduction

Early 2000 saw a breakthrough in the organized retail sector as shopping malls slowly began to develop in India with just three malls in the entire country. India did not adopt the mall culture in earlier days because of conservative shopping habits. Hence, in the beginning, the mall phase in India took baby steps but gradually it picked speed and developed into a culture. Modern society started to incline to shop in a vibrant, hygiene, comfortable, climate-controlled, and highly-enabled malls rather than in the usual 'Kirana shops and scattered individual stores. India offers an immense market opportunity because of increased income and the changed lifestyle of middle-class families. The growth started with 3 malls in 2001, this number grew to 343 by 2007. India had a total of 570 operational malls by the end of 2013 and presently there are almost 750 plus operational malls in India.

The modern mall culture is an amalgamation of product, entertainment, and service, all under a single roof and it provides a range of variety to customers with an ideal shopping experience. India has acquired great heights in the retail sector and the credit of this to a great extent goes to the 'Mall Culture'.

Literature review

- The dissertation entitled *'Mall Mania in India – Changing Consumer Shopping Habits'* by Kanika Taneja, aimed at understanding the changing shopping pattern of consumers of the Indian society. It analyzed the various factors on which the choice shopping mall or unorganized markets of Indian consumers depended.
- Research article entitled *'Why Do People Choose the Shopping Malls? The Attraction Theory Revisited'* by Maria D. De-Juan-Vigara, examined consumers' behavior towards a particular shopping mall to satisfy their retail needs and also attempted to analyze which factors in shopping malls influenced or attracted consumers.
- *'Customer Behaviour towards Shopping Malls – A Study in Bhavnagar (Gujarat State, India)'* research paper by Dr. Archana Chanuvai Narahari & Dhiman Kuvad, this research was carried out in

Bhavnagar, Gujarat which investigated the buying behavior of shoppers in the shopping malls there.

- Research paper entitled *'Impact of Shopping Malls on Small Retail Outlets- A study in Kollam city, Kerala'* by Neethu M Mathews, this research study was done particularly in Kollam city. The main focus of this research study was to understand the effect of shopping malls on small retail stores.

Research Methodology

The methodology of this research paper is conceptual in nature. Secondary sources of information have been used by the researcher. These sources are new journal and newspaper published, publications of various organizations, institutes, news articles, online and offline reports, magazines and commercial journals, websites, and discussions regarding the research subject on various blogs.

Research objectives

1. To define analyze the concept of a shopping mall.
2. To understand the perception of people towards shopping malls.
3. To investigate the blending of various factors like retail and recreation in shoppings malls.

Scope of Study

This research paper defines and explains the concept of a shopping mall and clearly brings out the picture with regards to, what a shopping mall stands for as per the perception of the general public and in particular for the mall visitors. It is an in-depth study of the various elements or factors other than retail that are the real influencers in attracting foot traffic to a particular shopping mall. Further, this study will serve as a detailed understanding for the mall visitors to know the various entertainment and recreational activities that the shopping malls offer.

Concept of Shopping Mall

Originally 'Mall' is a North American term which means a large enclosed area for shopping with an advantage of no traffic. It can also be interpreted as a project of one or more huge buildings confined for shopping having a fusion of shops representing a group of traders having a common goal of canvassing sale and has an interconnected pathway that enables customers to easily walk between the stores.

A shopping Mall is a collection of shops under one roof serving towards an identical objective. It is a commercial establishment consisting of a carefully landscaped complex of shops, food court, multiplexes, fun zones, play areas, amusement parks, and a convenient parking area. A shopping mall is a modern version of the traditional marketplace.

Meaning of Shopping Mall

A Mall in its original meaning referred to the tracts for strolling. It is a human tendency to go strolling around either to relax or for a leisurely walk. Merchandisers acknowledged this habit of strollers by offering them enclosed air-conditioned zones named shopping malls with all possible options that would give them a unique environment for refreshing and socializing. Shopping malls today serve as tracts to strollwhile you shop or shop in while you stroll. Today shopping malls are the largest form of organized planned retail facilities located mainly in metro citiesand they play a very vital role in the retail industry.Malls in India have encroached inalmost every city and is also reaching small towns and villages catering to millions of Indian populations. The ideal size of a mall generally ranges from 60,000 sq. ft. to 7, 00,000 sq. ft. and above.

Malls are no more just shopping centers for visitors but socialization and recreation center for them. Along with a variety of best brands to choose from they get the added benefit of entertainment such as multiplexes, amusement park, food court, free wi-fi,

parking facility and many other services and that too all under one roof in an environmentally protected atmosphere. All these facilities serve as a new art of living, a new way of living to visitors where they can pleasantly shop for all their needs in a single air-conditioned location and that too in one single trip. The food courts, multiplexes and fun zones are like value added services as they serve as major crowd attractors. It is a misconception that malls attract only youngsters. Malls visitors are from all age groups, children, youths and senior citizens. Overall, malls have architectural beauty and open spaces to allow visitors of all age and their families to hang-out.

Modern definitions of Shopping Mall

After going through the meaning of shopping mall it is necessary to study the definitions of mall. There is no single definition of a mall that covers all the features of malls. Hence, it is necessary to discuss the following few significant definitions:

I. *"A shopping mall is typically, a shopping complex connected by walkways. It provides shopping as well as entertainment options to the target consumers. It generally, contains one anchor store, which consumes twenty-five percent of its retail space. In addition, a mall contains specialty stores for clothes, accessories, home needs, books, as well as a food court, multiplexes, and entertainment zones."* **(Sankar, 2005)**

II. *"A place that not only provides suburbanites with their physical living requirements, but simultaneously serves their civic, cultural and social community needs, and as such it makes the most significant contribution to the enrichment of our lives."* **(Gruen)**

III. *"A mall is a shopping center which is typically enclosed, climate-controlled and lighted, flanked on one or both sides by storefronts and entrances. On-site parking, either surface or structured is usually provided around the perimeter of the shopping center."* **(ICSC-International Council of Shopping Centers)**

IV. "A shopping mall, a shopping center, or a shopping arcade is a building or set of buildings that contain stores, and has interconnecting walkways enabling visitors to easily walk from store to store. The walkways may or may not be enclosed."

V. In nutshell, it is clear from all the above definitions that a mall is a large retail complex where customers can enjoy as well as take the advantage of shopping in a pleasant mood with family and friends.

Entertainment and Recreation Centres

The prime focus of shopping malls across the globe now is recreation and entertainment, while shopping is given a backseat. In an enclosed world-class ambiance malls are now offering over-the-top features including indoor ice-skating, indoor ski-range, indoor theme parks, indoor amusement parks, water parks, kids play zones, zoos, science centres, shooting ranges, and even an underground aquarium. To go a few steps ahead they further enhance the experiences of mall visitors by providing background music, seasonal decorations, festival celebrations, special events, games for the visitors, lucky draws, shopping points, and many more such attention-grabbing activities. These structural buildings, the so-called shopping malls, with movie theatres, bowling areas, gaming zones, restaurants, dining areas, hotels, food courts, comfortable lobby areas, free wifi, and air conditions are becoming a center of attraction as they are a hub of hanging out with friends and family for leisure and enjoyment.

Analysis of Top Malls in India

To closely scrutinize the highlight of the research paper *'Indian Shopping Malls – A Blend of Retail and Recreation',* lets analyze a few top shopping malls in India. Here, we will check what factors and facilities or products and services these malls are providing.

1. Lulu Mall, Kochi

Lulu Mall, the leading tourist attraction in Kochi with retail space of 1.7 million sq.ft., is the largest mall in India. A gigantic 5 storeymagnificent building is a retail hallmark with 215 retail outlets. Along with a Hypermarket, the other eye-catchers in the mall are a party hall, 3 fine dining restaurants, multiplex, a fabulous food court, entertainment zones, ice skating rink of 5000 sq.ft., bowling alley, indoor climbing, money exchange centres, arcade games and 5D PVR cinema.

2. World Trade Park, Jaipur

World Trade Park with two separate blocks on either side of a major street in Jaipur, isthe first system of its kind in the world, known to display images on the ceiling and is a famous shopping, recreational and entertainment hub.The huge 11 storey attractive building is partitioned into two blocks which are connected by a foot over bridge for the convenience of mall visitors to explore the entire mall which is ahubof over 500 stores. The major crowd puller of the mall are the electronics and gadget stores. The mallhouses a number of clothing stores, accessory and jewelry stores, footwear and bags shops luggage, gift and beauty care stores. It is a one-stop destination for shopping, food, amusement and recreation. Amenities such as hotels, food courts, health clubs, cinema screens,commercial office spaces and entertainment zones are the added attractions.

3. DLF Mall, Noida

A shopping destination ofseven floors divided into five zones,accomodating 18 anchor tenants. It is a house of 333 retail outlets which makes it the largest tourist attraction. It is known for its finest food hub with more than 75 Food and Beverages choices along with 51 cafes,a wide range of fast-food restaurantsand universal bistros,7 screen PVR multiplexes, devoted children zone and amusement areas.

4. Phoenix MarketCity, Mumbai

This multi-storeyed mall is the largest mall in Mumbai. It offersa revolutionized shopping experience which makes it a world-class tourist attraction. The mall extends the finest luxury brands. It houses over 600 global and national stores, 14 screen PVRmultiplexand around 100 restaurants and kiosks. Mumbai's largest snow park, Snow World is the center of attraction. The blend of food and fashion, fun and games, culture and entertainment makes this place a grand place to visit with theentire family.

5. Select City Walk Mall, New Delhi

This is the second largest shopping mall in India and the biggest in New Delhi.The mall is well planned and designed which divides it into 2 parts; High Voltage for the youth and Traditional for family, Celebration for centre stage. The mall has around 6 acres of outdoor area and 100,000 sq.ft. open plaza. Besides this, there are fun and game zones, 6 screen PVR multiplex, gigantic food court area of 100,000 sq.ft. with innumerable food chain restaurants.It has a stand-alone Calvin-Klein store along with 2 flagship stores of Espirit and Tommy Hilfiger. Other than these the mall has around 180 retail outlets and more than 600 brands.

6. Elante Mall, Chandigarh

Elante Mall, being the second largest mall of Chandigarh,covers an area of 20 acres of outdoor space. The mall has 4 floors with an additional two-floor basement.The retail space areais facilitated with new-age technologies.This multi-storeyed mall is a hub of more than 200 Indian and global retail storessellingapparel, footwear and cosmetics. It has a fun floor for the kids and an 8 screen PVR multiplex.It boasts of a massive food court lined with umpteen eateries, a fantastic food hub, cafes and bistros.

7. UB City Mall, Bangalore

UB Tower is the tallest structure in Karnataka as on date with a height measuring up to 123 m. UB City is designed to produce the feeling of a city with the assimilation of four blocks with a distinctive look; Kingfisher Plaza, Concorde, Canberra and Comet block. Fashion brands like Estee Lauder, Rolex, Burberry, Jimmy Choo, Louis Vuitton, and Canali aptly justifies the title of India's first luxury mall. The place is

best known for high-end stores offering luxury beauty, shoes, jewelry and bags. Other highlights include an 800 seater Amphitheatre, internationally famed Oakwood Serviced Residences along with a Day Spa from Angsana. UB City is home to multi-cuisines ranging from Italian to Chinese and Japanese. Various events are also timely organized for mall visitors.

8. Phoenix Market City, Pune

The mall came up with a concept and vision to offer consumers the best brands, mind-blowing entertainment options, finest dining and overall an enjoyable shopping experience. It targets quality and brand-conscious consumers. It is one of the largest malls in the city that offers a revolutionaryretail and entertainment experience. It has around 300 retail stores of product mix–flagship stores of renowned brands andaround 20 Boutique Hotel Rooms. The state-of-the-art facilities for shopping, large food court, cafes, fine dining restaurantsand unmatched entertainment and leisure options with an 11 screen multiplex, an IMAX theatre, an interactive gaming zone called IPlayand Family Entertainment Centerit is a true 'Destination Mall'.

Shopping Malls turning into Profit Centres

The state-of-the-art facilities and luxurious shopping experience, splendid and adventurous gaming and play zones, bowling alley, amusement parks, multiplexes and cineplexes, community halls, cultural events, festivals and celebrations, offers and discounts, massive food courts, cafes, and restaurants serving multi cuisines, spa and beauty centers, well-organized parking facility, hygienic and clean ambiance, all such facilities and services convert a shopping mall into a family entertainment center. Such world-class facilities draw additional footfalls and encourage regular visitors to spend more time and money in a single visit to the mall. The development of a variety of entertainment and recreational activities has positively impacted the sales of shopping malls. Malls that extend extensive recreational and entertainment facilities attract considerably increased revenue compared to the malls that just offer shopping, as visitors spend more time in the mall to enjoy these facilities and are prone to spending more money in a single visit.

Conclusion

Malls today cannot afford to stand tall with just a bouquet of brands. Shopping alone is no more the primary idea of any mall visitor. As such, shopping experiences can be flovoured by addinga pinch of entertainment and a fist full of recreation.Only retailing might just allow a mall to survive, but if continuous and sustainable growth is expected, malls have to create a competitive atmosphere conducive enough to catch the attraction of people in the society. There is a substantial growth in the standard of living of the Indian population. Eventually, the expectations of consumers move from basic to comfort and then to luxury. Consumers today, look for entertainment and experiences surpassing conventional shopping and want to spend quality time with family and friends. Shopping malls are no more just retail destinations. Malls have now blended into a retail, entertainment, and recreation hub. As such they successfully pull the attention of even the non-mall visitors. Malls are not just providing customers with a wide range of national and international brands but are efficiently encouraging mall visitors for repeated visits by enhancing their stay in world-class hygiene and comfortable atmosphere and engaging them with top-of-the-world entertainment and recreational activities.

References

1. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.1773&rep=rep1&type=pdf
2. https://www.researchgate.net/publication/233178427_Why_Do_People_Choose_the_Shopping_Malls_The_Attraction_Theory_Revisited

3. http://ijariie.com/AdminUploadPdf/Customer_Behaviour_towards_Shopping_Malls_%E2%80%93_A_Study_in_Bhavnagar__Gujarat_State__India__ijariie3978.pdf
4. http://ijrar.com/upload_issue/ijrar_issue_1478.pdf
5. https://www.indiaretailing.com/2018/08/13/shopping-centre/family-entertainment-centres-malls-blend-retail-entertainment-into-winning-proposition/
6. https://www.ncrpages.in/blog/best-delhi-shopping-malls-for-eating-joint.html
7. https://www.holidify.com/collections/shopping-malls-in-india
8. https://www.kwgroup.in/blogs/evolution-of-shopping-mall-culture-in-india.html
9. https://fwdbusiness.com/2015/06/shopping-malls-a-journey-through-the-mall-revolution/
10. https://www.indiaretailing.com/2016/05/19/retail/evolution-shopping-malls-india/
11. https://worldarchitecture.org/architecture-projects/hfgzz/shopping-mall-project-pages.html
12. https://www.academia.edu/2448024/Role_of_Mall_Management_in_Altering_Retail_Landscape_in_India
13. https://www.academia.edu/5716858/Shopping_malls512
14. https://www.newworldencyclopedia.org/entry/shopping_mall
15. https://www.reviewsxp.com/blog/largest-malls-in-india/
16. https://wildtriumph.com/india-biggest-mall-largest-shopping-malls-of-india/
17. https://www.ubcitybangalore.in/about/overview.php
18. https://www.phoenixmarketcity.com/chennai/about-us

A STUDY OF GREEN ENTREPRENEURSHIP AND SUSTAINABLE DEVELOPMENT

H. A. Thorve[1], Rajesh Raut[2]
[1,2]Modern Institute of Business Management, Pune.
[1]harsha.mibm@gmail.com, rajeshraut.mibm@gmail.com

ABSTRACT

Green entrepreneurship is a trending concept of consciously addressing social and environmental problems with coming up brilliant ideas that brings solutions to the problems. World bank and other international organizations conducted various studies on different types of pollution. However, the adverse effects of this entails the scholar's attention. There is need to focus on core areas of Green Entrepreneurship in present environmental challenges. This paper attempts to investigate Green Tech entrepreneurs from Start-up India campaign. It is also highlighted the relationship of Green-entrepreneurship & sustainable development of Green-economy at global level.

Keywords: *Green entrepreneurs, Sustainable development, Green Tech.*

Introduction

Green Entrepreneurship is a practice to control environmental damages like global warming, climate-change. It is emerging concept that change the business approaches towards the ecofriendly business activities. A Green Entrepreneurship is not only an idea-innovation but a development of sustainable environment in the situation of Ecological imbalances; also works on technological development with the help of given freely available naturalistic production factors; having focus on Economic development of society.

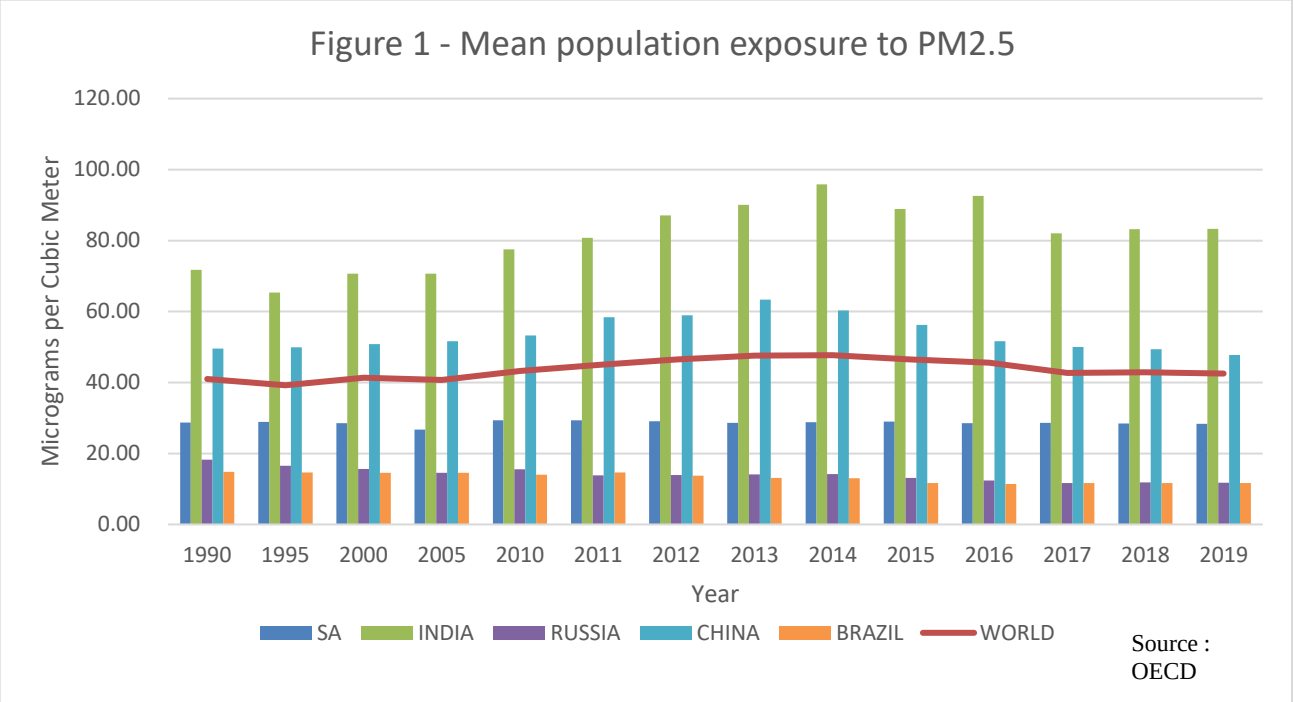
But the pace of required growth is not getting realized in green areas of technology. Majority of nations even with high natural support to such developments are lacking behind majorly due to unacceptability of changes.

Green Growth with Economic development has vital importance in current scenario of unpredictable climate changes, depletion of natural resources resulting into environmental and health issues. And these negative points are critically linked to issues of employment and the sustainability of ecosystems, and consequently, issues of resource security and political stability. It's importantly bringing up the need of such entrepreneurs who can resolve those difficulties & can develop forward with sustainable growth. Green Entrepreneurs are those who are working in resolving Environmental problems with their entrepreneurship skills & ideas to get a positive impact on nature with sustained development.

Literature Review

It is found that obstacle of environmental entrepreneurship on the basis of geographical locations. There is more need of financial support from government to solve the problem of uneven development of green technologies. (KAUR, 2014) The fact is that Developing countries get more benefit from Green Entrepreneurship for job creation and unemployment rates dropping at substantial rates. As per the researcher Afghanistan has a potential for green entrepreneurship. (Mohsen, 2018) New demands from consumers can be combined with environmentally friendly products and services; the changing shape of national and global economies is leading new forms of entrepreneurship. (Gibbs) Different sort of terminology used by green entrepreneurs, ecopreneurs, But environmental solutions are becoming more and more attractive and popular. Innovative technologies and digitalization of business process makes much wider possibilities for entrepreneurs to be environmentally oriented. (Inga Uvarova, 2020)

Data Analysis-For Data Analysis purpose OCED countries has taken into the consideration. The data analysis is from the period of 1990-2019.



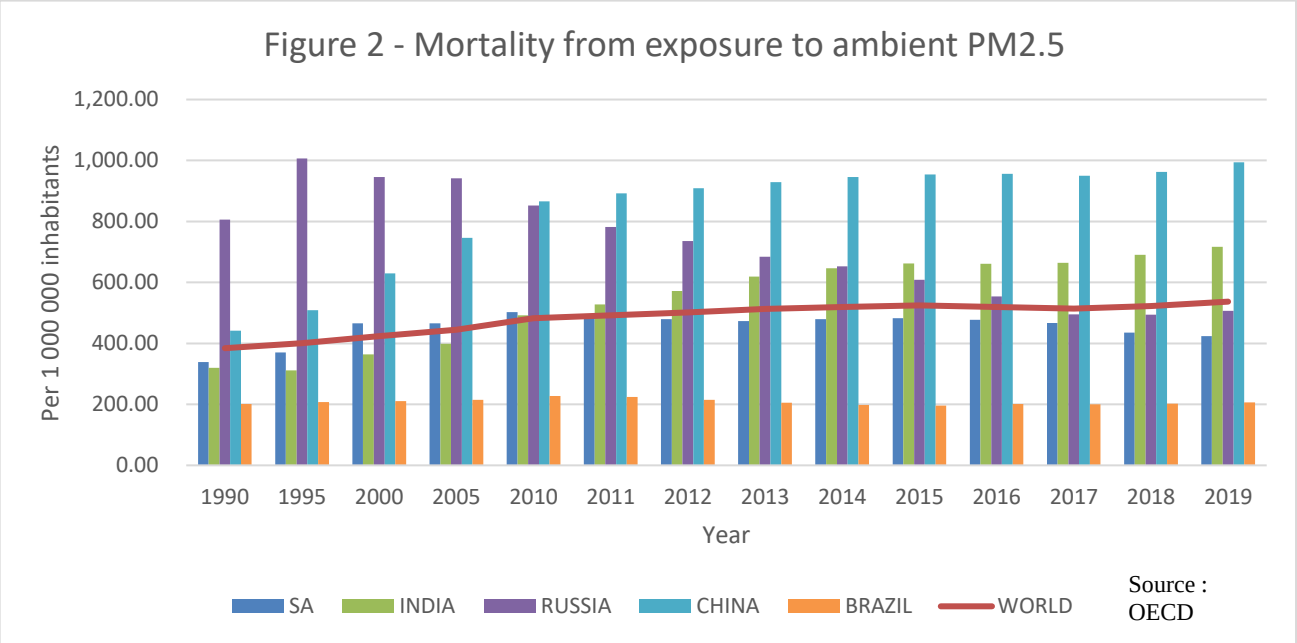
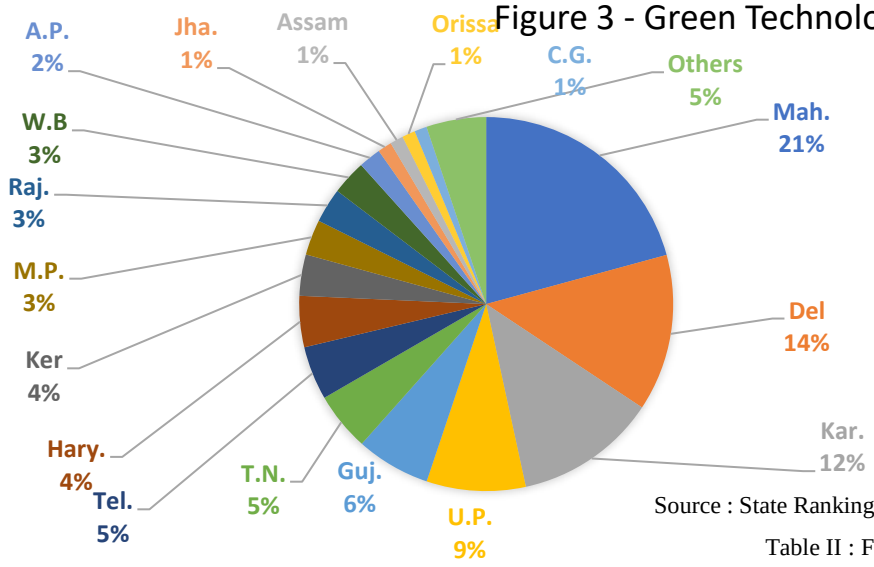


Figure 1 & Figure 2 shows relationship of BRICS (Brazil, Russia, India, China, South Africa {SA}) in comparison with world population exposure scale with measuring it with PM2.5 &with its negative effects due to high air high pollutant. India& China with heavy pollution exposure results to high death rates, which shows need of pharmaceutical technology at cheaper rate via Natural methods. As comparison Russia is growing positively with diminishing death rates &developing society on a sustainable way because of increasing focus on ways of pharmaceutics like less expensive medical education.

Figure 3 - Green Technology States in India

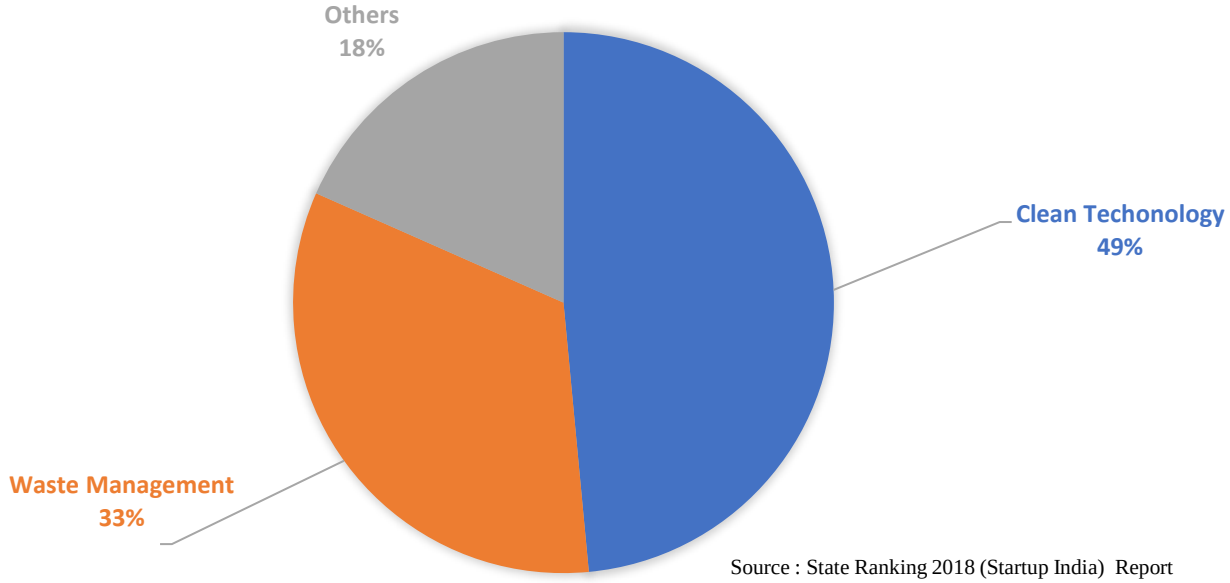


Source : State Ranking 2018 (Startup India)

Table II : Full name of

Figure 3 shows Indian states which holds 95% of Green Technology states. With 66318 Start-ups in 54 different industries till 2018, Indian entrepreneurs focused majorly on IT-sector with 8590 firms. Healthcare services & Education holds 2nd& 3rd rank; and green technology start-ups who work on environmental areas is at 15th rank with 1404 firms. Maharashtra, Karnataka & Delhi going up with 47% share; due to developed financial & Technological sectors compare to other states. Southern states with Self Help Groups& academic institutes collaborate with industries & develop fields according to requirements.

Figure 4 - Firms in Green Technology Sectors of India



Source : State Ranking 2018 (Startup India) Report

Figure 4 reflects the areas in which Indian firms are focused to different sectors in green technology industries. In Green technology industry, social service objective plays major role, importantly while tackling with less exposed population. Green Tech industries are divided as Clean Tech (solar, wind, ethanol, biomass, energy storage and more) with 49% share as demand is getting increase after price increment in non-renewable resources as well as hazardous pollution products, Waste management (liquid waste, organic waste, recyclable, rubbish& hazardous waste) & other relative sectors are working on the environmental products. Due to lack of resources availability, highly educated youth motivate towards IT-services for getting global exposure & big compensations pushes back Green technology sector.

Challenges for Green Entrepreneur:

- Less Monetary Returns-Green Entrepreneurs needs to provide eco-friendly products in market. However, many times returns cannot be more in monetary terms as the purpose is to serve social objectives
- Gaining Consumer's Acceptance – Consumers are dependent on advertisement and other sources of information. Advertisement increases cost of products it creates effects consumers' interests compare to other consumer products.
- Limited Consumer's Education – Necessity of such products & upcoming issues due to environmental distortion's information is not available to consumers as excepted. It majorly happens in rural areas due to less inclusive nation resulting on limited exposure
- Unpredictable Climate Changes - Sudden changes are happening in climate like global warming, heavy floods, ice melt etc. impact implementation of planned policies & designed. The requirements from sudden changes in market is not possible to immediately include in innovator's portfolio
- Dissimilar State Planning – Planning in environmental field must not majorly dependent only on central authority. Relatively similar planning in all states gives motivation & confidence to work on large market share. And not limited to any states. Dissimilarity results as unequal distribution of technology & impacting on price by various dimensions.
- Fluctuating Tax Policies- Long term planning can create impact on sustainability of a firm. Sudden changes in financial policies brings entrepreneur into debt. Many new entrepreneurs must rework on the financial model which consumes time & decline growth.
- Political Instability – Political environment reflects negativity to any investors and result pooling up startup capital as well as being small in size and cannot take burden of financial instability due to change in policy.
- Education at School Level - Environmental challenges & their negative impacts need to be added up' in education as it will develop ideas to improve those changes as wells can be build up informed consumers.
- Skill development in Higher Studies - Increases attitude as innovators &entrepreneurs via projects in green technology sector; and develops knowledge in society in professional way. As well as can grow students to think as an emerging opportunity in future.
- Inclusion of Green Sectors in SDGs – Sustaining green entrepreneurs can be obtained from SDG policies as it has an objective of long-term goals. India needs to include it with their economic growth policies.
- Dependency on Raw Materials– With Green entrepreneurs, sectors of raw materials to eco-friendly products should develop in same pace. Also, needs to target naturally grown states in their easily availability of resources.
- Develop Labour Intensive Products – Production from labour intensive techniques decreases cost of production & can also available products at nominal price, which is highly required from Low-income states. i.e., Labour-intensive techniques provide eco-friendly products, employment & income to utilize such products at low cost.
- Green Financing – For sustaining business models in environmental related products; Green financing plays major role by providing investment opportunities to investors.
- Products with Certification – Certification of these products needs to be done from signing authority under the guidance of subject experts. As it increases the trust of consumers towards product.
- Market Size Objective – Objectives of firm to have large market size instead of large profit margin; then only they can compete with low-cost global products & can also gain confidence. Only if these products don't increase consumer's expenditure.

- Collaborative Markets – Need to merge small villages as a big consumer & share the benefits at reasonable price. It can be utilized majorly in agriculture sectors.
- Attitude for Social Development- Entrepreneurs must have a social objective & not profit oriented one, which can be done by collaborating with Academic institutions & related NGO. As these institutes has trust from society & it will grow the firm with social development.
- Inclusion in CSR policy – Minimum margin of investment must include in CSR policies of large industries, as speedy changes in technology requires immediate &large capital to entrepreneur. Also, inclusion of brand name of large-scale industries exposes entrepreneurs to global environment.
- Restriction on FDI – To develop Indian entrepreneur, FDI must be restricted. Because of their easy availability of raw material & well-developed technology produces low-cost products, which negatively impacts Indian entrepreneurs market share.
- Measuring Green Entrepreneurs- OECD keep measuring green entrepreneur's performance from their innovation to implementation. Framework needs to be designed in such a work that any country can utilize it and it will answer policy-development from its implementation view.
- Triple Bottom Line (TBL), World Bank – The TBL approach needs to be include in India's start-up policies; it includes Financing to Human resource then Environmental development in path for any entrepreneur from bottom to the top.

Conclusion

Green entrepreneurship is depending on green policies; their frame work of having specific objective of environmental protection at first than to keep that level sustained. Presently due to immediate environmental disasters, destroying not only at one place but impacting world with interconnected financial markets. Developed nations with collaborations are performing well designed qualitative analysis of measuring ecological balance on the basis of green entrepreneurs, even their profit value. Getting at social environment interconnectedness, with in BRICS nations; China is in positive direction with developing new ideas. South Africa & Brazil on the basis of large number of natural resources, getting sustained on own. Russia with help of reserves & stable political system can utilize environmental related products.

India is on developing path, but Entrepreneurs are more in profit-oriented objective, which attracts interests of large investors. Following which responsibility of investments comes to government at large scale. Highly educated & technologically advanced youth focus in IT services instead of environmental sector as latter doesn't have quick returns. Indian government is on verge of adopting foreign technology, which is expensive for consumers. Consumers are not able to afford until green products are being made according to their requirements & at minimized cost. Difficulties in getting finance impacts substantiality of entrepreneurs& not able to compete with foreign products.

For getting green products to be consumed at large scale in India. Society &Entrepreneurs requires to be interconnected with help of freely & easily understandable education and providing such skills, such that even if they don't want to be in green technology than at least would be an informed consumer who understands values of environmental balancing; only with help of sustained Green entrepreneurs& develop Green Economy.

References

1. T. Gevrenova (2015). Nature and Characteristics of Green Entrepreneurship. Natural Resources Economy Department, Business Faculty, University of National and World Economy.
2. OECD Ministerial Council Meeting (1-2 June 2016) [C/MIN (2016)6]. Better

Policies for 2030; An OECD Action Plan on the Sustainable Development Goals.
3. Ms. Asha Sharma (2017). Green Entrepreneurship: Strengthening Indian Economy by Innovating the Future.
4. The Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce & Industry.States' Start-up Ranking 2018.
5. Ms. Asha Sharma (2017). Green Entrepreneurship: Strengthening Indian Economy by Innovating the Future.
6. (2018) Green Growth and Sustainable Development Forum & Green Growth Knowledge Platform 6th Annual Conference. Inclusive solutions for the green transition: Competitiveness, jobs, and social dimensions; OECD.

A PRODUCTION CONTROL USE A VARIOUS FUNCTIONS OF QUALITY FOR IMPROVING COST OF PRODUCTIONS IN PUNE ZONE

H. V. More[1], M. A. Kulkarni[2]
[1,2]Savitribai Phule Pune University, Pune.
[1]hemantvmore@gmail.com, [2]dr.milind.a.kulkarni@gmail.com

ABSTRACT

Production Control can be looked up based upon the requirements and customer's needs. In return, it implicates need of verification with respect to quality on the parameters of improvement quality of services and articles. Speaking about the possible utilization of repairing methods in organization, mentioning the precise qualifications of criterion utilization of tools used in improvement in quality is necessary. Defects during casting, however, be revealed either during the machining, assembly, or component utilization phase. The customer may pass the resultant value-added costs or warranty costs onto the foundry. This research work consists of analysis of types of castings and their sub-products. It was observed quantity of defected castings and kinds of defects in the castings during the year. Besides quality management each step has its marked response to problems of environment and to problems of safety and risk. In most sized plants make the situation considerably make them create such administration pretentious and cost-effective integrated management systems. Production quality, safety, protection of health, and environmental protection in work atmospheres are an integral part in 'modern management systems.

Keywords: *Production Control, Quality of Production, Improvement in PPC, foundry defects.*

1. Introduction

Production Control has been a long-standing subject, especially the matter of 'quality of goods and services. During the period of 1970 BC the concept of product quality and liability into the building industry was introduced by King Hammurabi of Babylon. Until the advent of mass production, the maintenance of quality was one of the key functions of the craft guilds of the Middle Ages with only those workers who could achieve acceptable quality standards being admitted to membership. Monopolistic unions were structured for ensuring achievement of a high-level skill and quality through its membership as well as the trade. Quality during the Industrial Revolution was set in large factories which employed militaries of persons which was in turn giving rise to new ways of management. Scientific management as given by Frederick Taylor fetched efficient operations for increasing output by segregating jobs into various parts leading to mass production where each worker was assigned a single task.

Mass producing practices gained striking early dividends. Henry Ford (1863-1947) constructed over how mass production brought increased productivity. Ford then flow lines and workers did thoughtlessly monotonous tasks. In its part of cost control, for producing lower prices, Ford fixed the price and confronted the organization for ensuring that the costs were sufficiently low to come across the figure. Scientific management emphasized disconnect of concept from its execution as well as labor substitutability. The concept of craftsmen vanished with Taylors. Inspection therefore endured the lone quality guarantor. Product was no longer built with Quality. The 'success in the war', thus led to establishment of institutes and associations as well as the publication of formalized quality of ideas. In 1919, the Technical Inspection Association was formed which became incorporated as the 'Institution of Engineering Inspection' in 1922 in Britain. In 1931, Economic Control of Quality of Manufactured Product was published by W. A. Shewhart of the 'AT&T Bell Laboratories'. Stern methods for observing and assessing everyday producing and improvement in quality were recorded. Konosuke Matsushita, Japanese businessman and one of the world's largest electronics group's founder was influenced greatly by Henry Ford's work. Suppliers, however, are also essential- Matsushita visited his supplier factories in 1930s and gave them advice based on effective production.

The industry was again bashed off-balance by the Second World War. More profound and longer lasting effects were found in North America. The War Production Board trained thousands of quality specialists and created the

American Society for Quality Control (ASQC). The ASQC memberships in 29 specialist divisions were expanded approximately up to 50000. One of the defeated nations, however, was the one to come up successfully with the quality thinking. A new nationalistic drive was launched by the Japanese to expand and pursue their economic goals rather than military goals. W. Edwards Deming was famous expert who served a key purpose in this upgradation process in collaboration with people like J. M. Juran from the United States. During the war as well as in the post-war period, Americans had an advantage of close participation over functioning with respect to sound quality systems. The Western method, the American Approach to Quality, the invention plan preferred by the U.S. after the war period considered to be policy in a period of economic resources low international competition and expanding markets. During that period, it is given highest importance to quantity than quality and management is interested in reducing cost and increasing production. It was made clear by Juran in the Harvard Business Review article (1993) during the 1950s, his Japanese audiences were the main managers of chief establishments while the North American viewers were mainly quality inspectors and engineers. In the Eastern approach, especially Japanese approach to Quality, managers took the advice about upcoming modifications in the customer ‘s insight regarding quality as well as their future demands very seriously so that they could quickly develop their customer-oriented services and products. In short, these concepts were easy to work out with given the long-established Japanese tradition of attention to detail by miniaturization when it comes to fine craftsmanship. The strong statistical essence of early work with an emphasis over quantitative variant within quality suited very well for numbers with the Japanese penchants. Since, Japan was poor in terms of natural resources, the only option for it was to export good quality goods at lower rates in order to afford the food and other essentials that were needed. 2. Review of Literature

FEIGNBAUM A.V. (1991), mentioned that Production Quality, safety, health, and environment protection in work environments are integral parts in modern management systems. ‘Integrated management system’ refers to a system incorporating management systems to a single continuous system allowing them in reaching the desired missions as well as goals.

According to PRIBULOVÁ A. (2010), the concept of Integrated Management System arrived as a Foundry Quality Management System is an example of continuous process of improvement in steel and iron foundry: research of occurrence of casting defects in steel and iron castings. Process of Foundry production consists of mold preparation as well as molding mixtures, preparation of liquid metal, casting, cleaning of castings, thermal and surface treatment of castings

Production of non-ferrous as well as ferrous metal castings takes place in the foundries. Ferrous castings include steel and iron, whereas non-ferrous castings mainly consist of copper, aluminum, zinc, tin, lead, magnesium, titanium, and nickel. Castings are formed by melting, pouring, and casting of non-ferrous and ferrous metals. Several foundries cast both ferrous as well as non-ferrous materials.

There are various number of casting techniques which involve construction of mold where a metal is melted and poured inside it. It is further divided into expendable and non-expendable mold casting. Expendable mold casting, very typical with respect to ferrous foundries even though they used in non-ferrous casting as well, use lost molds (e.g., sand molding). On the other hand, non-expendable mold casting, which is implemented mainly in non-ferrous foundries, involves usage of permanent molds (e.g. die-casting). Lost molds once used, cannot be reused, and are hence destroyed during the shakeout phase whereas, permanent molds are reused. Various methods are used in these two processes depending upon the melting, molding, and core-making systems, casting system, and the applied finishing techniques. The following processes take place in a typical foundry: melting and treatment of metal in the melting shop; mold and core preparation in molding shop; casting molten metal in the mold, cool down for solidifying and removal of casting from mold in casting shop; and

finishing shop where finishing of raw casting occurs. Electric arc furnaces or coreless induction furnaces are used in the melting process if Cast metal. The treatment of Cast steel consists of refining as well as deoxidization based on the metal charge as well as the quality requirement of the casting product (PRIBULOVÁ A. 2009).

Integrated Management System in foundry, thus arrives the idea of integrated management system is based upon the suitability of management systems according to the ISO 9000:2000, ISO 14000:2000 and OHSA1 18001:1999 standards. Discussion in Committee TC 176 caused the change: presently, integration of the standards isn't taken into consideration, nonetheless their compatibility and probability of "combination" has been discussed (EMMIMA E.M. 2008).

ISO 14000 and ISO 9000 systems have their compatibility defined in point 0.4 of ISO 9001, where there is a possibility for an organization for harmonizing or integrating its own Quality Management System with requirements of related system. However, the regular ISO 9001 is not containing total requests precise for the supplementary management systems, the organization can adjust its quality management system (ISO 9001:2000). A business know-how to adapt its Quality Management System (ISO 9001:2000) regardless about the fact that ISO 9001 doesn't consist of all requirements particularly for other systems of management.

The three above mentioned management systems have numerous similarities between them which are as follows:

a. Commitment of organization's management.
b. Control of documentation and records.
c. Politics and goals of the management.
d. Orientation to customer.
e. Responsibility, authority, communication.
f. Management review.
g. Representative of Management.
h. Source provision (human, financial, material, information).
i. Analysis of casting defects
j. Competence, education and training.
k. Internal audits.
l. Metrology.
m. Monitoring and measurement.

Quality can be perceived on the basis of costumers' needs and requirements. It, in return, involves need of verification according to this, i.e. quality inspection. Separations in quality criteria take place for investigation of all phases of formation and utilization of products: preproduction, production and after production phase. Each phase is characterized by information sequence regarding quality as well as the quality features that occur in assured methods. Effect gathered norms in manufacture might be utilized or intended for active request of various types in analytical tools. According to OTT D. (1997), molding flaws may have a negative effect over the bottom-line of a foundry.

Identification of problem formations' sources has been made possible by Ishikawa's diagram (also known as the "fish bone diagram") which is generally a diagram for cause and effect. According to SIEKANSKI K. (2002), it also helps in identifying a sequence of problems causing challenges in the next phases: research, therapy and diagnosis select while making easy solutions for problems.

According to Fayol, "Control consists in verifying whether everything occurs in conformity with the adopted plan and established principles. The objective of control is to point out weaknesses and shortcomings, if any, in order to rectify them and prevent recurrence. It operates on everything viz. material, equipment, men, operations etc. For control to be effective, it must be applied within reasonable time and be followed-up sanctions." ..BY Hennery Fayol 02

"Production is Management concerns itself with the conversion of inputs into outputs using physical resources." ….By- S.N. Chary 06,, Tata McGraw-Hill. Third Edition, Production and Operations Management .pp 02, Fourteenth reprint 2008 Just- in-Time Manufacturing System.

According to Schonberger, "Just-in-Time (JIT) is a system to produce and deliver finished goods just in time to be sold, sub-assemblies just-in-time to be assembled into finished goods, and purchase materials just in time to be transformed into fabricated parts."

The idea of just in time was originally developed by the Toyota motor company in Japan
. The idea was formalized into a management system when Toyota sought to meet the precise demand of customers for different models and colors of cars with minimum delays. JIT is being used in wide variety of industries such as automobiles, consumer electronics, office equipment's etc.

Functions	**Issues to be covered**
Product Design & Development	Customer needs, market needs, availability of similar product, demand-supply gap, functional aspects, operational aspects, environmental aspects etc.
Demand Forecasting	Quantity, Quality, Demand pattern.
Capacity Planning	No. of machines, No. of tooling, workers, No.of flow lines, Quantity, Quality and rate of production, demand pattern.
Equipment s Selection & Maintenance	No. of machines, type of M/c, Quality aspects, Quantity aspects, rate of production, Cost of equipments, support from the supplier, maintenance policy, storage of spare parts.
Tooling Selection	Compatibility between w/c steels, No. of tools, their cost, their material etc, storage policy.
Material Selection & Management nt	Types, specification, quality aspect, quantity aspect, cost, supplies reputation , lot size, inventory levels, setup cost, mode of transportation etc.
Process Planning	Generation of manufacture instruction, selection of M/c, tools, parameters, sequence etc.
Loading	Division of workload, assignment of tasks, uniform loading, matching between capability & capacity with job requirements.
Routing	Path selection for material movement as per the process plan and loading, minimum material handling and waiting time.
Scheduling	Time based loading, start and finish times, due dates, dispatching rules, re-scheduling.
Expediting	Operation Scheduling and order and progress reporting.

Important functions covered by production planning and control PPC) function in any manufacturing system are shown in Table1along with the issues to be covered.

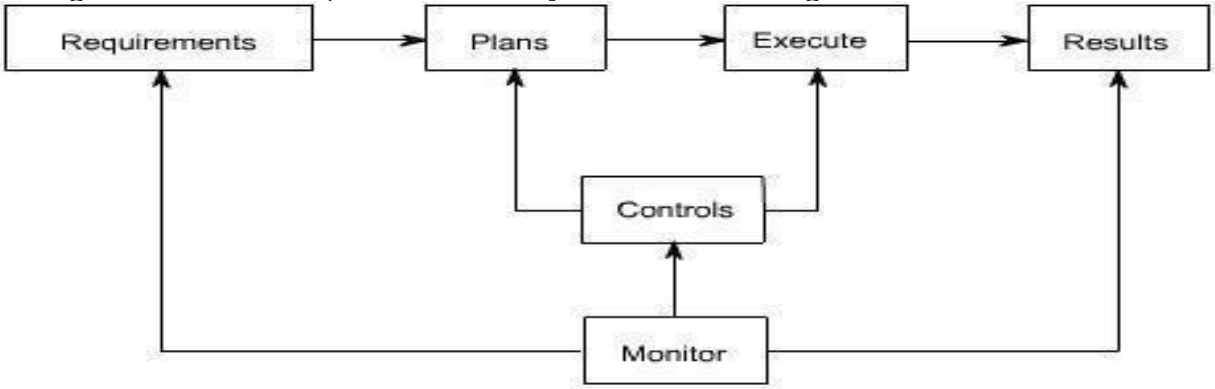


Figure 1: Architecture of Control System

2. The most common castings defects:

Casting process may come up with various defects which in turn reduces the total output of it alongside increases their production cost. Thus, it is important to consider and understand their causes, the imperfection or output that is obtained which is very contradictory to the quality requirements.

There are basically three types of Casting Defects :

1. Major defects, that can't be rectified, which results in denial of the molding ultimately leading to entire damage;
2. Rectifiable Flaws which may be treated, however the repair cost may not be a justification for the attempt of salvage;
3. Minor defects, that undoubtedly allow economic salvation of the castings thereby leaving a reasonable profit margin.

Reasons for such defects:

- Unsatisfactory or Unsuitable raw resources utilized in main creating, molding or casting; Applying inacceptable casting or molding exercise thru single employee(s) or incorrect instructions by the supervisor;
- Usage of inappropriate equipment, tools, patterns or appliances; and
- Improper management policy techniques, out of order organization and lack of training or poor work discipline.

According to Garvin, "Quality is an oddly dicey concept which is easy for visualizing, yet irritatingly challenging when defining."

The quality usually expresses notions of vague factors which aren't readily tied down or measured. Quality expresses a positive implication whatsoever it is directed to. It can be a compelling value and is robust enough in pertaining towards products, service standards, innovations, and people's caliber …. Everyone at every level can do something about it and feel satisfied about making a difference. Providing quality service and making quality products that work can be identified with from ones' own experience. (Pascale, 1991)

Quality can be evidently defined through several approaches such as:

- Peters, (1989), mentioned about Quality means delighting the customer,
- Feigenbaum, (1983) mentioned that it is well-defined as being about value.
- Crosby, (1979) says conformance to specifications, standards or requirements.
- Peters and Waterman, (1982) mentioned about Quality as excellence.
- Juran, 1989, explains its fitness for use.
- Parasuraman et al., (1985), says that Quality deals with meeting or exceeding customers' expectations

Each approach when defined with quality has strong points with respect to generalizability, comfort of utility as well as measurement. Hence, the superiority as conformance to criteria method is further significant in an environment for engineering in influenced individual service industry alongside being of countless value to emphasize productivity and efficiency. Quality as superiority is perceived to be equally valuable to a motivational expedient in a 'general call to arms' when it comes to quality management movement. Workforces may yield superiority in functioning for an association whose mission and vision reports highlight over existence the greatest.

Besides all of the above, every approach has its own disadvantages. Hence, a quality vision for conforming to standards each and every time is very unlikely being as effective when compared with proves to be 'Quality as excellence' when appealing employee assurance towards quality. However, quality as excellence is very difficult to measure or operationalize.

3. Objectives of Research

1. To study the awareness and usage of Production Control in various functions of large-scale industries in Pune Zone.
2. To study the impact of Production Control in selected large-scale industries in Pune Zone
3. To understand the impact on cost of production.
4. To work on the Production Control to reduce the wastage of raw material.
5. To understand the different factors responsible for wastage.

4. Hypothesis

Based on the objectives following hypothesis can be worked on

H1: - There is significant difference across production control function helps to formulate Policies to better performance of large-scale industries.

H0: - There is no significant difference across Production control function does not helps To formulate policies to better performance of large scale industries

H2: - There is significant difference across production control function helps to formulate Policies to better performance of large-scale industries.

H0: - There is no significant across production control function helps to formulate Policies to better performance of large-scale industries.

H3: - There is significant difference across awareness and usage of Production Control in various functions of large-scale industries in Pune Zone.

H0: - There is no significant difference across awareness and usage of Production Control in various functions of large-scale industries in Pune Zone.

5. Data and Methodology

a. Population and sample size: There are around 70 firms in and around Pune Zone. Randomly a few firms around 30 manufacturing units has been taken in to accounts. A Structured Questionnaire is designed comprising of 25questions selected to understand Quality and Works managers was taken from Primary data collection.

b. These determinants were put on to a scale of five-point Likert Scale, where 1 being never used to 5 being extensively practiced.

c. Reliability of data: A 29-items questionnaire was framed and circulated among the Quality Assurance and Production Managers/Works Managers.

d. In order to understand the questionnaires' reliability, Cronbach's alpha test was run on 10 manufacturing units, which is considered as Pilot study.

e. Hypothesis testing can be carried out understand the reliability, applicability by performing Chi2, T-Test, Z-test and other tests were carried out.

6. Conclusion.

The paper presented, identifies the importance of Production Control for cutting short of wastages and damages in the manufacturing process and implementation of the same is difficult task to be carried out. The main finding of the research paper is Firstly, most of the production control in large scale Industries or manufacturing units are having ISO 9000:2000 standards.

Secondly, the manufacturing units differs in implementation of Production Control in the production processes. Thirdly, some of the units are following Production Control, TQM and Kaizen models but others are not.

7. Limitation and scope for further research:

The study was performed on selected production or manufacturing units of Pune Zone. Further studies can be focus on same type of production or manufacturing firm but for other areas. The period of study was executed during the month of April-May 2020-21. Firms that use the tools process management like failure mode, and effect analysis and quality functions deployments can further be studied like tools like Kaizen, TQM and the hurdles to implementation of the same methodology can be studied further. Due to COVID-19 pandemic scenario most of the firms suffers Lock-down, this could be other constraints before the researchers.

References

1. Rama Murthy, P., Production and Operations Management, New Age International Publishers, 2005
2. Chase, R.B., Aquilano, N.J., and Jacobs, F.R., Production and Operations Management: Manufacturing and Services, Richard D. Irwin, Inc., 1998.
3. Narshimha, S.L., Production Planning and Inventory Control, PHI, 2002
4. Garg, A.K., Production and Operations Management, Mc GrawHill, 2012

5. Chary, S.N., Operations Management, TMH, 1996
6. Baffa and Sarin, R., Modern Production/ Operations Management, John wiley and Sons,2002.
7. Pribulová a., gengeľ p., bartošová m. 2010. odpady z výroby oceľových a liatinových odliatkov /prachy – ich charakteristika, vlastnosti a možnosti použitia, tuke košice.
8. Pribulová a. 2013. foundry. tuke košice.
9. Roučka j. 2000. casting alloy filtration.czech foundry society technological commision. brno
10. Wilson t.c. 2001. implementation for small foundries. hickman, williams & company, livonia michigan, iso 9000, American Foundry Society.

IMPACT OF COVID-19 ON INDIAN ECONOMY: A STUDY REFLECTING POLICIES AND PROGRAMME

S. Meshram[1], A. Mehta[2], S. P. Kharate[3]
[1, 2, 3]Dr. D. Y. Patil Vidyapeeth's, Global Business School & Research Centre, Pune.
[1]sonali.meshram20@gmail.com, [2]akankshamehtadoctor33@gmail.com, [3]sunita.kharate28@gmail.com

ABSTRACT

The COVID-19 epidemic put a halt to social as well as economic life. The focus of this research is on evaluating the effect on the sectors involved like oil, MSMEs, capital markets, retail, tourism, and aviation. Internal mobility and International is limited, and travel and tourism revenues generated that contribute 9.2 percent of Gross domestic product, will have an important influence on the GDP growth rate. Revenues from aircraft would fall by US$ 1.56 billion. For 18 years in March, oil has dropped to a level of $22 per barrel, and "Foreign Portfolio Investors" have pulled massive quantities of approximately US$ 571.4 million off India. If the deficit in the current account shrinks, the lower oil prices increase the reversal capital flows.The rupee continually depreciates. MSMEs are going through a big cash crunch. The crisis has seen an appalling mass migration of this floating migrant community on foot in the center of the country's lockout. Their issues have been mainly working loss, everyday consumption, and lack of a social safety net. India should rethink and become more inclusive about its development paradigm. COVID 19 also offered India some exceptional opportunities. The risk that the COVID-19 may recession globally in 2020 and 2021 will be very high as the ending of all financial activities – output, trade, and consumption – to monitor the COVID-19 spread has been noted globally. There is a chance for global supply chain involvement; multinational corporations lose faith in China. Some reforms are needed to "Make in India" one of which is labour reforms.

Keywords: *Sectorial impact, MSMEs,GDP growth rate, Import-export, Government, Economic impact,COVID-19, lockdown.*

Introduction

The world has been experiencing many epidemics including the Spanish Flu of 1918, MERS: "Middle East Respiratory Syndrome", Ebola, SARS: "severe acute respiratory syndrome", an outbreak of AIDS/HIV. In recent years, India has been confronted with diseases like smallpox, polio as well as plague. But one of the biggest health problems in our history is the Novel Coronavirus COVID-19, which originated in China between November-December 2019 and spread rapidly over the next few months to almost all countries around the world.

The epidemic of COVID-19 has tremendously affected nations, in particular the national lock-ups that have brought social as well as economic life to a halt. A world that has been always full of events has remained quiet and has diverted all energy to the never-experienced crisis. The virus has a multisectoral effect, as nations have slowed their economic activities. What should be remembered is a warning bell that the WHO: "World Health Organization" released in 2019 about the world failure to solve the world pandemic.In the 2019 World Bank and WHO joint study, the effects of anepidemic of this nature are projected to be 2.2% to 4.8% of the world GDP. This forecast seems to be accurate because we see this crisis in the world.

In a furtherstudytitled COVID-19 and the working world: The International Labour organization effects and policy responses clarified that the crisis had been an economic & labour market shock that had an effect not only on supply (goods & services production) but also on-demand (investment and consumption). The IMF: "International Monetary Fund's" Chief reported that the globe is facing unprecedented confusion around the depth as well asthe length of this situation, and this was the biggest economic implications since the Depression of Great. For developing markets and advanced

economies, the IMF estimated external funding requirements of trillions in dollars.India too is storming under a pandemic and the economists are locking COVID-19 costs at US Dollars 120 billion, or 4 percent of GDP, as stated in the "Economic Times" reported on March 23, 2020 *(The Economist, 2020)*.

This pandemic of COVID-19 has impacted the production as well as services sector — media, recreation, IT, health, education, real estate, hotels, hospitality, tours & travels banks, retail, healthcare, and others. The economy has begun and is rising fast. Although lock-downs and social inequalities contribute to productivity losses, on the one hand, consumer demand for goods and services on the other is drastically declining on the market, and subsequently, economic activity is collapsed. Lockdown and social separation are, nevertheless, the only economical instruments available to avoid COVID-19 spread.

Material And Methods

Earlier research experiments were carried out on simulation models to determine the economic impacts of epidemics. The neoclassical growth model was used to examine the effects of the Spanish flu outbreak in 1918 by Martin Karlsson (2014); the standard DID: "difference-in-difference" estimator was expanded to investigate different rates of flu mortality in Swedish areas. The policy brief released by the "Asian Bank" for Development in order to evaluate the economic effects of the avian flu pandemic in Asia's economies was conducted by macroeconomic simulations according to the model for the OEF: "Oxford Economic Forecast" that integrates both the supply side and demand and adjusts the shock to a new balance by Bloom (2005). Scientificevolution of the economic impact of SARS: "severe acute respiratory syndrome" outbreak is dependent on the global model of the "G-Cubed (Asia-Pacific) model" that has beenrecommended by McKibbin and Lee (2004)

Economic implications of epidemics are determined by economic costs and due cost of treatment associated with illness or the loss of income caused by mortality as well as morbidity.The economic impacts of an outbreak in a world are shifting in the global economy from the interconnected supply chains and financial markets to other countries. The pandemic COVID-19 is triggered by new coronavirus infections and an experimental study is underway to examine and establish a potential cure for this infection in the human body. In the epidemiological estimates for this disease, there are several variables dependent on hypotheses like the triggerof infection, rate of infection, and the asymptomatic instances to symptoms. The mysteries and propagation of the disease will be uncovered by scientific experiments in the future. Closely related to the disease pattern epidemiological forecasts are economic estimates or simulations.

This study focuses on evaluating the harm to the sectors concerned from COVID-19, like the loss of overall production, retail, tourism, air, socio-economic effects of working hours lost, with an overview of development policies along with the consequences of the program.

Sectorial Implications of COVID-19 Pandemic in India:

Impact on Retail, Tourism,and Aviation:

Internationally, the tourism sector is the most influenced by the crisis of COVID-19. Estimates of a 20% to 30% decline in foreign tourist arrivals are provided by the UNWTO: "World Tourism Organization" (2020). These estimates, too, are focused on current conditions and will possibly rise or decline in the future. The industry is expected to lose millions of people their jobs. The travel as well tourism industries in India are thriving

and make a major contribution to the economy.

The research on 'Indian Inbound Tourism' by FICCI-Yes Bank: India has been defined as the biggest tourist powerhouse in South Asia by Unlocking Opportunities. India's tourism represented 9.2 percent of GDP and in 2018 created 247.3 billion USD, creating 26.7 million jobs. Presently, it is the eighth biggest GDP contribution state (Jagan Mohan, 2020). The report estimates that almost 53 million people will be provided with jobs in the sector by 2029. In 2017, 10 million FTAs: "foreign tourist arrivals" crossed. The Coronavirus pandemic though has limited global mobility and the GDP growth rate will be greatly affected by the revenue generated by this industry. The growth rate of GDP could decrease by 0.45%.

India has currently provided US$72billion of aircraft to Indian GDP. In the first quarter, the number of foreign tourists arrived has fallen. In the second quarter, the lock-down will have an important effect on arrivals. It will amount to 18 billion when we approximate a conservative 25 percent decrease in aviation contribution. In 2019, railways provided GDP with a contribution of US$27.13 billion. A 21-day lockout will reduce revenues by 1.56 billion US dollars.

In FY 2019, the Indian retail sector amounted to US$ 790 billion. It makes up more than 10% of the GDP of the country and about 8 percent of employment. Online retail has grown very rapidly in the past few years and the expected rise in online retail in 2020 showed a 30% growth (National Investment Promotion and Facilitation Agency, 2020). Quarter 2 revenue is impacted by a month-long retail closure. The suppressed demand in the retail sector appears to revive quickly, enabling the lifting of the lockdown.

Impact on GDP Growth Rate:

This COVID-19 outbreak continually increases and there are no containment signs by April 15, 2020, the economic growth of the country is likely to have a very important negative impact. The United Nationwarned that the pandemic with coronavirus could have a severe impact on the global economy along with GDP growth in India is forecast to reduceto 4.8% in the present economy ("United Nations" 2020). Likewise, the United Nations (UN) Economic and ESCAP: "Social Survey of Asia and the Pacific" 2020 suggested that COVID-19 should have significant socio-economic effects on tourism, trade, and financial interconnections in the region with flooding across borders (United Nations, 2020).

The 2019-2020 economic survey presented a projected 5.0% rise in real GDP in 2019-2020 in Table 1, compared to a 6.8% growth rate in 2018-2019. The nominal GDP for 2019–2020 amounts to an approximate ₹204,400 billion and is 7.5% higher than the interim GDP forecasts for 2018–2019 (to ₹ 190 million).The National Statistics Office has announced revised GDP growth figures, in the first quarter from 8 percent to 7.1 percent, in the second quarter from 7 percent to 6.2 percent, as well asin the third quarter from 6.6 percent to 5.6 percent on 28 February 2020. (Economic Survey: 2020; p. 100). Goldman Sachs projected GDP growth at 1.6 percent, down 400 basis points due to 21days closures (Goldman Sachs, 2020). KPMG India has calculated that the GDP growth of India ranged from 5.3% to 5.7% for a fast retrograde COVID-19 pandemic worldwide by mid of May.In the second case, when India tracks the distribution of the virus, however, the global recession is important, the growth may range from 4% to 4.5%. KPMG India has forecast the GDP growth rate of India to fall below 3% in its study if the virus continues to spread and locks down (KPMG, 2020). Research by Motilal Oswal indicates that 14 to 19 basis points for annual growth could be shortened in a single lockout day (Oswal, 2020). The total cost of the shutdown in Barclays was

about USD120 billion, or four percent of GDP (Barclays, 2020). Former Indian Finance Minister Mr. Yashwant Sinha, estimate costs of a 21 daysnational lockdown at 1% point of GDP. A 2% decline in growth rates may be triggered by 2020 to 2021 by the global recession and potential uncertainties.

Table I. Growth of GYA and GDP at Constant Prices (2011-2012) Percentage

	2017-18 1st RE	2018-19 PE	2019-20 1st AE	Percentage Points Change in growth rate in 2019-20 Over 2018-19 (Increase(+)/Decrease (-))
GVA at basic prices	6.9	6.6	4.9	-1.7
Agriculture and allied sectors	5	2.9	2.8	-0.1
Industry	5.9	6.9	2.5	-4.4
Mining and quarrying	5.1	1.3	1.5	-0.2
Manufacturing	5.9	6.9	2	-5
Electricity, Gas, Water, supply and other Utility services	8.6	7	5.4	-1.6
Construction	5.6	8.7	3.2	-5.6
Services	8.1	7.5	6.9	-0.7
Trade ,Hotel, Transport, communication and services related to broadcasting	7.8	6.9	5.9	-1
Financial, real estate and professional services	6.2	7.4	6.4	-1.1
Public administration, defense and other services	11.9	8.6	9.1	-0.5
GDP at Market Prices	7.2	6.8	5	-1.8

Source: National Statistic Office, Year 2020
Notes: RE-Revised estimates, PE-provisional estimates and AE- advanced estimates

"Impact of COVID-19 Pandemic on Migratory Labour:

The "International Labour Organization" defines the worst global outbreak of the Coronavirus pandemic as the Second World War in its study.Approximately 400 million citizens in the informal economy in India (76.2% of total workers) are at deeper poverty risk as a result of the tragic influences of the virus. With half the world locked, 195 million full-time workers or 6.7 percent of working hours worldwide will be lost. A significant number of people work in low-paid, low-skilled positions with unexpected revenue losses (International LaborOrganization, 2020).

In rural India, seasonal labour migration is an all-encompassing reality. Millions of people move from countryside to commercial, urban as well as farming areas. In India major migration corridors in Maharashtra, Gujarat, Haryana, and Punjab are located from UP

and Bihar. Newer corridors are built from West Bengal, North East, and Odisha to Andhra Pradesh and Karnataka, from Tamil Nadu to Kerala, from MPs to Maharashtra & Gujarat as well as from Rajasthan to Gujarat. These immigrant workers are engaged in the brick kiln work (10 million), textile (11 million), domestic work (20 million), construction sector (40 million), mining, agriculture, and transportation(IIPS, 2001). 92.5% of employees missed 1 month of work during a lockdown. A study carried out between 27 March and 29 March by Jan Sahas (In North and Central India, 3196 migrant workers)demonstrates that 80% of migrant workers were afraid of food being lost before lockouts end on 14 April and will not be returning to work afterward (Figure 1).The study found, that 55% of migrants earn a regular salary from ₹200 to ₹400, with 39% earning a minimum salary of ₹400 to ₹600. This is lower than the minimum salary. Just 4% of employees earn a minimum wage rate of approximately ₹600, which is similar. They operate in situations of exploitation are always indebted, and save tiny of themselves. Around 49.2% of those surveyed said they had no ration, and 39.4 percent said they have a ration to do so for around 2 weeks.

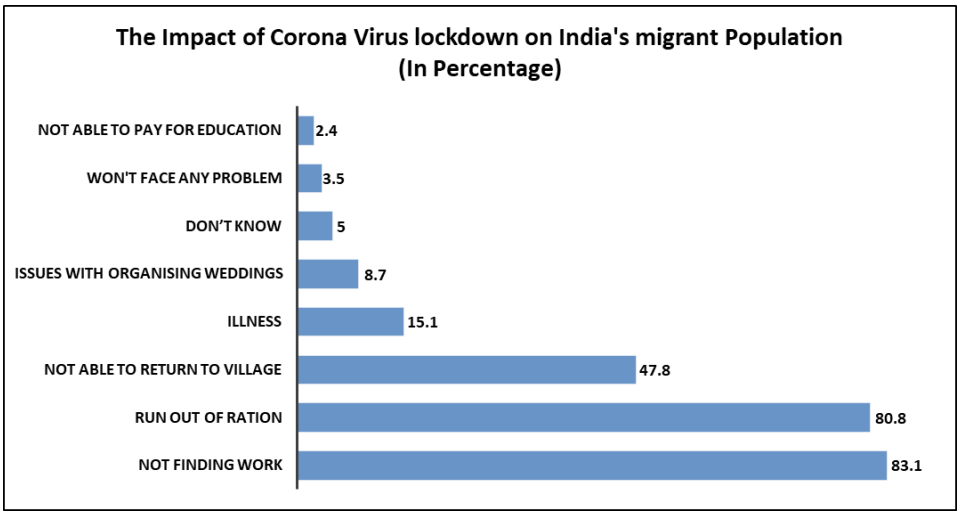


Fig. 1. COVID-19 impact on the population of migrants

In addition, the survey describes that approximately 99.2 percent of employees have "Aadhaar cards", 86.7 percent have bank accounts, 61.7 percent have "ration cards" and 23.7 percent have BPL: "Below Poverty Line" cards. While anaid package of $1,700 billion has been announced by the government, it will be difficult for most of them to benefit. These staff expected to obtain monthly assistance and financial support from the government (Jan Saahas Survey, 2020). The crisis saw such a floating migrant population on foot through the country's lock-in mass exodus.Their issues are largely due to job loss and the lack of a social security network. Despite the government's promise, they kept returning to their homes. The disparities, poverty, and social isolation of marginalized people fail to cope with this unexpected outbreak.

The Supreme Court ordered a progress report from the Center on steps taken to avoid migratory workers' mass migration to their villages. Sudden jobs displaced by coronavirus would have far-reaching implications for the economy of India.Any of these employees could not back to work in the industrialized city of Gurugram, Mumbai& Surat. In their marginal farms or in the vicinity they may look for jobs. As

labour is not possible immediately after a lockdown, MSMEs and the agriculture sector will face the effects of behavioral changes forced by lock-downs. Unless handled correctly by legislation, global unemployment, inequality, exclusion, medium, and long-term disparities may also be exacerbated by the pandemic of the COVID-19 social crisis.

Implications on Capital Markets, Global Oil Market and its Impact on India:

Fears of coronavirus have shaken financial markets around the world. Indian capital markets envisage movements of funds into western equity markets due to rate cuts as well as the stock market falls across the world. According to the NSDL info, FDIs have withdrawn enormous amounts in India—₹247.76 billion in the stock exchange and ₹140.50 billion in the short 13-day period 1 to 13 March 2020, from debt markets. In the next 6 months, financial markets will be extremely volatile due to massive capital flows from one sector to another worldwide.

A historic fall in oil demand has decreased crude oil prices from US$ 65 per barrel in January to 18 years below 22 USD per barrel in March. For all US $5 a barrel of declining prices of crude oil has been estimated for India to save the US $7 to US$8 billion. Prices of crude oil will decline the Current Account Deficit in India by GDP 1.55 from 2019 to 2020 (Economic Survey, 2020). But India's capital flows will surpass the current-account deficit savings potential. The average INR to US dollar exchange rate was ₹ 70.4 per US dollar however, the mentalobstacle to ₹75 per US dollar has already been stated. In the future, rupees (INR) could depreciate further, if Indian capital outflows persist.

Policy and Programme Implications:

Fiscal and Monetary Measures:

The outbreak of Coronavirus includes concerted efforts to deal with it in fiscal and monetary policy. Fiscal actions include payment of the pandemic health bill. Offering testing kits, gloves, medicines, quarantine wards, ICU beds, ventilators, personal protection equipment, masks, and other equipment will dramatically increase health care expenditure. In India, public health expenditure is 1.1% of GDP. In the current fiscal year, it is likely to rise. The State has announced a ₹1700 billion aid package to allow transfers of cash to the needy and disadvantaged parts of society. At least 2 percent of GDP can be reduced in tax receipts. Both of these fiscal policies will raise the fiscal deficit by 1–1.5%, currently 3.2% as economists forecast.

The crisis resulting from the spread of the coronavirus would reduce investment and demand for consumption. In the tradition, the market-based components of GDP are 72.1% consumed, of which only 11.9% are public consumption as shown in Table 2. The major risk to economic growth is an anxiety-led reluctance to spend.So as to raise demand, the government would have to raise expenditure. In order to improve investment, support must be given to various sectors. As part of a relaxed monetary policy, the Repo Rate was lowered by 75 basis points. The Federal Reserve had lowered its rate of interest by 1% point and agreed to retain it in the USA to 0-0.25%. Monetary policy is less efficient in the management of a pandemic as liquidity is not the only problem.The economic turmoil, as well as uncertainty of the future, minimize the feeling of investment. Frugality caused by anxiety between companies and stockholders reduces the appetite for investment.

Table 2. Consumption and Investment Demand in India

	2017-18 1st RE	**2018-19 PE**	**2019-20 1st AE**	**Percentage Points Change in growth rate in 19-20 over 2018-19 (Increase (+)/Decrease (-)**
Total Consumption	70.0	70.6	72.1	1.5
Government Consumption	11.0	11.2	11.9	0.7
Private Consumption	59.0	59.4	60.2	0.8
Gross Fixed Capital Formation	28.6	29.3	28.1	-1.2
Net Exports	-3.2	-3.9	-2.8	1.1
Exports of Goods and Services	18.8	19.7	18.4	-1.3
Imports of Goods and Services	22.0	23.6	21.2	-2.4

Source: National Statistical Office. Year 2020, Consumption and Investment Demand
Notes: RE- Revised estimates, PE -provisional estimates and AE-estimates.

Impact on Start-Ups and Micro, Small and Medium Enterprises (MSMEs)

"Micro, small, and medium Enterprises" with 114 million staff and 30% of GDP created more than 90 % of India's employment (Radhika Pandey, 2020) risks a serious cash shortage by extending the lockdown to eight weeks. Several of these MSMEs have loan commitments and EMIs payable on a monthly basis. Many may just vanish if the lockdown disturbs their cash cycles, and in such a case there are fixed costs. You need a loan repayment moratorium. RBI has made funding available to financial non-banking firms, some of which offer MSMEs finance.Furthermore, the flow of destructive goods is disrupted and thus the corporations are at immense losses. Without a thriving MSME market, India cannot have sustainable and real growth. The COVID-19 crisis would also test start-up resilience in India. Cross-border fundraising is the base for startups. Many other founders see their companies stopping. The receivable is spiraling and they have painful expenses to undertake control steps that must be taken in their undertakings. The government must make funds available for the industry, as the global flows of capital could be confined to venture capital firms and supports for a little longer.

Economic Inequity and a Rethink on Developmental Paradigm for India

The survey on "Income Inequalities in India" by the OXFAM "Oxford Committee on Famine Relief"in 2019produces some observations on the asymmetrical model of growth in India. In the survey, 73 percent of the wealth produced in the country accounted for the richest 1% of the population from 2017–2018. This group's wealth expanded by ₹20913 billion, comparable to the central government's budget in the same year. The richest 1% in the world possesses 953 million (below 70 percent of the population of the country) more than four times the income. In 2017-2018, the income of six hundred &seventy million Indians who make up the poorest half of the population increased by 1%. It is apparent that certain people in society have taken advantage of growth. High-income differences in this country illustrate why a significant proportion of the

population belonging to the living sector demands nothing more than food and shelter survival needs.A natural or pandemic economic shock drives back several into the subsistence industry. The COVID-19 pandemic has contributed to the country's leading growth. The fall of day-to-day salaries has forced much of the society to combat famine without anassistance measure is given to them.

DISCUSSION

A micro virus erodes riches, corrodes consumer trust, slows down investment and private consumption, disrupts employment, and distorted markets. The 2019–2020 Economic Study set out proposals to encourage network product exports, to incorporate "assemble in India for the world" into making India generate 40 million jobs by achieving the 5 trillion-strong economyby 2025. ("Economic Survey, 2020, p. 100"). The pandemic of COVID-19 compelled us to reconsider this strategy. Integration into chains of global supply also renders the country vulnerable to disruptions shocks in global supply. The study stated: "As no other country could match China in the wealth of its labour", the space in labor-intensive industries must be emptied. The COVID-19 pandemic threatened the foundation of global manufacturing, as Chinese worker's migrant mobility was limited and action of output halted. Half of humanity is currently being locked, and the loss of revenue in Chinese businesses in the rest of the world would lead to layoffs, investment cuts, and a serious recession if the lockdown continues. A spike in product demand can increase prices when the virus is not contained, even when the world supply shock is present and the unemployment rate is high when stagflation is in effect. The Indian economy is largely safeguarded against these global upheavals because India's manufacturer is not active in global supply chains except in a few sectors.

Economists have projected different scenarios for the socio-economic effects of virus outbreaks and containment efforts through models of simulation. The first possibility is a viral containment by the end of May, and the third quarter saves the economy very rapidly.The second case is the spread of the virus to the population, which will take longer to control, and will not enable economic recovery until September. In the second case, basic goods will be a shortage, resulting in shocks to demand and inflation. A longer downtime would affect the supply of production companies and eliminate profits in the year. Healthcare costs will also rise and relief programmes should be increased. The third case is a 2nd or 3rd virus epidemic that happens during the year and all attempts to keep it safe. The third scenario is not regulated without the production of herd immunity or the inventing of a vaccine. If this does not happen, there will be a deep economic decline, high unemployment rates, major death losses, and millions of people forced into poverty.

Economists say that if the poor don't die of the corona, they'll be starving if the lockout continues.There is a special framework in the Indian economy. 50% of households in Indian are still directly or indirectly dependent on agriculture. People are not entitled to unemployment benefits in the livelihood sector as thesocial safety net they are not included. They expect the administration to look after their food as well asa shelter during tough times. When basic requirements are taken care of, they can bounce back. In order not to suffer the poor and helpless, Government would have to make relief measures successful. Many philanthropists have established a private social security network as well.

However, several socio-economic and behavioral factors will rely upon employees after being lockdown back to farm and manufacturing houses.Labour can be hesitant

to return to other countries for jobs. They may choose to look for jobs in the vicinity or rely on marginal farms.The consequence is an industrial labour shortage. Industrial buildings and the construction industry will commence development by lifting a partial lockdown. Government and industry must put their faith in workers by ensuring that they are safe and economic to get them to work again. Returning the migrant workers to work will be a significant factor after the lock is removed, although if resistance is present, businesses are forced to work in a sub-optimal way, leading to a supply shock.

India must rethink its model for growth. Fair health and education access is an essential prerequisite for sustainable growth. A significant lesson learned by the pandemic of COVID-19 from policymakers in India is to improve the distribution of resources and reducing the disparity of incomes in the sectors.The COVID-19 has also taught a lesson that people are dependent on the agriculture sector in a crisis. India has a wide arable region however there are systemic problems in the agriculture sector.Even so, 50% of households still rely directly or indirectly on the agricultural sector.Enhanced aid to MSMEs, enhanced public health and training expenditure, and make the labour force a structured economic employee are some of the key milestones that the country has to act.

The pandemic of COVID-19 presented the opportunity to accelerate the labour reform process. Labour reforms would enable financial inclusion to raise incomes and minimize unemployment.

Social protection was primarily community centered in India before the advent of the modern state. In the village and in the town the society used to look after the aged, the needy, and the helpless. The sharing of food or food was an essential part of our culture and part of our everyday life as alms. Several charitable efforts were performed for the community by people with wealth in the society. The State offered the funding at the time of the crisishowever; the local philanthropists offered a great deal of support. Community-based social security services have been discontinued since the democratic state was formed. Measures of social security are divided. The time has come to offerall social security cardsin the country with a unique identification number, and financial inclusion of 100%. This could be easily accomplished in India by the accessibility of advanced digital technology.Mass migration of migrant workers, reports about some of them dying as a result of miles of sunlight, and a lot of people still starving for days are some of the worst lockdown photographs.Duplication of relief activities without a structured social safety net and some of the facts that the pandemic brought on was without hitting the final mile where some of the population is left out.

It is time for every citizen of the country to build a strong national-sponsored social security net.

Conclusion

The overall spiraling COVID-19 pandemic has unpredictably and ambiguously skewed the prosperous global economy. But the current downturn seemed to vary dramatically mainly from previous recessions, that upset the world's economic order. Although the conglomerates, companies,nations,and multinationals fail to comprehend the significance of the outbreak, there is no question that it is time to plan for a future that is prosperous and structurally more feasible for working as well asthe living.

Although the situation was unprecedented particularly during lock-down times, the economy has been seriously affected; the nation will be forced to take its lead in implementing fiscal measures. Security of

life and livelihoods is important according to the national government. After the workers are tested, economic activity should gradually begin. The industry must introduce strict preventive measures to protect the health of the employees. While policies and changes of government are needed to rescue the economy appropriately, communities, civil society,and Industry have an equal role in preserving balance. The principles of social isolation, the avoidance or cancellation of sets, and the usage of masks and sanitary devices oughtto be a part of life before the virus can be eradicated. The economy conflicts with human social conduct at this moment, but it is not government alone that has responsibility for bringing back economic activity.

The demand shock and the collapse of the market were attributed to a supply shock and the essence of the shutdown is unique for COVID-19. The economic recovery is dictated by the timing and scale of government aid and corporate debt and how businesses and markets cope with reduced demand. State help for the neediest (mainly established by unorganized industry, immigrants,as well as vulnerable populations) is a vital step towards saving many lives.

Each crisis, nevertheless, offers a unique opportunity for the growth of a human being, a culture, and a society to represent. In order for Indian economies to follow sustainable development models based on their autonomy and inclusive structures that are an environmental-friendly, the COVID 19 pandemic has a strong message.

References

1. Barclays. (2020). How will India lockdown play out for economy & markets: 4 scenarios. EconomicTimes. https://economictimes.indiatimes.com/markets/stocks/news/how-will-india-lockdown-play-out-for-economy-markets-4-scenarios/articleshow/74804087.cms
Google Scholar

2. Bloom, E., Wit, V. d., Jose, M. J.-S. (2005). Potential economic impact of an Avian Flu Pandemic on Asia. Asian Development Bank. https://www.think-asia.org/handle/11540/2165.
Google Scholar

3. Economic Survey. (2020). Key indicators. Government of India.
Google Scholar

4. Economic Survey. (2020). Chapter 5. Government of India.
Google Scholar

5. Godman Sachs. (2020). Goldman Sachs estimates India's GDP growth rate at 1.6%, predicts RBI will reduce interest rates by another 50 basis points. https://www.news18.com/news/business/goldman-sachs-estimates-indias-gdp-growth-rate-at-1-6-predicts-rbi-will-reduce-interest-rates-2569465.html
Google Scholar

6. IIPS. (2001). Major net migration flows. Indian Institute of Population Sciences.
Google Scholar

7. International Labour Organization. (2020). COVID-19 and the world of work, impact and policy responses. ILO.
Google Scholar

8. Jagan Mohan, M. (2020). Travel and tourism industry in India, statistics and facts. https://www.statista.com/topics/2076/travel-and-tourism-industry-in-india/
Google Scholar

9. Jan Saahas Survey. (2020). Lockdown is only the beginning of misery for India's migrant labourers. Quartz.com. https://qz.com/india/1833814/coronavirus-lockdown-hits-india-migrant-workers-pay-food-supply/

Google Scholar
10. KPMG. (2020). Coronavirus: India's GDP growth may fall below 3% if lockdown extends, says KPMG report. Business Today. https://www.businesstoday.in/current/economy-politics/coronavirus-india-gdp-growth-may-fall-below-3-if-lockdown-extends-says-kpmg-report/story/400135.html
Google Scholar
11. Lee, J.-W., McKibbin., J. W. (2004). Estimating the global economic costs of SARS. In Knobler, S., Mahmoud, A., Lemon, S., Mack, A., Sivitz, L., Oberholtzer, K. (Eds.), Learning from SARS: Preparing for the next disease outbreak. Institute of Medicine (US) Forum on Microbial Threats. https://www.ncbi.nlm.nih.gov/books/NBK92473/
Google Scholar
12. Martin Karlsson, T. N. (2014, July). The impact of the 1918 Spanish flu epidemic on economic performance in Sweden: An investigation into the consequences of an extraordinary mortality shock. Journal of Health Economics. https://www.sciencedirect.com/science/article/pii/S0167629614000344
Google Scholar
13. National Investment Promotion and Facilitation Agency. (2020). Invest India. https://www.investindia.gov.in/sector/retail-e-commerce
Google Scholar
14. Oswal, M. (2020, March 26). With 75% economy under lockdown, analysts see sharp fall in GDP. Business Standard. https://www.business-standard.com/article/economy-policy/with-75-economy-under-lockdown-analysts-see-sharp-fall-in-gdp-120032600231_1.html
Google Scholar
15. Radhika Pandey, A. P. (2020). Covid-19 and MSMEs: The 'identification' problem. Ideas for India for More Evidence Based Policy. https://www.ideasforindia.in/topics/macroeconomics/covid-19-and-the-msme-sector-the-identification-problem.html
Google Scholar
16. Sonal Verma, A. N. (2020). COVID-19's impact on the world economy. Nomura.
Google Schola
17. The Economist. (2020, February). Apple's Chinese troubles. https://www.economist.com/business/2020/02/20/apples-chinese-troubles
Google Scholar
18. The Economist. (2020, February 15). The new coronavirus could have a lasting impact on global supply chains. https://www.economist.com/international/2020/02/15/the-new-coronavirus-could-have-a-lasting-impact-on-global-supply-chains?cid1=cust/ednew/n/bl/n/2020/02/29n/owned/n/n/nwl/n/n/AP/415278/n
Google Scholar
19. The Hindu. (2019). Unemployment rate at 45-year high, confirms Labour Ministry data.
Google Scholar
20. United Nations. (2020). *Economic and social survey of Asia and the Pacific*. Economic and Social Commission for Asia and the Pacific Decade of Action (ESCAP).
Google Scholar | Crossref

A REVIEW ON QUALITY CIRCLE AND ITS VALUE

V. N. Sayankar
Neville Wadia Institute of Management Studies and Research, Pune.
vnsayankar@gmail.com

ABSTRACT

A Quality Circle is a management strategy for managing and improving an organization's overall quality. A Quality Circle's strength comes from the mutual trust that exists between managers and employees, which leads to a higher degree of mutual understanding. The goal of a Quality Circle is to foster positive relationships with employees so that they are more engaged and devoted to their work. Quality, productivity, and cost will all improve as a result. The Quality Circle concept is based on mutual respect, with no room for preconceptions or mistrust. A manager is the most qualified person to lead a small group. Employees that participate in Quality Circles can put all of their skills, knowledge, and creativity to use to improve their activities. They are able to turn difficult difficulties into possibilities with the solution they supply.

Keywords: *Quality, Mutual Trust , Positive Relationship, Productivity , Creativity*

Introduction

A group of workers known as a Quality Circle (QC) or Quality Control Circle. These workers perform the same or similar tasks. It is an employee work group that sets the meeting schedule and meets on a regular basis to discuss quality issues. In most cases, QC refers to a small group of people who work in the same area. This is due to the fact that individuals who perform similar tasks are familiar with the issues they face. The QC's size should not be too large so that certain members are unable to participate evocatively in its sessions. Normally, a QC with six to eight members is deemed ideal.

In the Quality Circles, employees are usually permitted to choose their own topics. Improvements in workplace health and safety, improvements in the workplace, and improvements in production processes and product design are all common topics that are ideal for debate in circles.

They meet on business time on a regular basis and are instructed by knowledgeable individuals (usually designated as facilitators). They offer their recommendations to management; workers then apply the solutions to improve the organization's performance and motivate personnel.

When employees are eager to collaborate to explain and fix quality issues, they are more devoted and dedicated to their firm. This is the simplest way when dealing with smaller groups. It is essential for this that they join willingly in the quality circle and meet on a regular basis. It is vital that the members of the quality circle have a deep understanding of the subject and are qualified facilitators as well as people and employment relations professionals.

The notion of quality control was developed in the United States and spread to Japan in the 1950s. The principle of quality control allows Japanese enterprises to produce high-quality goods at affordable prices.

Professor Kaoru Ishikawa defined the term Quality Circles most succinctly in his 1988 manual, "Total Quality Control (TQC) is a word used to describe the process of ensuring The Japanese Way of Life "In 1960, the Japanese Union of Scientists and Engineers published a report that was widely distributed throughout Japanese industry.

Objectıves Of The Study

1. To study the concept of Quality Circle.
2. To understand the features of Quality Circle
3. To examine the Quality Circle Tools
4. To evaluate the benefits of Quality Circles.

Research Methodology

This is undeniably a practical oriented paper, a combination of experience, practice and actual happenings at the work place. Hence author of this paper has endured an extensive study of literature and is rational with recent Quality Circle Processes. The main source of primary information is knowhow of industry and academia. The secondary data and basic primary pragmatic information has been collected from appropriate primary sources and farsightedly used to arrive at meaningful findings and prolific conclusion. Simple statistical tools, such as mean, average, tables etc., are used wherever necessary to right size and increase the trustworthiness of the information.

Significance Of The Study

Hence by virtue of this study, efforts are being made to understand the concept, benefits, features of Quality Circle. Quality management is concerned not only with the quality of a product or service, but also with the means of obtaining it. To achieve more consistent quality, quality management employs quality assurance and control of processes as well as products. To achieve product quality, management focuses on the establishment of Quality Circles within the business.

Statement Of The Problem

The dynamism and global competition has a lot more subsistence challenges with leadership tag. The innovative technology, management excellence, increased customer test and effective services in the changing environment are really great to get best results out of that. Hence it is necessary to maintain the quality culture in the organization and focuses on the continual improvement. Thus, looking to the societal need, researcher has made a sincere attempt, by virtue of this paper to focus on the quality circle importance and its benefits to the organization.

Literature Review; A Review On Quality Circle And Its Value

A QC is a assembly of workforces who share or have comparable job responsibilities. They meet on a regular basis to discuss various techniques to detecting and addressing problems related to their professions. These groups of people, mentioned to as a (QC) Cycle, are generally lesser (3-10) and lead by the supervisor.

Modest modifications to in what way work is done can be espoused by assembly accord, however larger complications approximately always demand presenting the answer to management teams.

History Of Quality Circles

QC were originated in the 1950s by W. Edwards Deming, who pioneered the concept. Toyota loved the concept and began implementing it in a number of ways across the company's manufacturing sites and other departments. Companies all across the world began to use this strategy, and by 1978, there were over a million circles in use, with 10 million people in Japan alone.

Quality Circles have fallen out of favour in many Western countries in recent decades, but they were a popular alternative in the year 2000. (1960s, 1970s, and 1980s). Some businesses are realising that Quality Circles may be effective again, especially when combined with other approaches such as Lean, Six Sigma, and others. QC was founded with the following goals in mind:

- An increase in the quality of the organization's products.
- Improvements in production procedures.
- Training and development of personnel who work in quality control.
- Increasing employee morale.
- Show humanity and create a positive work environment where people want to come to work.

Features Of Quality Circle

The following are the primary characteristics of QC:

1. **Voluntary Groups**:
QC is a self-organized group of employees that all work in the same department. There is no compulsion on employees to join QC from anywhere.

2. **Small Size:** The QC is generally lesser, with 6-8 members.

3. **Weekly Meetings**: QC assemblies are apprehended once a week for about an hour. Associates assemble in working hours, usually at the conclusion of the day, in coordination with the boss. Meeting times are usually arranged in advance in consultation with the manager and members.

4. **Agendas that are self-contained:** Each QC has its own agenda and terms of reference. As a result, each QC discusses its own problems and takes corrective measures.

5. Quality Focused:
By its own nature and goal, QC is solely concerned with quality issues. This is because the ultimate goal of QC is to increase product quality and service life.

QUALITY CIRCLE TOOLS

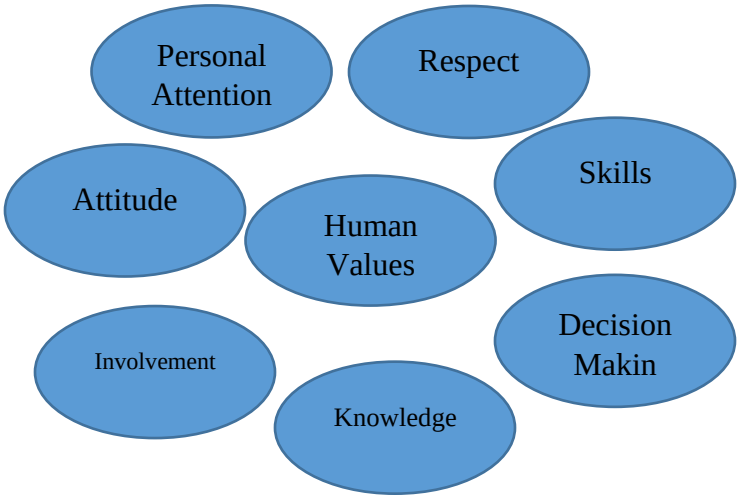
A quality control circle is allowed to use any tools they desire to improve their roles. Some of these circles are more casual, with participants just talking and providing solutions to various professional difficulties. In this case, a simple notepad may be sufficient. While this is an excellent place to begin a quality control circle, it would be ideal if it evolved into something more official where more particular issues could be addressed.

When this occurs, some of the quality improvement tools listed below are routinely utilised to assist in identifying the root causes of problems and how to remedy them.

1. Flowcharts
2. Scatter Plots
3. Run Charts
4. Graphical Tools
5. Process Mapping Tools
6. Pareto Charts
7. Fishbone Diagrams

There are a lot of additional potential strategies that a group could apply depending on the specific difficulties that they are aiming to tackle. When equipped with the required tools, a quality control circle may more efficiently uncover issues and propose solutions, which is the primary goal of these groups.

Quality Circles And Its Value



To ensure that things are truly having a positive influence in the workplace, quality circles must collect data and track their progress. When groups of people from one department get together and discuss solutions to difficulties, it might be tempting to try to get an agreement on how something should be done and then implement it right away.

This can cause a plethora of problems, but even if it does turn out to be a good answer, determining why it succeeded is difficult until data is collected. Before adopting a solution, the group should gather data on how things are currently working in order to establish a baseline.

By having all of the information available before making adjustments, the Quality Circle will be able to demonstrate exactly how much progress they have generated. This data will help to justify future process improvement activities and ensure that the corporation continues to support the concept of quality circles in the facility. Gathering this information may appear to take more time at first, but the work will be well worth it.

Benefits Of Quality Circles

In the QCs, there are no monetary incentives. However, there are numerous more benefits that primarily benefit the individual and, as a result, the business. These are the following:

• **Self-development**: QCs assist members in developing self-confidence, changing attitudes, and gaining a sense of accomplishment.

• **Social development**: The QC programme is a consultative and participatory programme in which all participants collaborate. This interaction helps to the growth of harmony.

• **Possibility of learning new knowledge**: QC members can gain new knowledge by sharing their thoughts, opinions, and experiences.

• **Leadership potential**: Because any member has the capacity to become a leader, each member is given the opportunity to develop his or her own leadership potential.

•**Improved communication skills:** Members' communication skills are improved through joint problem solving and management presentations.

• **Job satisfaction:** QCs foster creativity by making use of an individual's underdeveloped intellectual potential. Individuals also engage in non-work-related activities, which increases their self-esteem and gives them with a high degree of job satisfaction.

• **A stress-free work environment**: QC's promotes a stress-free environment in which each employee loves, understands, and collaborates with others.

• **Organizational benefits**: When the individual benefits are combined, they have a synergistic effect, resulting in cost savings, waste reduction, enhanced quality, and greater productivity.

All of these benefits are long-term and result in progress over time.

Findings

The Quality Circle is comprised of individuals who conduct similar duties. This, however, does not exclude the circle from talking with specialists or others. In reality, ideas and solutions can come from everywhere. In theory, quality circles are groups of workers who perform comparable work, but they can be made up of people from other positions as long as they operate in the same area and can identify common problems. The essential perception of the quality circle is that it should be a homogeneous and coherent unit working toward a single goal.

Conclusion

Quality circles have proven to be a blessing in disguise for firms in practise. Meetings may be held after a maintenance pause, a job transfer, or after the weekly work plan has been finished. Even in Japan (where this concept originated), meeting duration and frequency vary. It is advised that sessions last at least an hour and occur at least once a week. The circle members, on the other hand, should decide on the frequency and duration of each meeting, taking into account all parameters such as the severity of the problem, the urgency of the problem, the number of difficulties, and so on.

Quality circles have proven to be a blessing in disguise for firms in practise. Meetings may be held after a maintenance pause, a job transfer, or after the weekly work plan has been finished. They might gather together at the start or end of the shift, or around lunchtime

References

1. Besterfield, D. H. (2006). *Quality control*. New Delhi: Pearson Education India.
2. Charantimath, P. M. (2011). *Total quality management*. Chennai: Pearson Education India.
3. Evans, J. R., & Lindsay, W. M. (2013). *Managing for quality and performance excellence*. Cengage Learning.
4. H., B. D. (2012). *Total quality management,*. New Delhi: Pearson Education India.
5. Lakhe, R. M. (2008). *TQM in the service sector*. Jaico Publishing House.
6. Mukherjee, P. N. (2010). *Total quality management*. Ddelhi: PHI Learning Pvt.
7. https://en.wikipedia.org/wiki/Quality_circle
8. http://www.yourarticlelibrary.com/employee-management/quality-circles-qcs-definition-objectives-and-other-details/35388
9. https://www.toolshero.com/quality-management/quality-circle/
10. https://www.creativesafetysupply.com/articles/quality-circle/
10. http://www.whatishumanresource.com/quality-circles
11. https://qcfi.in/introduction-of-quality-circle-in-india/
12. http://shodhganga.inflibnet.ac.in/bitstream/10603/15949/11/11_chapter%203.pdf
13. https://accountlearning.com/quality-circles-meaning-characteristics-advantages-problems/

AWARENESS OF MATERNAL CARE AMONG REPRODUCTIVE WOMEN IN BARAMATI

[1]P. Mohite, [2]N. K. Dhane
[1]Shri Jagdishprasad Jhabarmal Tibrewala University Jhunjhunu, Rajasthan.
[2]Department of Statistics, Tuljaram Chaturchand College, Baramati.
[1]pmprity@gmail.com; [2]neetadhane@gmail.com

ABSTRACT

The main aim of this paper is to investigate awareness of maternal care among reproductive women in Baramati and to find factors which significantly affect the woman's maternal health during pregnancy. Data was collected through face-to-face interviews using questionnaire from 200 respondents. The findings are, on an average 72% of the reproductive women in Baramati are aware of maternal health care. Type of delivery may depend on the factors Mothers age, Living Area, Number of family members, Mothers age at marriage, Mothers sugar, Mothers weight, Pregnancy period till the delivery and Number of ANC visits. Baby's weight may depend on the Pregnancy period till the delivery. Number of ANC visits may depend on the Knowledge about danger sign of pregnancy. The study will further help the medical practitioners to improve upon the ways to aware the women regarding the Maternal Health care program undertaken by the Government of India.

Keywords: *Maternal Health Care Service, ANC, Reproductive Women.*

Introduction

The direct cause of the maternal deaths in India are due to the factors such as, excessive bleeding, infections, pregnancy induced hypertension, obstructed labor, and unsafe abortions. These factors arise in the delivery period due to lack of knowledge regarding the maternal health care programs for the reproductive women carried out in the hospitals.

Maternal mortality rate in India continues to be a National challenge despite of the various measures taken by the Indian government, nonprofit organizations in and outside the country including the World Health Organization.

Women's health throughout pregnancy, delivery, and the postpartum period is referred to as maternal health. One of the most important aspects of promoting healthy motherhood is antenatal care. Antenatal care (ANC) is prenatal health care provided by a doctor or other health professional at a medical institution or at home. Minimum four antenatal checkups are needed for pregnant woman.

The objective of the study is to find out the awareness of the maternal care among reproductive women in Baramati and to investigate factors which affect the time of ANC visits, factors which affect the weight of delivered baby, and factors which affect the type of delivery.

Literature Review

1. Joanna Marie S.Alvaro & Ryan Michael F. Oducada (2015),carried out analysis and the study reveals that most of the respondents were highly aware of the Rural Health Unit (RHU) as a BEmONC facility and its services, most of them have utilized only the prenatal package also shows significant relationship between utilization of BEmONC services and employment status, income level, educational status, OB score, pregnancy status and awareness of services.
2. A.R.Johnson et.al (2015), carried out study which shows maximum awareness for maternal nutrition supplements under ICDS , the awareness of the schemes was significantly associated with education of mother, socio economic status of family, gestational age and parity index, awareness of schemes among antenatal mothers range from 0% to 83.6%.
3. W S Kingori et al. (2016), shows age, education, religion, marital status and employments have significant influence on awareness and level of education is the best predictor of awareness of maternal health systems initiatives, in the area of awareness of maternal health systems initiatives and FMS had the lowest awareness level.

Methods

Discussions were carried out with various gynecologists from Baramati to form the questionnaire. The questionnaire contains 55

questions. Two well-known hospitals from Baramati namely Rui Hospital and Silver Jubeli Hospital consider for the study. 200 married women of reproductive age who had at least one child or had delivered the last child within two years from the period of data collection (during Nov 2015 to Dec 2015) were interviewed.

Materials

The data entry was done on MS-Excel and the statistical analysis was carried out by using R Software. Chi square test of independence and Binary Logistic model are used for the statistical analysis.

Data Analysis

Table 1: Chi-Square tests for Delivery Type (See Appendix)

Source: Primary Data

Table 2: Chi-Square tests for ANC Visits

Selected Variables		ANC Visits			χ^2 Cal	p-Value
		≤ 2	3 to 6	>6		
Living Area	Rural	28	33	93	0.112	0.946
	Urban	8	9	29		
Distance	< 10km	23	24	58	3.243	0.198
	≥ 10 km	13	18	63		
Knowledge about danger sign of pregnancy	Poor	17	16	21	16.021	0
	Better	19	26	101		

Source: Primary Data

Table 3: Chi-Square tests for Baby's weight

Selected Variables		Baby's Weight		χ^2 Cal	p-Value
		< 2.5	≥ 2.5		
Family Type	Joint	29	99	0.568	0.443
	Nuclear	13	59		
Mothers weight	< 45	13	44	0.157	0.692
	≥ 45	29	114		
Pregnancy Period	274-281	35	106	4.21	0.04
	<274 and >281	7	52		
New born baby's sex	Female	24	65	3.441	0.064
	Male	18	93		
Child Order	1	18	77	5.061	0.08
	2	21	72		
	3 and 4	5	5		
USE	≥ 3	20	70	0.147	0.701
	> 3	22	88		

Source: Primary Data

Table 4: Logistic Model by considering all the predictors: Type of delivery

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-19.543	9.462	-2.07	0.039**			
MOTHERS Age	0.3295	0.1322	2.49	0.013**	1.39	1.07	1.80
LIVING Area	1.5027	0.4603	3.26	0.001***	4.49	1.82	11.08
FAMILY TYpe	-0.4693	0.5624	-0.83	0.404	0.63	0.21	1.88
FAMILY Member	-0.1604	0.1158	-1.39	0.166	0.85	0.68	1.07
WORKING Status	0.0988	0.4677	0.21	0.833	1.10	0.44	2.76
FATHERSAge	-0.00481	0.08100	-0.06	0.953	1.00	0.85	1.17
MARRIAGE Age	-0.2602	0.1336	-1.95	0.052*	0.77	0.59	1.00
MOTHERS Age at Marriage	-0.3186	0.1394	-2.29	0.022**	0.73	0.55	0.96
MOTHERS Hb	-0.3128	0.1386	-2.26	0.024**	0.73	0.56	0.96
MothersSugar	-0.01686	0.01168	-1.44	0.149	0.98	0.96	1.01
MothersWeight	0.07261	0.02162	3.36	0.001***	1.08	1.03	1.12
PREG.PER	0.06348	0.03315	1.91	0.056*	1.07	1.00	1.14
CHILD Order	0.2147	0.3304	0.65	0.516	1.24	0.65	2.37
BABY WEIGHT	0.3093	0.3489	0.89	0.375	1.36	0.69	2.70
ANC Visits	0.23345	0.06746	3.46	0.001***	1.26	1.11	1.44
USE	-0.0047	0.1422	-0.03	0.974	1.00	0.75	1.32
PLANNED Preg	0.3856	0.4568	0.84	0.399	1.47	0.60	3.60
VACCINAT	0.2685	0.4743	0.57	0.571	1.31	0.52	3.31
KNOWLEDG Abt Danger Sign Of Pregnancy	-0.4598	0.4731	-0.97	0.331	0.63	0.25	1.60

Log-Likelihood = -97.337

Test that all slopes are zero: G = 63.989, DF = 20, P-Value = 0.000

(ANC: Antenatal care *** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<

Source: Primary Data

Table 5: The Logistic Model is: Type of Delivery

=-19.543+0.3295*Mothers Age+1.5027*Living Area-0.4693*Family Type-0.1604*FamilyMembers+0.0988*Working Status-0.00481*Fathers Age-0.2602*Marriage age -0.3186*Mothers age at marriage -0.3128*Mothers Hb -0.01686*Mothers Sugar + 0.07261* Mothers Weight +0.06348*Pregnancy Period +0.2147*Child order +0.3093*Babys Weight + 0.23345*ANCVisits-0.0047*USE+0.3856*Planned Pregnancy +0.2685*Vaccination -0.4598*Knowledge about danger sign pregnancy.

Source: Primary Data

Table 6: Logistic Model by Considering the Significant Predictors from Model I: Type of Delivery

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-18.478	9.253	-2.00	0.046**			
Mothers Age	0.3133	0.1302	2.41	0.016**	1.37	1.06	1.77
Living Area	1.6867	0.4442	3.80	0.000***	5.40	2.26	12.90
Fathers Age	-0.02154	0.08067	-0.27	0.789	0.98	0.84	1.15
Marriage Age	-0.2218	0.1287	-1.72	0.085*	0.80	0.62	1.03
Mothers age at marriage	-0.2958	.1359	-2.18	0.030**	0.74	0.57	0.97
Mothers Hb	-0.3043	0.1370	-2.22	0.026**	0.74	0.56	0.96
MothersSugar	-0.01484	0.01155	-1.28	0.199	0.99	0.96	1.01
MothersWeight	0.07125	0.02138	3.33	0.001***	1.07	1.03	1.12
Pregnancy Per	0.05644	0.03214	1.76	0.079*	1.06	0.99	1.13
Child order	0.1622	0.3171	0.51	0.609	1.18	0.63	2.19
BabysWeight	0.3083	0.3472	0.89	0.375	1.36	0.69	2.69
ANC Visits	0.22792	0.06665	3.42	0.001***	1.26	1.10	1.43
USE	-0.0250	0.1398	-0.18	0.858	0.98	0.74	1.28
Planned Preg	0.4860	0.4439	1.09	0.274	1.63	0.68	3.88
Vaccination	0.2347	0.4594	0.51	0.609	1.26	0.51	3.11
Knowledge Abt-Danger Sign of Preg	-0.4912	0.4648	-1.06	0.291	0.61	0.25	1.52

Log-Likelihood = -98.472

Test that all slopes are zero: G = 61.720, DF = 17, P-Value = 0.000

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 7: Descriptors of the Logistic Model

Type of Delivery = -18.478 +0.3133 *Mothers Age+1.6867 *Living Area-0.02154 *Fathers Age-0.2218 *Marriage Age-0.2958* Mothers age at marriage -0.3043 *Mothers Hb -0.01484*Mothers Sugar + 0.07125 * Mothers Weight + 0.05644 *Pregnancy Period + 0.1622 *Child order + 0.3083 *Baby's Weight + 0.22792 *ANCVisits-0.0250 *USE+0.4860 *Planned Pregnancy +0.2347 *Vaccination -0.4912 *Knowledge about danger sign pregnancy.

Source: Primary Data

Table 8: Logistic Model by considering the significant predictors from model II: Type of delivery

Predictor	Coef	SE Coef	Z	P	Ratio	Lower	Upper
Constant	-20.047	8.851	-2.26	0.024**			
MOTHERS	0.2939	0.1129	2.60	0.009***	1.34	1.08	1.67
LIVING A	1.6126	0.4249	3.80	0.000***	5.02	2.18	11.53
MARRIAGE	-0.1914	0.1178	-1.63	0.104*	0.83	0.66	1.04
MOTHERS	-0.2748	0.1247	-2.20	0.028**	0.76	0.59	0.97
MOTHERS	-0.3271	0.1356	-2.41	0.016**	0.72	0.55	0.94
Mothers	0.06881	0.02028	3.39	0.001***	1.07	1.03	1.11
PREG.PER	0.05820	0.03106	1.87	0.061*	1.06	1.00	1.13
BABY WEI	0.2822	0.3387	0.83	0.405	1.33	0.68	2.58
ANTENATA	0.23223	0.06336	3.67	0.000***	1.26	1.11	1.43
VACCINAT	0.0789	0.4420	0.18	0.858	1.08	0.45	2.57
KNOWLEDG	-0.4785	0.4438	-1.08	0.281	0.62	0.26	1.48

Log-Likelihood = -99.995
Test that all slopes are zero: G = 58.674, DF = 12, P-Value = 0.000

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 9: Descriptors of the Logistic Model

Type of Delivery = -20.047 + 0.2939 * Mothers Age + 1.6126 * Living Area -0.1914 * Marriage Age -0.2748 * Mothers age at marriage -0.3271 * Mothers Hb + 0.06881 * Mothers Weight + 0.05820 * Pregnancy Period + 0.2822* Baby's Weight+ 0.23223 * ANC Visits+ 0.0789 * Vaccination - 0.4785 * Knowledge about danger sign of pregnancy.

Source: Primary Data

Table 10: Logistic Model by considering the significant predictors from model III: Type of delivery

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P	Ratio	Lower	Upper
Constant	-18.442	8.695	-2.12	0.034**			
Mothers Age	0.3019	0.1094	2.76	0.006***	1.35	1.09	1.68
Living Area	1.6347	0.4168	3.92	0.000***	5.13	2.27	11.61
Marriage Age	-0.2105	0.1134	-1.86	0.064*	0.81	0.65	1.01
Mothers Age at marriage	-0.2979	0.1193	-2.50	0.013**	0.74	0.59	0.94
Mothers Hb	-0.3264	0.1353	-2.41	0.016**	0.72	0.55	0.94
MothersWeight	0.06592	0.01990	3.31	0.001***	1.07	1.03	1.11
Pregnancy Per	0.05623	0.03050	1.84	0.065*	1.06	1.00	1.12
ANC Visits	0.22303	0.06135	3.64	0.000***	1.25	1.11	1.41

Log-Likelihood = -100.914

Test that all slopes are zero: G = 56.836, DF = 8, P-Value = 0.000

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 11: Descriptors of the Logistic Model

Type of Delivery = -18.442 + 0.3019 * Mothers Age + 1.6347 *Living Area -0.2105 * Marriage Age -0.2979 * Mothers age at marriage -0.3264 * Mothers Hb +0.06592 * Mothers Weight + 0.05644 * Pregnancy Period + 0.22303 * ANC Visits

Source: Primary Data

Table 12: Logistic Model by considering all the predictors: Baby's Weight

According to WHO new born baby is healthy if its weight is greater than 2.5, so we have categorized the baby's weight as less than 2.5 kg and more than 2.5 kg.

Predictor	Coef	SE Coef	Z	P	Ratio	Lower	Upper
Constant	-15.950	7.769	-2.05	0.040**			
Mothers Age	-0.0326	0.1169	-0.28	0.781	0.97	0.77	1.22
Living Area	-0.2464	0.4863	-0.51	0.612	0.78	0.30	2.03
Family Type	1.2184	0.5980	2.04	0.042**	3.38	1.05	10.92
Family members	0.1684	0.1169	1.44	0.150	1.18	0.94	1.49
Working Type	0.4759	0.5028	0.95	0.344	1.61	0.60	4.31
Marriage Age	0.0912	0.1244	0.73	0.464	1.10	0.86	1.40
Mothers age at marriage	-0.0273	0.1305	-0.21	0.834	0.97	0.75	1.26
Mothers Hb	0.1164	0.1390	0.84	0.402	1.12	0.86	1.48
MothersSugar	-0.00201	0.01160	-0.17	0.862	1.00	0.98	1.02
MothersWeight	0.04725	0.02349	2.01	0.044**	1.05	1.00	1.10
Pregnancy per	0.05360	0.02530	2.12	0.034**	1.06	1.00	1.11
Child order	-0.6241	0.3340	-1.87	0.062*	0.54	0.28	1.03
New born baby sex	0.8983	0.4113	2.18	0.029**	2.46	1.10	5.50
ANC visits	0.10317	0.06701	1.54	0.124	1.11	0.97	1.26
Health problems	-0.6896	0.5694	-1.21	0.226	0.50	0.16	1.53
USE	-0.3484	0.1573	-2.22	0.027**	0.71	0.52	0.96
ABNORMAL	-0.0868	0.5505	-0.16	0.875	0.92	0.31	2.70

Log-Likelihood = -89.513
Test that all slopes are zero: G = 26.557, DF = 17, P-Value = 0.065

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 13: Descriptors of the Logistic Model

Baby's Weight = -15.950 -0.0326 * Mothers Age -0.2464 * Living Area+ 1.2184 * Family Type+ 0.1684 * Family Members + 0.4759 * Working Status + 0.0912 * Marriage age -0.0273 * Mothers age at marriage - 0.1164 * Mothers Hb -0.00201 * Mothers Sugar + 0.04725 * Mothers Weight + 0.05360 * Pregnancy Period -0.6241 * Child order + 0.8983 * New born baby's sex + 0.10317 * ANC Visits - 0.6896 *Health problem -0.3484 * USE -0.0868 *Abnormality

Source: Primary Data

Table 14: Logistic Model by considering the significant predictors from model V: Baby's Weight

Predictor	Coef	SE Coef	Z	P	Ratio	Lower	Upper
Constant	-11.152	6.183	-1.80	0.071*			
Family Type	0.4154	0.3948	1.05	0.293	1.51	0.70	3.28
Mothersweight	0.03893	0.02131	1.83	0.068*	1.04	1.00	1.08
Pregnancy pe	0.04295	0.02207	1.95	0.052*	1.04	1.00	1.09
Child order	-0.3960	0.2750	-1.44	0.150	0.67	0.39	1.15
New born baby sex	0.9188	0.3852	2.39	0.017**	2.51	1.18	5.33
USE	-0.3060	0.1380	-2.22	0.027**	0.74	0.56	0.97

Log-Likelihood = -95.407
Test that all slopes are zero: G = 14.769, DF = 6, P-Value = 0.022

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 15: Descriptors of the Logistic Model

Baby's Weight = -11.152 + 0.4154 * Family Type + 0.03893 * Mothers weight +0.04295 * Pregnancy Period -0.3960 * Child order +0.9188 * New born baby's sex - 0.3060 * USE

Source: Primary Data

Table 16: Logistic Model by considering the significant predictors from model VI: Baby's Weight

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-10.232	6.098	-1.68	0.093*			
Mothersweight	0.03695	0.02064	1.79	0.073*	1.04	1.00	1.08
Pregnancy pe	0.03746	0.02163	1.73	0.083*	1.04	1.00	1.08
New born baby sex	0.9050	0.3812	2.37	0.018**	2.47	1.17	5.22
USE	-0.2586	0.1339	-1.93	0.053*	0.77	0.59	1.00

Log-Likelihood = -96.868
Test that all slopes are zero: G = 11.846, DF = 4, P-Value = 0.019

*** (p<0.01) Highly Significant, ** (p<0.05) = Moderately Significant, *(p<0.1) = Significant

Source: Primary Data

Table 17: Descriptors of the Logistic Model

Baby's Weight = - 10.232 +0.03695 * Mothers weight + 0.03746 * Pregnancy Period + 0.9050 * New born baby's sex -0.2586 * USE

Discussion

1. Type of delivery may depend on the factors such as Mothers age, Living Area, Number of family members, Mothers age at marriage, Mothers sugar Mothers weight, Pregnancy period till the delivery, Number of ANC visits and Health problems whereas
2. New bornbaby's weight may depend on pregnancy period till the delivery.
3. Number of ANC visits may depend on Knowledge about danger sign ofpregnancy.
4. Binary Logistic Model is developed with response as type of delivery using predictors Mothers Age, Living Area, Marriage age, Mothers age at

marriage, Mothers Hb, Mothers Weight, Pregnancy Period and ANC Visits.

5. Binary Logistic Model is developed with response as weight of the new born baby using the predictors such as Mothers Weight, Pregnancy Period, New born baby's sex and USE.

Conclusion

The main aim of this paper is to investigate awareness of maternal care among reproductive women in Baramati and to find factors which significantly affect the woman's maternal health during pregnancy. Data was collected through face-to-face interviews using questionnaire from 200 respondents. The findings are, on an average 72% of the reproductive women in Baramati are aware of maternal health care. Type of delivery may depend on the factors Mothers age, Living Area, Number of family members, Mothers age at marriage, Mothers sugar, Mothers weight, Pregnancy period till the delivery and Number of ANC visits. Baby's weight may depend on the Pregnancy period till the delivery. Number of ANC visits may depend on the Knowledge about danger sign of pregnancy. The study will further help the medical practitioners to improve upon the ways to aware the women regarding the Maternal Health care program undertaken by the Government of India.

References

1. Neetu Ahirwar, "Study to assess knowledge attitude and practices of antenatal care among antenatal women attending outdoor clinic in tertiary care hospital" International Journal of Reproduction, Contraception, Obstetrics and Gynecology, Vol 7(5):1754-1759

2. Joanna Marie S.Alvaro & Ryan Michael F. Oducada (2015). "Maternal Profile , Awareness and Utilization of Basic Emergency Obstetrics and Newborn care (BEmONC) in a rural Municipality in Iloilo, Philippines" Asia Pacific Journal of Education, Arts and Sciences, 2:1

3. A.R Johnson, B. Rock, N. Catherin, Sr. Berlin, R Rupini, and A. Kasthuri (2015). "Awareness of Government Maternity Benefit schemes among women attending ante-natal clinic in a rural hospital in Karnataka, India. International Journal of Current Research and Academic"Review. 3(1): 137-143

4. Wairia Samuel Kingori, Dr Dominic Charles Okero, Ms Eunice Muthoni (2016)." Uptake of Maternal health systems initiatives among mothers in Nakuru County,Kenya. International Journal of Scientific and Research" Publications, Vol 6: 1

5. NomitaChandhiok, Balwan SDhillon, Indra Kamboo, Nirakar C Saxena (2006) "Determinants of antenatal care utilization in rural areas of India: A cross sectional study from 28 districts (An ICMR task force study)." ObstetGynecol India Vol 56:1, pp 47-52.

6. V. M. Sarode.(2009)" Maternal care among reproductive women in slums un Greater Mumbai"

A STUDY ON CRYPTOGRAPHIC HASH FUNCTIONS IN BLOCKCHAIN AND CRYPTOCURRENCY

Richa Purohit[1], H. K. Bhatia[2]
[1,2] DY Patil International University.
[1]richapurohit81@gmail.com, [2]heenabhatia@ gmail.com

ABSTRACT

Hash functions is one of crucial part of cryptography that ensures integrity and authenticity of data. Cryptographic hash functions are extensively used in blockchain for verifying the legitimacy of transactions and building un-tampered chain of blocks. Crypto-currency is the new currency for this digital world. Bitcoin, Monero, XCurrency, Litecoin, Ethereum etc are few of the crypto-currencies that are being used for digital or electronic trade and transactions. Each transaction is treated as a block and these blocks are cumulated in a block chain. Block chains use hash functions extensively to verify the newly created block before making actual transactions. This paper discusses the basic structure of Merkle Tree to store blocks in blockchain and comparative study of few popular hash functions to implement authenticity and proof of work. It also focuses on the process of verifying a block and a transaction.

Keywords: *Proof-of-work, hash function, cryptocurrencies, performance, Merkle Tree, block chain, Bitcoin*

Introduction

The rapid development of digitalization in the sectors all over the world led to formidable rise in sensitive data. However, if this sensitive data is exposed to wrong hands, it can lead to leakage of data, misuse of data which in turn hampers the confidentiality of data. Cryptographic encryption techniques have emerged as propitious alternative to secure such huge amount of delicate data. It is technique used transmit the sensitive data securely to intended receiver in presence of adversaries over the internet. It prevents the leakage of data from unauthorized access and achieve information securities in terms of data integrity, data confidentiality, data authentication and non-repudiation. Cryptography can be implemented using encryption techniques. Encryption is process of converting plain or readable text to unreadable or cipher text. Cryptographic encryption algorithms are broadly classified into 3 categories- symmetric (Private/Secret key) encryption algorithms, asymmetric (Public key) encryption algorithms and hash functions.

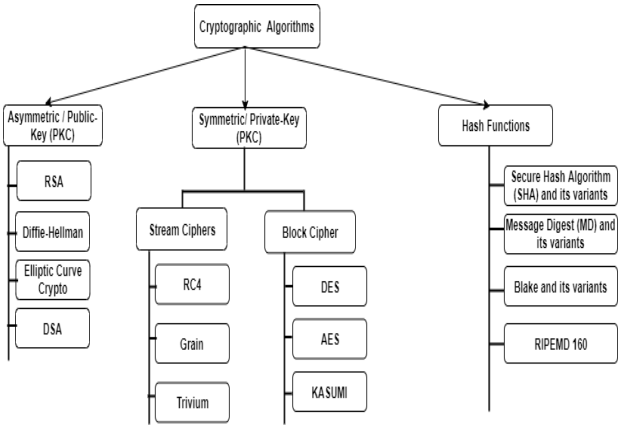


Figure 1: Taxonomy of Cryptographic Algorithms

A Symmetric algorithm is type of encryption algorithm which uses same key for encoding and decoding data. Whereas, an asymmetric algorithm is type of encryption algorithm which uses different keys for encoding and decoding the data. Both symmetric and asymmetric algorithms safeguard the data from invalid user and thus provide data privacy by transforming plain or readable data (encryption) and again back converting unreadable or cipher text (decryption). Hash functions are one of the most extensively-used cryptographic algorithms in blockchain technology that are designed to protect integrity of data. Hash functions provides data integrity by ensuring that correct data is received by receiver and is not altered in middle way during transmission.

Blockchain is defined as distributed ledger of growing chain of immutable data blocks which

is linked and secured using cryptography. In blockchain, cryptography plays a vital role to protect user privacy and ensure consistency and immutability of transaction data etc. [1]. At the fundamental core of Blockchain, asymmetric/public encryption algorithms and Hash algorithms are implemented. Blockchain uses public key cryptography in form of digital signatures that uses pair of private-public keys to sign and verify the transaction data respectively. Hash functions are responsible for secure binding of data blocks to one another so as to maintain the integrity of the data stored inside each block.

Hash functions owns several features that prove to be useful to perform various blockchain operations. Blockchain widely make use of crypto hash functions to assure data consistency, data immutability, data integrity in turn led to overall enhanced security.

This paper aims to explore the performance of few popular Proof-of-Work based hash functions used in blockchain like SHA-256, Ethash, Equihash, Keccack, Scrypt, X11, Cryptonight, Blake256, X11 etc.

Figure. 1 shows the Euler diagram which depicts the several hash functions that exists in Proof of Work at a glance.

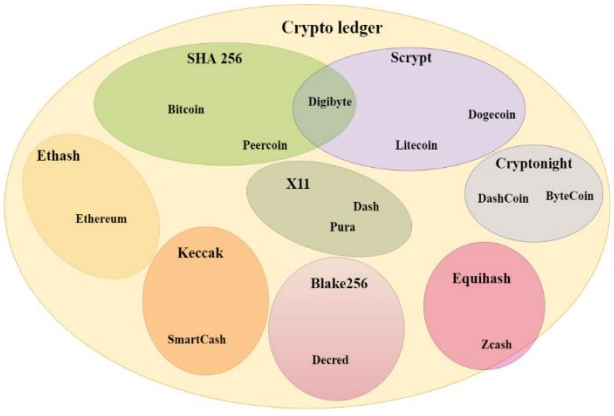


Figure 1: Few popular POW based hash functions

We compared and analysed the performance of these hash functions using hash rate, block time or confirmation time used for hashing the block in blockchain. Also, through our study we tried to find out which is better hash function in terms of its performance and speed.

The remaining part of the paper is structured as follows:

Section 2 defines study methodology with the term Cryptographic Hash functions and the related properties. Section 3 explains the terms involved in evaluating performance of hash functions. Section 4 presents the previous work done on hash functions in blockchain. Section 5 describes various cryptographic hash functions that exists in Proof of Work. Section 6 compares all the cryptographic hash functions discussed in section 3, based on their performance. Section 7 concludes the paper and section 8 discusses about the future work.

Cryptographic Hash Functions

Cryptographic Hash functions are functions that uses message of arbitrary or random length and produces fixed length output called hash-value, hash-code, digest or simply hash [2]. If this message or data is changed after calculating its corresponding hash value, then this hash value or digest will no longer remain valid. Thus, Cryptographic hash functions provide a mean to assure message integrity and message authentication too**.**

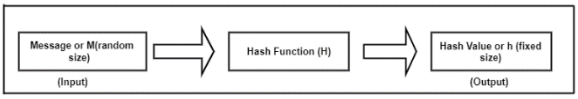


Figure 2: Simplified Hash Function

Here, hash Function H takes random length message M to produce fixed length hash value h as output. It can be symbolically represented as h=H (M). A well-designed hash function must possess the following properties [3]:

1. Efficiency- It should be computationally easy to calculate and verify hash value on given message.

2. Collision Resistance- Ideally it should be computationally not possible to have two different messages colliding to same hash value.

3. Pre-image Resistance- For given message digest y, it is difficult to find a message M such that H(M) = y i.e. There should be only one hash value for one message (using any given hash function each time).

4. Second Pre-image Resistance- For given message M and its digest H (M), it is difficult to find another M` such that H (M) = H (M`) i.e. It should not be possible to generate or even assume the original message from the given hash value.
5. Randomness- The final output of hash function should be totally random. There should be no relation of any output with previous or next output.

Hash Functions are also called one-way encryption algorithms which means once the original message is converted to hash value, there is no way to recover that data.

Few more terms involved in performance of hash functions, such as:

a. Hash rate- Hash power or hash rate indicates the number of hash values calculated per second. Hash rate is usually expressed as hashes per sec (h/s). Hash rate of hash function in blockchain depends on type of hash algorithm used, mining device or rig and difficulty level.

b. Block Time or Latency- The time required to generate new block in the chain is called Block time. In simple words, it is time between submission and first confirmation of transaction in the blockchain.

Proof of Work

Proof- of-work is the original and most popular consensus algorithm used in blockchain technology that is used for many popular cryptocurrencies. In proof-of-work, group of people (called miners) uses computational power and nonce (number used only once) to solve difficult mathematical problem which validate and confirm transaction records inside each block in network.

While making any transaction, the transaction block is prefixed with 'n' number of zeros. This string of zeros is called "challenge string". This pre-padding makes task of miners more complex. The miner recalculates the hash on the block, verifies it against the received hash and if it matches than new transaction is converted into block and added to the block chain. Before completion of this verification process, the miner may need to reassume the challenge string again and again, until precise requirements are contented. This process of verifying challenge string before adding block to block-chain, is called proof-of work [4].

Following are two basic two terms are involved in proof of work:

a. Nonce: The nonce is 32-bit number which varies input to hash function. It is part of block header which is manipulated to meet the hash criteria. It is one of inputs given to hash function.

b. Target value or Difficulty level: It is number that determines how long it takes miners to add new validated block of transactions to blockchain. The difficulty value is adjusted after every 2016 blocks to ensure blocks of transactions are added to blockchain at regular intervals.

In proof of work, for each iteration nonce is incremented to get the output hash value with predefined leading zero bits. The exponential to the number of zeros in correct hash indicates average work performed for a particular block. Once the output hashed value is less the target difficulty level, the transactions within block are verified and are added to new block wherein new block gets added to end of longest chain in blockchain. This denotes that Proof of Work needs a high level of computation on the verification process.

Proof-of-work is extensively used for crypto mining. Crypto mining is the process of introducing new cryptocurrencies by verifying and adding the transactions between the users to a global public ledger of the blockchain. In crypto-currencies, an array of inputs and an array of outputs form a transaction. This entire transaction is hashed using a specific hash function for that crypto-currency. The hash output of each transaction is used as transaction ID in each subsequent step [5]. The security of crypto mining depends on the hash rate. The hash rate is the sum of all the processing power utilised to mine and process transactions in a proof-of-work chain. The higher the network's hashing (computing) power, the more secure and resistant a coin will be to attacks.

Literature Review

This section covers the literature review of papers which have been already published on cryptographic hash functions.

Table1 summarize the literature review for the given context.

Sr. No	Author name	Architecture/Hash function/Performance criteria used for Hash functions been covered	Specification
1.	B. Seok , J. Park, J.H. Park. A[6]	A Lightweight Hash-Based Blockchain Architecture for Industrial IoT	For Industrial IoT, the author proposed a lightweight hash-based blockchain architecture. QUARK, PHOTON, and SPONGENT were compared in the suggested architecture based on hash function security and performance. The top ten hash functions for blockchain-based currency are also presented in this study.
2	Kuznetsov, Alexandr Shekhanin, Kyryl Kolhatin, Andrii Kovalchuk, Diana Babenko, Vitalina Perevozova, Iryna[7]	Performance of Hash Algorithms on GPUs for Use in Blockchain	On GPUs, the author compared the performance of various cryptographic hash functions. The cryptographic hash function is chosen depending on its ability to work well on a variety of devices.
3.	Kuznetsov, Alexandr Oleshko, Inna Tymchenko, Vladyslav Lisitsky, Konstantin Rodinko, Mariia Kolhatin, Andrii[8]	Performance Analysis of Cryptographic Hash Functions Suitable for Use in Blockchain	The author analyzed 80 distinct algorithms, including both internationally accepted hash functions and lesser-known specialized algorithms, using hash rates computed on a variety of processing platforms, including desktop PCs and GPUs.
4.	Kuznetsov, Alexandr, Maria Lutsenko, Kateryna Kuznetsova, Olena Martyniuk, Vitalina Babenko, and Iryna Perevozova[9]	Statistical Testing of Hash Algorithms in Blockchain	To analyze statistical security criteria of different hash functions, the author used 15 statistical tests from the NIST STS statistical test suite, which is approved by the National Institute of Standards and Technology in the United States. This research shows that the hashing technique RIPEMD160 has low statistical security values, and that hash functions like DJB-2, DJB-2 XOR, and LOSELOSE are not suitable for usage in cryptographic applications.
5	Wang, Maoning, Meijiao Duan, and Jianming Zhu[10]	Security criteria of Hash function based on hiding and puzzle-friendliness	Author compared hash functions based on two security parameters-hiding and puzzle friendliness. The study proves that hash functions which ensures both hiding and puzzle-friendliness is more difficult to defeat or crack and most suitable for application in blockchain.

5. Blocks in Blockchain and use of Hash Functions

Block Chain is the base for Crypto-currency. As the name suggests, in block chain, a new transaction is added as a new block into the chain of previous blocks. Every time a transaction is verified, its hash is generated and stored for future reference and verification by miners [11]. The block consists of many entries including block header, and Merkle Tree (also known as Hash Tree). The block header contains hash of previous block, timestamp of block creation, difficulty level of block hash computation, nonce etc [12].

Merkle Tree are binary trees that store the hashes of data block in a specific manner so that verifier need not take all previous blocks of chain to verify the newly inserted block or transaction in the sequence. At the last level of the tree, which is at leaf level, hash of specific block is stored. Each parent node of Merkle Tree stores hashes of both of its children nodes, in concatenated fashion. The root of the tree stores hashes in the similar manner as all other parent nodes. This concept can easily be shown with following Figure 2:

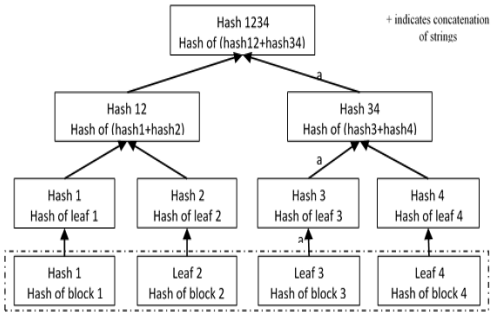


Figure 3: Design of Binary Merkle Tree (Hash tree)

Because the Merkle Trees are binary trees, therefore they are always expected to contain leaf nodes in even number. Leaf nodes represent individual transactions. So, there may be cases when number of transactions is odd, and a node has only one child instead of two for storing concatenated hash. In that situation, the last leaf node will be duplicated once, so that last hash is also duplicated. The structure of Merkle Tree helps in reducing time, effort and cost of verifying a transaction significantly [4]. For example, to check block 3, all nodes that are there with the path labelled as 'a', need to verified only, complete tree with all existing blocks need not be verified and retrieved.

As its name suggests, Blockchain is a list of blocks that are linked to each other with help of cryptographic validation lock called hash function. This hash function is responsible for generating hash value for each new transaction. Each block includes the hash value of the previous block to ensure that transactions on the blockchain are processed in the correct order. Finally, the hash of the preceding block results in a sequence of blocks to form an immutable data structure. The integrity of transactions can be assured by storing the hash of the previous block in the current block. If the transactions in a block are altered, the hash value in the following block will be invalidated, which will have an impact on all subsequent blocks on the blockchain. [12]. Thus, the hash value is of extreme importance in blockchain technology, as it provides methods for verifying transaction detail without considering all previous transactions into account [13].

Apart from this, there are various other operations performed by hash functions in blockchain which are as follows:

i. It is used for mining the coins by solving cryptographic puzzle in the proof of work.
ii. Used for verifying and confirming transaction in blocks (in the Merkle tree).
iii. Digital signatures internally use hash function to check authenticity of transaction.
iv. Bitcoin uses hash functions like SHA-256 and RIPEMD 160 for its address generation [14].

In this section, we analysed and compared different hash functions under proof-of-work.

1. SHA256

SHA stands for Secure Hash Algorithm. SHA256 is a member of SHA-2 family. SHA256 is hashing algorithm developed by National Security Agency (NSA) in the USA. SHA256 is core part used of bitcoin blockchain. In bitcoin, SHA-256 hashing algorithm is used for confirming transactions via Proof of Work consensus mechanism and for creation of Bitcoin addresses [15]. Bitcoin (BTC), Bitcoin Cash (BCH), and Bitcoin SV (BSV) are three well-known coins that uses SHA-256 hashing algorithm [16].

2. Cryptonight

Cryptonight is a memory-hard hash algorithm that use the Keccak hashing function and employs a scratchpad to perform a series of random reads and writes. The desired hash is obtained by hashing the entire scratchpad after performing a number of read and write operations on it. Cryptonight is resistant to ASICs since it generates hash values solely from scratchpad memory. Cryptonight's hash rate is hashes per second. Cryptonight also presents the concept of "equalitarian proof of work," [17] which allows everyone to participate in the mining process using any modern CPU or GPU. Cryptocurrencies mined using cryptonight algorithm are Monero (XMR), Bytecoin (BCN), Boolberry (BBR), Dashcoin (DSH), DigitalNote (XDN), DarkNetCoin (DNC), FantomCoin (FCN), Pebblecoin (XPB), Quazarcoin (QCN) etc [18].

3. Scrypt

Scrypt is a password-based key-derivation hash function that requires lot of memory compared to other key -derivation functions making it difficult to perform using FPGA and ASIC enabled custom Hardware. Scrypt uses Salsa20/8 Core [19] as its internal hash function. It uses large vectors of pseudorandom strings that are produced from the last block and accessed in a pseudorandom order to output the derived key [20]. Hash rate of Scrypt is expressed in kilo hashes per second (KH/s), which translates to one thousand hash computations per second. Popular Cryptocurrencies mined using Scrypt algorithm are Litecoin (LTC), Dogecoin (DOGE) Einsteinium (EMC2) Syscoin – SYS, Monacoin - MONA etc [21].

4. Ethash

Ethash is ASIC resistant proof-of-work hash function used in Ethereum blockchain. It was originally called as Dagger-Hashimoto algorithm because of its utilization of two different algorithms: Dagger and Hashimoto [22]. At its core, it also employs the keccak hash function. Dagger Hashimoto was used in Ethash to provide ASIC resistance by being IO-bound while also achieving memory-hard computations and memory-easy validations. Ethash represents the scratch pad with a 1 GB custom-generated direct acyclic graph (DAG) dataset that is re-generated every 30,000 blocks. The DAG dataset is a two-dimensional array of 4-byte unsigned integer values that allows miners to run memory-intensive calculations on the scratch pad. Mega-hashes per second (MH/s) are used to measure the hash rate of the Ethash algorithm. The cryptocurrencies that are mined using this algorithm are: Ethereum, Ethereum Classic, KodakCoin, Ubiq etc [23].

5. Equihash

Equihash (also known as ZCash) is a memory-bound POW algorithm. This approach is based on a generalisation of the birthday problem [24], which finds hash values that are clashing. It's also known as an ASIC-resistant proof of work algorithm because it computes hash values entirely in RAM. As a result, the quality of memory used by the required hardware determines the mining process. Hash rate of Equihash algorithm is measured in hashes per second. The key advantage of Equihash is that it makes decentralised mining easier. Zcash, Zcoin, Zclassic, Bitcoin Gold, Komodo, ZenCash, and others [25] are among the cryptocurrencies mined with this algorithm.

6. X11 Algorithm

X11 algorithm is called chained POW because it it employs 11 different chained hashing methods, each of which is run in sequence.These hashing algorithms are blake, bmw, groestl, jh, keccak, skein, luffa, cubehash, shavite, simd, and echo. It is an ASIC-resistant and can be mined using both CPU and GPU. In comparison to Scrypt, the X11 algorithm uses

just 30% less electricity because it is 35 to 50% cooler and more energy efficient. As a result, using X11 is highly recommended. Its hash rate is measured by Mega-hashes per second (MH/s) [26]. Hash rate of X11 algorithm is measured in Mega-hashes per second (MH/s). The amount of chained hashing functions varies in different variations. X13, for example, employs 13 hashing functions, while X15 employs 15. X11 cryptocurrency is used to mine a variety of major cryptocurrencies, including: Badgercoin (BDG), BankCoin (BANK), Bantam (BNT), Capricoin (CPC), Checkcoin (CKC), ChipCoin (CHIP), CryptCoin (CRYPT), DarkCash (DRKC), Dash (DASH) DigitalPrice (DP), ESportsCoin (ESC), EuropeCoin (ERC) etc [27].

Table 2 Few popular hash functions used for crypto currencies

S. No.	Hash Function	Specific feature	Used to mine following crypto currencies
1	SHA-256	a. Hash rate is at Giga hashes per second. b. Can be performed on ASIC H/W.	Bitcoin, BitcoinCash, Namecoin, Devcoin, Betacoin, Bytecoin, Unicoin, Zetacoin, Titcoin etc.
2.	Scrypt	a. Hash rate is at Kilo hashes per second. b. Can be performed on CPU, GPU or ASIC H/W.	Litecoin, Latium, Bitmark, Goldcoin, Ekrona etc.
3.	X11	a. Hash rate is at Mega hashes per second. b. Can be performed on GPU. c. Energy efficient 30-50% cooler than Scrypt.	Dash, XCurrency, StartCoin etc.
4.	CryptoNight	a. Hash rate is at hashes per second. b. Suitable for PC CPU. c. Based on open-source protocol. d. Depends on all the previous blocks for each new block.	boolberry, DigitalNote, Monero etc.
5.	Dagger Hoshimoto-Ethash	a. Hash rate is at Mega hashes per second.	Ethereum, Expanse, Ethereum Classis etc

		b. Can be used on shared memory hardware.	

Following Table3 gives little information about various crypto-currencies along with their hash function

S. No.	Name of Crypto-Currency	Name of Hash Function used	Time to mine crypto-currency
1	BitCoin	SHA-256	10 minutes
2	Ethereum	Ethash	12 seconds
3	BitCoin Cash	SHA-256	10 minutes
4	LiteCoin	Scrypt	2.5 minutes
5	Dash	X11 or SHA-3	5 seconds
6	NEM	SHA-256	1 minute
7	ZCash	Equihash	2.5 minutes

In block chain technology, hash functions are used to trace genuine property of the message or block that is received now and is yet to be appended to the block chain. This checking and appending process can be summarized in given flowchart in Figure 4:

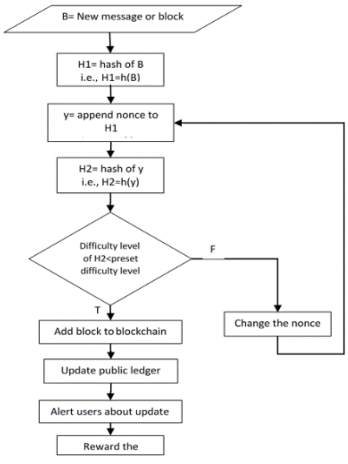


Figure 4: method of verifying block and adding to block chain

A block can be added to block chain if following requirements are fulfilled:

a) If it is the last block in the chain. New block is always added at the end of the chain.
b) If block hash of previous block correctly matches with calculated block hash for verification.
c) If calculated hash for new block is correct.
d) If difficulty at the current level is lesser than pre-decided block difficulty.
e) If all transactions stored in block chain are valid.
f) If sum of O/P transaction = sum of I/P transaction + block miner's reward.
g) If there is no double spending transaction in that block.
h) If for each block chain there exist only one reward transaction and one fee transaction.
i) Similarly, a transaction is valid in a block if following requirements are fulfilled:

j) If hash of transaction is equal to calculated hash and thus the hash is verified.
k) If public key of group is used to sign all data for all of I/P transactions.
l) Sum of O/P transaction < sum of I/P transaction. The difference indicates transaction fees.
m) The block is not creating a duplicate entry in block chain.
n) The block chain contains all unspent I/P transactions.

Conclusion

Now-a-days, cryptographic hash functions are used in most of security applications. The cryptographic hash function is a most crucial part of the blockchain technology. Essentially, it is a security feature that provides processed transactions more security by making them immutable. unchangeable. Blockchain makes extensive use of hash functions to safeguard the immutability and integrity of the data recorded on the distributed ledger. Immutability of the ledger is crucial due to the fact that it is kept in a decentralised manner with each node retaining its own copy. Otherwise, nodes could alter their copies of the ledger to benefit themselves at the expense of the network as a whole.

As a result, the integrity of the hash function is critical to the security of the blockchain. As soon as the hash function of a blockchain becomes weak or compromised, the entire system's security breaks down.

There is wide range of Crypto currencies available in the digital market. Crypto currency work in a concept, known as block chain, which is a consecutive arrangement or chain of valid transactions, known as blocks. All transactions performed using crypto-currency, need to be validated by miners, who use proof-of-work algorithm and after validating add a transaction into block chain in the form of a new block. This paper emphasizes on cryptographic hash functions, proof-of-work and basic terminologies involved in comparison of these hash functions and blocks in the block chain technology.

References

1. Zhu, Y. (2016). Security architecture and key technologies of blockchain. Journal of Information Security Research, 2(12), 1090.
2. Lin, C. H., Lee, C. Y., Kavi, K. M., Chen, D. J., & Yeh, Y. S. (2013). Finding near-Optimum message scheduling settings for SHA-256 variants using genetic algorithms. Journal of information science and engineering, 29(5), 889-905.
3. Available at: http://www.tutorialspoint.com/cryptography/cryptography_hash_function, last retrieved on 16th April, 2021
4. Sebastin, P. (2017). An introduction to Ethereum and smart contracts: A programmable blockchain.
5. Bonneau, J., Miller, A., Clark, J., Narayanan, A., Kroll, J. A., & Felten, E. W. (2015, May). Sok: Research perspectives and challenges for bitcoin and cryptocurrencies. In 2015 IEEE symposium on security and privacy (pp. 104-121). IEEE.
6. Seok, B., Park, J., & Park, J. H. (2019). A lightweight hash-based blockchain architecture for industrial IoT. Applied Sciences, 9(18), 3740.
7. Kuznetsov, A., Shekhanin, K., Kolhatin, A., Kovalchuk, D., Babenko, V., & Perevozova, I. (2019, December). Performance of hash algorithms on gpus for use in blockchain. In 2019 IEEE International Conference on Advanced Trends in Information Theory (ATIT) (pp. 166-170). IEEE.
8. Kuznetsov, A., Oleshko, I., Tymchenko, V., Lisitsky, K., Rodinko, M., & Kolhatin, A. (2021). Performance Analysis of

Cryptographic Hash Functions Suitable for Use in Blockchain. International Journal of Computer Network &Information Security, 13(2).

9. Kuznetsov, A., Lutsenko, M., Kuznetsova, K., Martyniuk, O., Babenko, V., & Perevozova, I. (2019, November). Statistical Testing of Blockchain Hash Algorithms. In CMiGIN (pp. 67-79).

10. [10] Wang, M., Duan, M., & Zhu, J. (2018, May). Research on the security criteria of hash functions in the blockchain. In Proceedings of the 2nd ACM Workshop on Blockchains, Cryptocurrencies, and Contracts (pp. 47-55). [ApA]

11. [11] Narayanan et. al. "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Published by Princeton University Press, 2016.

12. [12] Available at: https://www.oreilly.com/library/view/mastering-bitcoin/9781491902639/ch08.html, last retrieved on 2 January, 2019

13. [13] Wei-Meng Lee. Understanding How Blockchain Works, Available at: https://blog.ndcconferences.com/understanding-blockchain/#:~:text=A%20blockchain%20is%20a%20digital,an%20unbroken%20chain%20%E2%80%94%20a%20blockchain , last retrieved on 17 April 2021.

14. Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. Decentralized Business Review, 21260.

15. Available at: https://coinguides.org/sha-256-algorithm-coins/ . Last retrieved on April 12, 2021.

16. Available at: https://cryptodelver.com/algorithm/sha256, last retrieved on 1 June, 2021.

17. Seigen, M., Jameson, T., Nieminen, N., & Juarez, A. (2013, March). Cryptonight hash function. In CRYPTONOTE STANDARD 008.

18. Available at: https://cryptodelver.com/algorithm/cryptonight , last retrieved on 1 June, 2021.

19. Bernstein, D. J. (2008). The Salsa20 family of stream ciphers. In New stream cipher designs (pp. 84-97). Springer, Berlin, Heidelberg.

20. Percival, C., & Josefsson, S. (2016). The scrypt password-based key derivation function. IETF Draft URL: http://tools. ietf. Org/html/josefsson-scrypt-kdf-00. txt (accessed: 30.11. 2012).

21. Available at: https://cryptodelver.com/algorithm/scrypt, last retrieved on 1 June, 2021.

22. Available at: https://academy.bit2me.com/en/what-is-the-algorithm-of-ethash-mining/ Last retrieved on April 24, 2021.

23. Available at: https://cryptodelver.com/algorithm/ethash, last retrieved on 1 June, 2021.

24. Biryukov, A., & Khovratovich, D. (2017). Equihash: Asymmetric proof-of-work based on the generalized birthday problem. Ledger, 2, 1-30.

25. Available at: https://cryptodelver.com/algorithm/equihash, last retrieved on 1 June, 2021.

26. Ferdous, M. S., Chowdhury, M. J. M., Hoque, M. A., & Colman, A. (2020). Blockchain consensus algorithms: A survey. arXiv preprint arXiv:2001.07091.

27. Available at: https://cryptodelver.com/algorithm/x11, last retrieved on 1 June, 2021.

COMPARING THE PERFORMANCE OF DATA MINING ALGORITHMS IN THE PREDICTION OF TEACHER'S PERFORMANCE

P.S. Zanjurne[1], V.V. Patil[2]
[1]Jagdish Prasad JhabarmalTibrewala University Jhunujhunu,Rajastan.
[2]T. C. College Baramati, Maharashtra.
[1]poojaszanjurne21@gmail.com[2]vaishutcc@gmail.com

ABSTRACT

Teachers are the most significant part of the educational system in terms of improving student learning and ensuring their future success. Teacher's performance has a direct impact on student learning and student progress. The performance of a teacher in the classroom is based upon various factors such as Lecture preparation, teaching method/communication ability, Utilization of teaching aids, Coursework and day-to-day living are inextricably linked, distribution of Study materials, Subject-matter expertise, Completion of the curriculum preparation Punctuality and regularity, Class control and behavior with students. The aim of this paper is to predict a teacher's performance by using various Machine learning algorithms. For prediction of teacher's performance, we develop models using Decision tree (CART) , k nearest neighbor(KNN), Naïve Baye's Classifier, Support Vector Machine (SVM) and Artificial Neural Network (ANN). We consider above 10 Independent variables to develop models. We collected primary data from students by designing a questionnaire which is called feedback form. Data analysis was done by using R studio. This study observe that Artificial Neural Network (ANN) had higher accuracy than other algorithms.

Keywords: *Decision tree, KNN, Naïve's, SVM, Artificial Neural Network(ANN).*

Introduction

Teachers are responsible for developing knowledge and culture in children. God is the creator of the entire world, and a teacher is the creator of a whole nation, a teacher is a precious gift from God. A teacher is a pivotal factor in a student's life since his knowledge, devotion, and love shape the student's entire life.A teacher utilizes creativity in the classroom to help students focus on their studies.

The teacher shapes the future and present of the students. He also contributes to a good society by being a good student throughout his life. In order to acquire quality objectives related to students, teachers play a crucial role in the education sector. As a result, all educational institutions are concerned about teacher performance.

A proper system for evaluating a teacher's performance has yet to be developed, and there has been little related work done to examine the performance. Using various ways, they are aiming to construct a good evaluation system for the same.

Teachers can educate to assist students in understanding knowledge and concepts that are not included in the textbook.Students will have a better understanding and awareness of the subject if teachers connect with them using relevant, real-life examples, occurrences, and so on. They canapply their learning to a variety of subjects while using real-life examples.Sample of 100 teachers' were used for this study according to 10 questions teacher's performance was evaluated and categorized. For prediction purpose machine learning algorithms like Decision tree, KNN, Naïve Baye's, SVM, Neural network algorithms were used. Neural network algorithm shows greater accuracy rather than other algorithms.

Literature Review

Patil V V. et.al. (2019) have used Naive Bayes classifier technique for prediction of teacher's performanceand also estimates accuracy of the model.Bansal et.al (2018) has developed modelsusing machine learning algorithms to detect Dementia and then compare those algorithms by their accuracy of classification.Huapaya et.al (2020) focuses on the classification of machine learning algorithms and the determination of the most efficient algorithm with the help of accuracy and precision.

Objectives

1. To predict a teacher's performance by using various Machine learning algorithms.
2. To find the best predictive machine learning model for the prediction of teacher's performance.

Methodology

For evaluation of Teacher's performancecollege collect feedback of teachers from students. A questionnaire type feedback forms are given to

the students which contains questions like Preparation of lecture, teaching method/communication skill , Use of teaching aids, Correlation of curriculum with day to day life, Supply of study ,Depth of subject knowledge , Syllabus completion-Exam preparation , Regularity and punctuality , Behavior with students and Class control. Each question got a 10 rating from the students. They were divided into different categories such as Outstanding, Very Good, Good, Satisfactory, Fair, and Average College evaluates the teacher's overall performance based on these questions. Overall performance is used as a response variable for classification. For further analysis, college uses weighted mean to analyze the performance of the teacher. And this calculated weighted mean is used to categorize the teacher according to the classes such as Outstanding, Very good, Good, Satisfactory, Fair and Average.

1) k-fold cross validation:

K fold cross validation is a technique in which initial data randomly partitioned into k mutually exclusive subsets or folds, D_1, D_2, …, D_k and testing is performed k times.In iteration i^{th}partition D_i is reserved as a test data or test set and remaining partitions are collectively used to train the model. That is, in the first iteration subset of dataset D_2, D_3,…, D_k collectively use as a training set to obtain a first model which is tested on D1. The second iteration is trained on D_1, D_3, D_4,…,D_k and tested on D_2 and so on. In general 5 to 10 folds cross validation is used.

2) Decision Trees:

Decision Trees (DTs) are a one of the non-parametric supervised learning method used for classification and regression.The purpose is to learn simple decision rules from data attributes to create a model that predicts the value of a target variable.A decision tree classifier can bebuilt without any domain information or parameter settings, making it suitable for exploratory knowledge discovery.In the machine learning domain, CART is one of the most often used methods for constructing decision trees.

CART develops a binary decision tree by splitting records at each node based on a single attribute's function. CART uses the GINI Index for best split. The initial split generates two nodes, each of which we try to split in the same way, resulting in a root node.To identify the candidate splitters, we go over all of the input fields once more. We label a node a leaf node if no split is identified that significantly reduces diversity of that node. Eventually, just a leaf node remains, and we have built a whole decision tree. Because of overfitting, the complete tree that is not to be treated does not do the greatest job of classifying a fresh batch of records.Every record from the training set was assigned to a leaf of the full decision tree at the end of the tree-growing procedure. A class can now be assigned to each leaf. High-dimensional data can be handled via decision trees.

3) Naïve Baye's classifier: Naive Baye's classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. Bayesian classifiers are statistical classifiers that predict probabilities of class membership, such as the probability that a given tuple belongs to a specific class. Naïve Baye's classifier is based on the concept of Baysean classifier.When used to big data sets, Bayesian classifiers results showed great accuracy and speed.

4) Support Vector Machine (SVM):

The Support Vector Machine is a one of the best supervised machine learning algorithm for classification and regression. It can solve both linear and non-linear problems and widely used.SVM algorithm uses the nonlinear mapping to transform the original training data into higher dimensions within this new dimension.It searches for the linear optimal separating hyper plane (that is a decision boundary separating the tables of one class from another) with an appropriate non linear mapping to sufficiently high dimensional data from two classes can always be separated by hyper plane. The SVM finds this hyper plane by support vectors (essential training tuples) and margins (defined by support vectors)

5) k-nearest neighbors (KNN) algorithm:

k-nearest neighbors (KNN) algorithm is one of the simple procedures that can be used for classification.When large samples are involved, it classifies them based on the category of their closest neighbors.This classifier used some or all the pattern available in training set to classify test pattern. The basic idea behind this classifier is to detect similarities between the pattern and every

other pattern in the training set.

Without making any assumptions about the distribution from which the training examples are selected, the nearest neighbor approach achieves consistently high performance among the various method of supervised learning. The distances to the nearest training case are used to classify the sample. The KNN algorithmamplifies this idea by taking the k-nearest points and assigning the class of majority. It is normal to choose k small and/or break ties (typically 1,3 or 5). Large k values help to reduce the effect of noisy point within the training data set and the choice of k is often performed through cross validation.An object is classified according to majority vote of the class of the neighbors.

- The object is allocated in the class with the most members among the k-nearest neighbors.
- If k = 1 then it becomes a nearest neighbor algorithm (NN).
- This algorithm gives you a more correct classification for boundary patterns than N-N algorithm.
- The value of k has to be specified by the user and the best choice depends on data.
- Larger value of k reduces the effect of noise on the classification. The value of k can be arbitrarily increased when the training data set is large in size.
- The k value can be chosen by using the validation set and choosing the k value giving the best accuracy on the validation set.

6) Artificial Neural Network (ANN):

A neural network is a network of connected input-output units with a weight assigned to each connection.The network learns by modifying the weights during the learning phase so that it can anticipate the right class label of the input tuples.However, Artificial Neural Network algorithms have certain advantages, including a high tolerance for noisy input and the capacity to classify factors for which they have not been trained. They can be used when you may have little knowledge of the relationship between attributes and the classes. There are many different types of neural networks and neural network algorithms. Back propagation is the most famous neural network method.

Data Analysis:

We use 10 –fold cross validation for all the algorithms to predict teacher's performance. Using 10-fold cross-validation the following results are obtained.

Decision tree (CART): A

Decision tree was build by using CART i.e. Classification And Regression Tree

Table 1: Results of Decision tree using 10-fold cross validation

cp	Accuracy	Kappa
0.04166667	**0.59**	0.3685185
0.13333333	0.56	0.3248966
0.35000000	0.49	0.1999374

Here, highest accuracy (0.65) corresponds to cp= 0.04166667

The final value of cp which was used for the model was cp = 0.04166667.

K-nearest Neighbor algorithm (KNN):

Table 2: Results of KNN using 10-fold cross validation

k	Accuracy	Kappa
5	**0.65**	0.4529262
7	0.62	0.4018927
9	0.62	0.4028476

Here, highest accuracy (65%) corresponds to k=5 Therefore, the final value of k which was used for the model was k = 5.

Support Vector Machine (SVM):

Table 3: Results of SVM using 10-fold cross validation

Accuracy	Kappa
0.59	0.3740053

The SVM Model is obtained with accuracy 59% Tuning parameter 'C' was held constant at a value of 1

Naive Baye's classifier:

Table 4:Results of Naïve Baye's using 10-fold cross validation

usekernel	Accuracy	Kappa
FALSE	0.2555556	-0.07440561
TRUE	0.2555556	-0.07440561

The Naïve Baye's Model obtained with accuracy 25.5556%

Artificial Neural Network algorithm (ANN):

Table 5: Results of ANN using 10-fold cross validation

size	decay	Accuracy	Kappa
1	0e+00	0.57	0.3399217
1	1e-04	**0.66**	0.3399217
1	1e-01	0.62	0.4113711
3	0e+00	0.54	0.2952031
3	1e-04	0.51	0.2586085
3	1e-01	0.56	0.3263785
5	0e+00	0.60	0.3965171
5	1e-04	0.58	0.3649415
5	1e-01	0.56	0.3229756

The highest accuracy 66% corresponds to the size = 1 and decay = 1e-04.
The final values of size and decay which was used for the model were, size = 1 and decay = 1e-04.

Results & Discussion

Comparative analysis of machine learning algorithms

Table 6: Classification Accuracy of all models

Sr.No.	Method	Accuracy
1	Decision tree	59%
2	SVM	65%
3	KNN	59%
4	Naïve Bayes	25%
5	ANN	66%

As shown in the table the Neural network algorithm shows greater accuracy (66%) than other algorithms. SVM shows 65% accuracy which can also be considerable. The accuracy of the Naive Baye's algorithm, on the other hand, is only 25% which is not considerable for prediction purpose.

Conclusion

Teacher performance evaluation is essential to meet the institute's quality objectives, as we all know, but the most important thing is to make accurate predictions of teacher performance. Correct prediction can be achieved by using a model with high accuracy. In this case, the optimum model for predicting teacher's performance is an Artificial Neural Network (ANN). Therefore, for teacher's performance prediction, a neural network algorithm is helpful.

References

1. Patil V V, Zanjurne PS, Reddam LR. Statistical Model for Classification of Teacher ' s Performance. Published online 2019:4153-4158. doi:10.15680/IJIRSET.2019.0804090
2. Huapaya HD, Rodriguez C, Esenarro D. Comparative analysis of supervised machine learning algorithms for heart disease detection. *3C TecnolinnovaciónApl a la pyme*. Published online 2020:233-247. doi:10.17993/3ctecno.2020.specialissue5.233-247
3. Bansal D, Chhikara R, Khanna K, Gupta P. Comparative Analysis of Various Machine Learning Algorithms for Detecting Dementia.

ProcediaComput Sci. 2018;132:1497-1502. doi:10.1016/j.procs.2018.05.102

4. Hammad I, El-Sankary K, Gu J. A comparative study on machine learning algorithms for the control of a wall following robot. IEEE IntConf Robot Biomimetics, ROBIO 2019. Published online 2019:2995-3000. doi:10.1109/ROBIO49542.2019.8961836
5. Bari Antor M, Jamil AHMS, Mamtaz M, et al. A Comparative Analysis of Machine Learning Algorithms to Predict Alzheimer's Disease. J Healthc Eng. 2021;2021. doi:10.1155/2021/9917919
6. Awan FM, Saleem Y, Minerva R, Crespi N. A comparative analysis of machine/deep learning models for parking space availability prediction. Sensors (Switzerland). 2020;20(1). doi:10.3390/s20010322
7. Schaffer C. Technical Note: Selecting a Classification Method by Cross-Validation. Mach Learn. 1993;13(1):135-143. doi:10.1023/A:1022639714137
8. Pal S. Evaluation of Teacher ' s Performance : 2014;2(January):359-369.
9. Kaur P, Singh M, Josan GS. Classification and Prediction Based Data Mining Algorithms to Predict Slow Learners in Education Sector. ProcediaComput Sci. 2015;57:500-508. doi:10.1016/j.procs.2015.07.372
10. Abdar M, Kalhori SRN, Sutikno T, Subroto IMI, Arji G. Comparing performance of data mining algorithms in prediction heart diseses. Int J ElectrComput Eng. 2015;5(6):1569-1576. doi:10.11591/ijece.v5i6.pp1569-1576