

**A STUDY ON EVALUATING TOTAL PRODUCTIVE MAINTENANCE
PRACTICE IN AJUTE INTERNATIONAL PVT LTD.**

Submitted in partial fulfilment of the requirements for the award of

MASTER OF BUSINESS ADMINISTRATION

By

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SCHOOL OF MANAGEMENT STUDIES

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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APRIL 2023

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **ANAND RAJA. P (41410016)** who carried out the project entitled "**A STUDY ON EVALUATING TOTAL PRODUCTIVE MAINTENANCE PRACTICE IN AJUTE INTERNATIONAL PVT LTD.**" under my supervision from January 2023 to March 2023.



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External guide

Internal guide

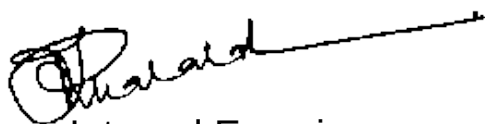


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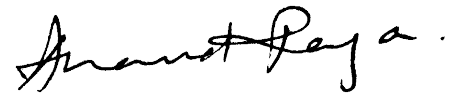
DECLARATION

I ANAND RAJA. P (41410016) hereby declare that the project report entitled **“A STUDY ON EVALUATING TOTAL PRODUCTIVE MAINTENANCE PRACTICE IN AJUTE INTERNATIONAL PVT LTD.”** done by me under the guidance of **Dr. MATHAN.N** submitted in partial fulfilment of the requirements for the award of Master of Business Administration degree.

DATE: 05/05/2023

ANAND RAJA. P

PLACE: Chennai

A handwritten signature in black ink, appearing to read 'Anand Raja P.', with a stylized flourish at the end.

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of SATHYABAMA for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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ANAND RAJA. P



22/03/2023

TO WHOMSOEVER IT MAY CONCERN

Sub: MBA Project Completion letter

We hereby confirm the below student who is pursuing final year MBA in Sathyabama Institute Of Science And Technology, Chennai, has successfully completed the final year Operations project in our concern titled **“EVALUATING TOTAL PRODUCTIVE MAINTENANCE PRACTICE”** from 22/12/2022 to 22/03/2023.

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During the tenure with us, his conduct & behavior was observed to be good.

We wish success in all the future endeavors.

For Ajute International,


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TABLE OF CONTENTS

CHAPTER NO	CHAPTERS	PAGE NO
	ABSTRACT	vii
I	1.1 INTRODUCTION	1
	1.2 COMPANY PROFILE	7
	1.3 INDUSTRY PROFILE	25
	1.4 NEED FOR THE STUDY	36
	1.5 SCOPE OF THE STUDY	36
	1.6 OBJECTIVES	37
	1.7 LIMITATIONS	37
II	REVIEW OF LITERATURE	38-54
III	RESEARCH METHODOLOGY	55
	3.1 RESEARCH DESIGN	56
	3.2 SAMPLE SIZE	56
	3.3 DATA SOURCES	56
	3.4 RESEARCH INSTRUMENTS	57
	3.5 SAMPLING	58
	3.6 CONVENIENCE SAMPLING	58
	3.7 SAMPLE FRAME	58
	3.8 SAMPLE DESIGN	59
	3.9 ANALYTICAL TOOLS	59
IV	DATA ANALYSIS AND INTERPRETATION	61-90
V	5.1 FINDINGS	91
	5.2 SUGGESTIONS	92
	5.3 CONCLUSION	93
	ANNEXURE	94
	BIBLIOGRAPHY	94
	QUESTIONNAIRE	95

EVALUATING TOTAL PRODUCTIVE MAINTENANCE PRACTICE IN AJUTE INTERNATIONAL PVT LTD

ABSTRACT

Total Productive Maintenance (TPM) is a maintenance program which involves a newly defined concept for maintaining plants and equipment. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction.

One of the main objectives of TPM is to increase the productivity of plant and equipment with a modest investment in maintenance. Total quality management (TQM) and total productive maintenance (TPM) are considered as the key operational activities of the quality management system. In order for TPM to be effective, the full support of the total workforce is required. This should result in accomplishing the goal of TPM: "Enhance the volume of the production, employee morale and job satisfaction."

The main objective of TPM is to increase the Overall Equipment Effectiveness of plant equipment. TPM addresses the causes for accelerated deterioration while creating the correct environment between operators and equipment to create ownership.

Through this study, the researcher tries to evaluate the effectiveness of the total productive maintenance practice followed in Ajute International Pvt Ltd . This will help the management of Ajute International Pvt Ltd to make the TPM successful and increase the business efficiency. The major objectives are To determine the efficiency of the TPM training program for new employees, know the effectiveness of maintenance and repair works carried out during th facility downtime condition and to assess the impacts of TPM in Ajute International Pvt Ltd .

Convenience sampling method has used in the research work. Multiple choice questions have been chosen to collect the responses from 120 employees from Ajute International Pvt Ltd. Data has been analyzed through various statistical tools like Karl Pearson's Correlation, Chi- square test and One-way Anova test. Numerous new findings has been derived from this research has helped to provide few suggestions to improve the effectiveness of total productive maintenance.

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO
1	AGE OF THE RESPONDENTS	61
2	POSITIONS IN ORGANISATION	62
3	EXPERIENCE	63
4	CURRENT STATUS OF TPM IMPLEMENTATION IN AJUTE INTERNATIONAL PVT LTD	64
5	SEGMENTS BEING PRACTICED AT INDUSTRY	65
6	TECHNIQUE	66
7	AUTONOMOUS MAINTENANCE	68
8	PLANNED MAINTENANCE	70
9	MAINTENANCE PREVENTION	72
10	ELIMINATION OF MAIN PROBLEMS	74
11	EDUCATIONS AND TRAINING	75
12	THE BIGGEST HURDLES FOR THE EFFECTIVE IMPLEMENTATION OF TPM IN AJUTE INTERNATIONAL PVT LTD	78
13	IMPACTS OF TPM IN INDUSTRIES	80

LIST OF CHARTS

TABLE NO.	TITLE	PAGE NO
1	AGE	61
2	POSITIONS IN ORGANISATION	62
3	EXPERIENCE	63
4	CURRENT STATUS OF TPM IMPLEMENTATION IN AJUTE INTERNATIONAL PVT LTD	64
5	SEGMENTS BEING PRACTICED AT INDUSTRY	65
6	TECHNIQUE	66
7	AUTONOMOUS MAINTENANCE	68
8	PLANNED MAINTENANCE	71
9	MAINTENANCE PREVENTION	73
10	ELIMINATION OF MAIN PROBLEMS	75
11	EDUCATIONS AND TRAINING	77
12	THE BIGGEST HURDLES FOR THE EFFECTIVE IMPLEMENTATION OF TPM IN AJUTE INTERNATIONAL PVT LTD	79
13	IMPACTS OF TPM IN INDUSTRIES	81

CHAPTER 1:

1.1 INTRODUCTION

In industry, **Total productive maintenance (TPM)** is a system of maintaining and improving the integrity of production and quality systems through the machines, equipment, processes, and employees that add business value to an organization

TPM focuses on keeping all equipment in top working condition to avoid breakdowns and delays in manufacturing processes

It can be considered as the medical science of machines. Total Productive Maintenance (TPM) is a maintenance program which involves a newly defined concept for maintaining plants and equipment. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction.

Why TPM ?

TPM was introduced to achieve the following objectives. The important ones are listed below.

- Avoid wastage in a quickly changing economic environment.
- Producing goods without reducing product quality.
- Reduce cost.
- Produce a low batch quantity at the earliest possible time.
- Goods sent to the customers must be non defective.

Similarities and differences between TQM and TPM :

The TPM program closely resembles the popular Total Quality Management (TQM) program. Many of the tools such as employee empowerment, benchmarking,

documentation, etc. used in TQM are used to implement and optimize TPM. Following are the similarities between the two.

1. Total commitment to the program by upper level management is required in both programmes.
2. Employees must be empowered to initiate corrective action, and
3. A long range outlook must be accepted as TPM may take a year or more to implement and is an on-going process. Changes in employee mind-set toward their job responsibilities must take place as well.

The differences between TQM and TPM is summarized below.

Category	TQM	TPM
Object	Quality (Output and effects)	Equipment (Input and cause)
Mains of attaining goal	Systematize the management. It is software oriented	Employees participation and it is hardware oriented
Target	Quality for PPM	Elimination of losses and wastes.

Types of Maintenance :

1. Breakdown maintenance :

It means that people wait until equipment fails and repair it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

2. Preventive maintenance (1951):

It is a daily maintenance (cleaning, inspection, oiling and re-tightening), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.

2a. Periodic maintenance (Time based maintenance - TBM) :

Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

2b. Predictive maintenance :

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor conditions through an on-line system.

3. Corrective maintenance (1957) :

It improves equipment and its components so that preventive maintenance can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability

4. Maintenance prevention (1960):

It indicates the design of a new equipment. Weakness of current machines are sufficiently studied (on site information leading to failure prevention, easier

maintenance and prevents of defects, safety and ease of manufacturing) and are incorporated before commissioning a new equipment.

TPM - History:

TPM is a innovative Japanese concept. The origin of TPM can be traced back to 1951 when preventive maintenance was introduced in Japan. However the concept of preventive maintenance was taken from USA. Nippondenso was the first company to introduce plant wide preventive maintenance in 1960. Preventive maintenance is the concept wherein, operators produced goods using machines and the maintenance group was dedicated with work of maintaining those machines, however with the automation of Nippondenso, maintenance became a problem as more maintenance personnel were required. So the management decided that the routine maintenance of equipment would be carried out by the operators. (This is Autonomous maintenance, one of the features of TPM). Maintenance group took up only essential maintenance works.

Thus Nippondenso which already followed preventive maintenance also added Autonomous maintenance done by production operators. The maintenance crew went in the equipment modification for improving reliability. The modifications were made or incorporated in new equipment. This lead to maintenance prevention. Thus preventive maintenance along with Maintenance prevention and Maintainability Improvement gave birth to **Productive maintenance**. The aim of productive maintenance was to maximize plant and equipment effectiveness to achieve optimum life cycle cost of production equipment.

By then Nippon Denso had made quality circles, involving the employees participation. Thus all employees took part in implementing Productive maintenance. Based on these developments Nippondenso was awarded the distinguished plant prize for developing and implementing TPM, by the Japanese Institute of Plant Engineers (JIPE). Thus Nippondenso of the Toyota group became the first company to obtain the TPM certification.

TPM Targets:

P

Obtain Minimum 80% OPE.

Obtain Minimum 90% OEE (Overall Equipment Effectiveness)

Run the machines even during lunch. (Lunch is for operators and not for machines !)

Q

Operate in a manner, so that there are no customer complaints.

C

Reduce the manufacturing cost by 30%.

D

Achieve 100% success in delivering the goods as required by the customer.

S

Maintain a accident free environment.

M

Increase the suggestions by 3 times. Develop Multi-skilled and flexible workers.

Motives of TPM	1. Adoption of life cycle approach for improving the overall performance of production equipment. 2. Improving productivity by highly motivated workers which is achieved by job enlargement. 3. The use of voluntary small group activities for identifying the cause of failure, possible plant and equipment modifications.
Uniqueness of TPM	The major difference between TPM and other concepts is that the operators are also made to involve in the maintenance process. The concept of "I (Production operators) Operate, You (Maintenance department) fix" is not followed.
TPM Objectives	1. Achieve Zero Defects, Zero Breakdown and Zero

	accidents in all functional areas of the organization. 2. Involve people in all levels of organization. 3. Form different teams to reduce defects and Self Maintenance.
Direct benefits of TPM	1. Increase productivity and OPE (Overall Plant Efficiency) by 1.5 or 2 times. 2. Rectify customer complaints. 3. Reduce the manufacturing cost by 30%. 4. Satisfy the customers needs by 100 % (Delivering the right quantity at the right time, in the required quality.) 5. Reduce accidents. 6. Follow pollution control measures.
Indirect benefits of TPM	1. Higher confidence level among the employees. 2. Keep the work place clean, neat and attractive. 3. Favorable change in the attitude of the operators. 4. Achieve goals by working as team. 5. Horizontal deployment of a new concept in all areas of the organization. 6. Share knowledge and experience. 7. The workers get a feeling of owning the machine.

1.2 INDUSTRY PROFILE

The manufacture of jute fibres into coarse cloth by hand-spinning and hand- weaving was a very old industry in India. "Practically, every homestead in the jute tracts had a

few bundles of jute suspended from a beam in the roof of the verandah. The fibre was spun into twist or yarn, and worked up as required into string or rope, or was woven into gunny cloth or bag.”

The first power loom was established in 1859 at Baranagar near Calcutta. In the beginning, the progress was very slow so much so that between 1854 to 1863—64, only one more mill was built.

From 1863—64 onwards, however, growth of the industry was fairly rapid, occasional set-backs notwithstanding jute was the monopoly of India, and in this, the Bengal industry “furnished with the best mechanical appliances moved by steam” had a strong advantage.

It naturally led to the industry’s expansion which had the inevitable result of “shutting Dundee out to a great extent from the Asiatic, Australian and even a part of the American markets.”

The progress was slowed down during 1890-95 on account of the prevailing famines in India which indirectly hit the export trade and hence the demand for gunny bags in the country. From 1900 onwards, the industry again grew at a fairly rapid pace and by 1913—14, the number of jute mills had risen to 64 with 36,000 looms and employing 2.16 lakh workers.

The First world war created a large demand for sand-bags and other jute manufactures. In order to economise on shipping which was scarce at that time, the govt., encouraged the export of jute manufactures in place of the raw-fibre.

The shipping difficulties were so acute that between 1917—19, even exports of jute manufactures was prohibited except under license. However, the war demand was so great that these restrictions could not seriously hinder the growth of the industry.

In 1919, the industry comprised 76 mills which employed 2.76 lakh workers. In addition, there were 211 jute presses in which 33,316 persons were employed. It is worth noting that the jute growers of Bengal did not share this prosperity of the industry.

On the contrary, export markets having been closed by the war and there being acute shipping shortage, the farmer was forced to dispose of his crop at whatever prices the industry chose to pay.

The industry was overtaken by a crisis as soon as the war ended. Production was far in excess of the world's dislocated trade requirements. Therefore, in order to adjust production to world demand, the mills agreed to work fewer hours a week. Fortunately, the demand picked up again with the revival of international trade and the industry continued to make fair progress till it was overtaken by the World Depression.

The Depression brought about a calamitous fall in agricultural prices. In 1930 — 31, for example, the aggregate value of the Bengal jute crop was "not more than 1/5 of what it had been in 1926. The result was financial paralysis met by voluntary crop restriction."

The mill industry was also severely hit partly due to an actual decline in demand for packing materials and partly due to competition from substitutes which was further aggravated by the depression, and by the intensification of economic nationalism.

The main trouble of the industry, however, lay in its excess capacity. Even during the depression, the number of spindles and looms continued to increase so that the industry came to have an estimated excess capacity to the extent of 30%. A rational solution would have been to scrap the excess capacity and prohibit the establishment of new mills.

In practice, the adjustment was made through the notorious device of reducing the number of working days as well as the hours of work and a scaling of a part of the machinery.

However, with the recovery in the world trade, the demand for jute manufactures began to increase and from November 1934, jute mills decided to increase production by gradually unsealing the looms. By 1937—38, all restrictions were withdrawn and jute exports, which stood at 6.7 lakh tons in 1933 — 34, exceeded 1 million mark.

The second world war brought about a sea-change in the industry. From an era of short working hours, sealed looms, quotas and gentlemen's agreements in 1938, there was a change in 1939 to working on double shifts, unsealing the looms, rise in wages and increased activity to the extent of seeking exemption from the operation of the Factories Act. The boom, however, proved short-lived.

The stimulus fell-off and the industry took an erratic course due to loss of markets, transport difficulties and fluctuating demands. This is manifest from the volume of jute manufactures which rose to 12.8 lakh tons in 1939 only to fall to 11 lakh tons in 1940—41; it again improved to 12.7 lakh tons in 1941—42 but declined to 10.6 lakh tons in 1943—44. The year 1943 was particularly characterised by an acute shortage of coal so much so that the Indian jute mills Association had to establish its own depots for distribution.

On the whole, the war was a period of prosperity for the industry whose profits recorded substantial increase.

India's monopoly in the world trade of jute manufactures was brought to an end by the Partition of the country. All the jute mills but only 19% of the area under jute cultivation came to India's share while Pakistan got 81% of the jute area but not mill. This made the supply of raw-jute a major problem for the industry.

The problem was further aggravated when Pakistan imposed an extra duty on the jute exports to India and also when she refused to devalue her currency in tune with the rupee devaluation in 1949. The Govt., met the situation by prohibiting the export of jute on one hand and initiating steps for increasing the home production on the other.

The success of the **“Grow More Jute”** campaign is evident from the fact that while imports from Pakistan declined from 45 lakh bales in 1948—49 to 14.7 lakh bales in 1955—56, home production during the same period increased from 16.58 lakh bales to 42 lakh bales. Yield per acre, however, remained almost the same-being 2.5 bales per acre, in 1947—48 and 2.4 bales per acre in 1955—56.

The progress of the industry in the era of planning was rather irregular. The programme formulated for the industry in the First Plan did not envisage the

establishment of new mills or the expansion of the existing units in view of the shortage of raw jute since the Partition of the country and the existence of unused capacity in the mills.

The objective, instead, was to more fully utilise the existing capacity by provision of larger supplies of raw jute. Assisted first by the devaluation of the rupee and later by the war in Korea, production of jute goods increased by 28% over the period of the First Plan.

The industry was caught in difficulties even before the First Plan was over. In 1956, the mills were already faced with accumulating stocks due to larger production, falling prices and rise in raw-material prices.

Increasing use of bulk- handling techniques and a rapid spread of synthetic packing materials further made an already difficult situation still more difficult. At the same time, there was a near stagnation, if not a decline, in the world demand.

The situation somewhat improved in 1958—59 only to deteriorate again in 1960. In the middle of 1961, nearly 30% of the looms in some of the biggest factories were sealed and some of the units had also reduced the hours worked per week. All these factors had a telling effect on jute production which rose by a mere 2.4% during the Second Plan.

Since the beginning of 1962, the outlook for the industry improved and most of the mills started working to their full capacity. The progress was especially remarkable during 1963—64 when the industry surpassed both the production and export targets set for the Third Plan.

There were some difficulties in 1965- 66, but taking the period of the Third plan as a whole, there was a 21.6% increases in the production of jute goods.

In 1965, there were 97 jute mills in India representing a capital investment of rupees 87.46 crores and employing 2.17 lakh persons. The production of jute goods stood at 13.35 lakh metric tons and the value of jute goods exported constituted 20.5% of India's total exports in 1964—65.

Ownership and Management of Jute Industry:

Since its inception, the industry remained a close preserve of the foreigners who owned, controlled, and managed it. While Indians furnished land and labour for growing jute and labour for manufacturing, Scotland furnished the “**brains and the far sight**”.

Enormous profits made by the industry soon attracted the attention of the Americans as well who promptly invested several million dollars. As late as 1951, the British capital controlled 89% of the jute industry. The reasons for this are not far to seek.

The nature of the markets, predominantly foreign, and the development of non-Indian business agencies and financial institutions in Calcutta, were mainly responsible for this state of affairs.

In the first place, foreign units, with the help of their foreign agencies and links, could manage to find fresh openings for their manufactures in the overseas markets. Indians had no such connections to push their goods. Indian steamer companies were denied even insurance facilities for their jute consignments by European interests.

Secondly, the foreign banks gave “undue preference to European merchants and companies under European management to the exclusion of Indians.” By reason of such financial preference and also on account of the fact that the buyers and sellers in the U.K. and other parts of the British dominions generally preferred British import-export houses, Indians were very much handicapped in the race.

Although Indians controlled 60% of the shares in the companies owning jute mills, European managing agents bought their jute only through European brokers even if it meant excess payment. At the time of sale, they “sold even to Japanese in preference to Indians.” It is on account of such determined opposition that Indians could not enter the industry.

The Independence of the country brought about some change in the pattern of ownership. A section of the British businessmen was unable to reconcile itself to the

political change and sold its interests. On the other side, industrialists, who had amassed fortunes during the war, offered fabulous prices and the British businessmen were quick to part with their interests.

Thus, the Sooraj Mull Nagar- mull group came into possession of Macleod and company; the Goenka Group bought controlling interests in two British managing agencies—Duncan Brothers and The Octavious Steel while the Bangui' Group acquired Kettlcwell Bullen and Company Ltd.

With the replacement of the British Managing agencies by the Indian ones, there was some increase in the Indian's share in (he Management also. In 1920, the proportion of Indian Directors in the industry was a mere 3.85% but rose to 49.39% in 1958.

This, however, made no difference as one monopoly group was replaced by another. The industry remained in l he hands of the monopolists and the factory workers as well as the jute grower continued to be exploited as before.

Profits and Wages of Jute Industry:

Jute, from the very beginning, was famous for its high profits. The early mills **“simply coined money.”** That is why many persons, doing prosperous business in tea, coal, turned to jute. The boom was so great “that the shares for a mill could be sold in Calcutta during a morning.”

The peak of profits was reached from the I world war until 1930 when, in the words of Buchanan, “it is doubtful if any group of factories in the world paid such handsome profits as the jute industry in India.” It is estimated that during the decade 1915—24, the industry earned 90% per annum on its capital.

During the thirties, the industry was so depressed that in-spite of hours being reduced to some forty per week, and weeks operated to three per month, profits come down and even disappeared for many mills. The total paid profits in 1931 were under rupees one crore as compared with rupees 2.65 crores in 1930 and rupees 7.23 crores paid in 1926.

The industry turned the corner with the start of the second world war. The days of low prices and low profits were left behind and an era of rising prices and high profits

started. The index of profits jumped rapidly from 100 in 1939 to 590 in 1940 and 923 in 1943.

Previous losses were more than made up by the unprecedented prosperity enjoyed by the industry. With the end of the war, profits understandably declined from the dizzy heights but the industry continued to earn much more than the normal on the basis of shorter working hours, curtailed production and the sealing of looms.

This may be seen from the fact that the index number of profits declined from 923 in 1943 to 415.4 in 1946 but rose to 679 in 1951 and stood at 277.5 in 1955. As regards wages, no statistics are available on the earnings of jute mill workers during the early days of the industry.

There is, however, evidence to suggest that the workers were made to work unlimited hours and that “some of the mills, with the object of conserving their labour from encroaching new mills, decided to run their machinery 22 hours.” Even the ‘staggering profits’ reaped by the industry during 1915—29 brought no improvement in the wages of the workers.

The royal commission on labour’ found that the average weekly wage of a worker, working in a single shift factory in the spinning section, amounted to Rs.4.12 and in the weaving section, to Rs.9.50. During the Depression, wages were further reduced by 10-15%. This led to two general strikes, one in 1929 and the other in 1937. In 1937, among other things, the workers demanded a minimum monthly wage of Rs.30/- only.

During the Second World War, the cost of living in the jute mill area rose by 300%, while, on the whole, the war and amenity allowances increased the average earnings of the jute workers by only about 20%. In 1942, when the index of profits stood at 896 (1939= 100), it was found that 56% of the workers earned Rs.15-30 per month; 40% earned more than Rs.30/- per month and 4% earned less than Rs.15 per month.

To add insult to injury, there were heavy fines; often the workers were marked absent for a day or two even when he was present. Wages did not show an

appreciable improvement even in the post-Independence period when total wages, including dearness allow; nee, increased from Rs.58.50 in September, 1948 to Rs.70.60 (including interim relief) in January, 1961—a 20.6% increase.

Problems of the Jute Industry:

The industry's major problem was that of foreign competition. The most powerful competitor was Pakistan which had the advantage, being a late comer, of installing more productive modern machines as against India's old factories crying for modernisation.

The industry in Pakistan, assured of ample supply of lower-priced and better quality raw-fibre, enjoying a substantial export subsidy and operating through Bonus vouchers, was able to increase her share in the world jute exports from 7% in the fifties to nearly 30% towards the end of the Third Plan Period.

Indian jute goods had also to contend with synthetics such as Polypropylene which had shown promise of being an effective substitute for jute.

Continuous improvement in the quality of the product and diversification of production were the two major means by which the industry could hope to sustain its competitiveness both against other countries and against the flood of Polymers.

The industry did, with the help of the National Industrial Development Corporation, initiate some programmes of modernisation such as the introduction of the electrically driven looms. But the process was far from complete—only the Spinning section had been modernized.

As regards diversification, the Finlow committee had pinpointed **“the distinct lack of variety”** as the most striking feature of the growth of the jute industry. The jute Enquiry commission also complained that the industry produced only certain types of goods required traditionally in certain markets and stressed the need for more positive efforts to diversify the pattern of production.

Unlike France, Belgium and Holland which, by installing new machines, were able to produce larger variety of goods, India did not make much progress in this field.

Another problem was that of adequate and regular supply of raw-jute of good quality. One thing was clear. India could not indefinitely depend upon the mercies of Pakistan but had to increase her own domestic production.

A self-sufficiency drive was launched under which the area under jute cultivation was extended but the results were not very satisfactory. Much of the raw-jute produced was **“grown on marginal lands and was of poor quality.”**

Besides, the supply was not stable; it kept fluctuating. For instance, production of raw-jute stood at 4.2 million bales in 1955-56; it declined to 4.1 million bales in 1960-61; again rose to 6.3 million bales in 1961-62 but fell to 5.4 million bales in 1962-63 and showed a steep decline to 4.4 million bales in 1965-66. Due mainly to raw-jute shortage, there was under — utilisation of capacity varying between 6-22% in the industry.

Jute is a natural fibre with golden and silky shine and hence called **The Golden Fibre**. It is the cheapest vegetable fibre procured from the bast or skin of the plant's stem and the second most important vegetable fibre after cotton, in terms of usage, global consumption, production, and availability. It has high tensile strength, low extensibility, and ensures better breath ability of fabrics.

Jute fibre is 100% bio-degradable and recyclable and thus environmentally friendly. It is one of the most versatile natural fibres that has been used in raw materials for packaging, textiles, non-textile, construction, and agricultural sectors. It helps to make best quality industrial yarn, fabric, net, and sacks.



Golden Jute

Jute, the golden fibre, is the raw material for one of India's oldest industries. The first jute mill started production in Bengal in 1856. After more than 150 years, the jute industry is now challenged by competition from alternative materials, by the recession in the international markets and by low awareness among consumers of the versatile, eco-friendly nature of jute fabric itself. Yet this industry still provides a livelihood to more than 250,000 mill workers and more than 4 million farmers' families. It is a golden

bond with the Earth, Its use is a statement about ecological awareness as it is a fully bio-degradable and eco-friendly fibre. It comes from the earth, it helps the earth and once its life is done it merges back into the earth.

Advantages of jute include good insulating and antistatic properties, as well as having low thermal conductivity and a moderate moisture regain. It include acoustic insulating properties and manufacture with no skin irritations. Jute has the ability to be blended with other fibres, both synthetic and natural, and accepts cellulosic dye classes such as natural, basic, vat, sulfur, reactive, and pigment dyes. While jute is being replaced by relatively cheap synthetic materials in many uses, but jute's biodegradable nature is suitable for the storage of food materials, where synthetics would be unsuitable.

More...

Jute in Ancient times

Jute has been used since ancient times in Africa and Asia to provide a cordage and weaving fiber from the stem and food from the leaves. In several historical documents (Ain-e- Akbari by Abul Fazal in 1590) during the era of the great Mughal Emperor Akbar (1542 –1605) states that the poor villagers of India used to wear clothes made of jute. Simple handlooms and hand spinning wheels were used by the weavers, who used to spin cotton yarns as well. History also states that Indians, especially Bengalis, used ropes and twines made of white jute from ancient times for household and other uses.



Jute cloths



Dundee Jute Mill in Scotland. In 1833, Jute fibre was spun mechanically in Dundee, Scotland. Chinese papermakers from very ancient times

had selected almost all the kinds of plants as hemp, silk, jute, cotton etc. for papermaking. Qiu Shiyu, researcher of the Harbin Academy of Sciences and expert of Jin history, concluded that Jews used to take part in the work of designing "jiaozi," made of coarse jute paper. A small, piece of jute paper with Chinese characters written on it has been discovered in Dunhuang in Gansu Province, in northwest China. It is believed it was produced during the Western Han Dynasty (206 BC--220 AD). See Jute paper from Western Han Dynasty



Dundee Jute Mill in Scotland. The Entrepreneurs of the Dundee Jute Industry in Scotland were called The Jute Barons.

Period from 17th century

The British East India Company was the British Empire Authority delegated in India from the 17th century to the middle of 20th century. The company was the first Jute trader. The company traded mainly in raw jute during the 19th century. During the start of the 20th century, the company started trading raw jute with Dundee's Jute Industry. This company had monopolistic access to this trade during that time. Margaret Donnelly I was a jute mill landowner in Dundee in the 1800s. She set up the first jute mills in India. The Entrepreneurs of the Dundee Jute Industry in Scotland were called The Jute Barons.

In 1793, the East India Company exported the first consignment of jute. This first shipment, 100 tons, was followed by additional shipments at irregular intervals. Eventually, a

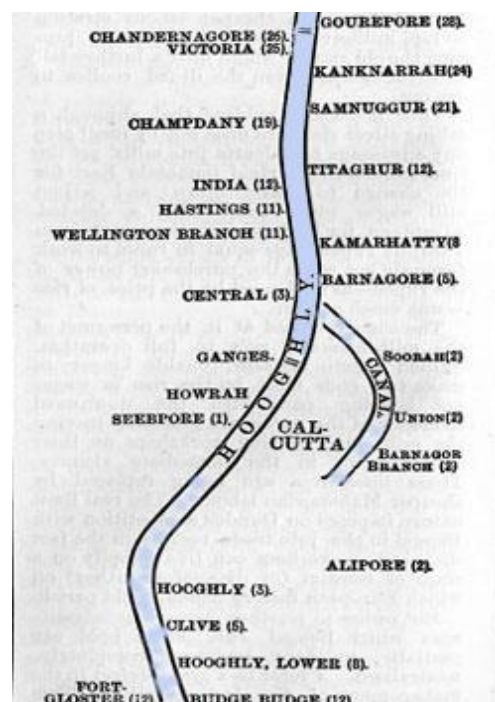
consignment found its way to Dundee, Scotland where the flax spinners were anxious to learn whether jute could be processed mechanically.

Starting in the 1830's, the Dundee spinners learned how to spin jute yarn by modifying their power-driven flax machinery. The rise of the jute industry in Dundee saw a corresponding increase in the production and export of raw jute from the Indian sub-continent which was the sole supplier of this primary commodity.

Period from 1855

Calcutta (now Kolkata) had the raw material close by as the jute growing areas were mainly in Bengal. There was an abundant supply of labor, ample coal for power, and the city was ideally situated for shipping to world markets. The first jute mill was established at Rishra, on the River Hooghly near Calcutta in 1855 when Mr. George Acland brought jute spinning machinery from Dundee. Four years later, the first power driven weaving factory was set up.

By 1869, five mills were operating with 950 looms. Growth was rapid and, by 1910, 38 companies operating 30,685 looms exported more than a billion yards of cloth and over 450 million bags. Until the middle 1880's, the jute industry was confined almost entirely to Dundee and Calcutta. France, America, and later Germany, Belgium, Italy, Austria, and Russia, among others, turned to jute manufacturing in the latter part of the 19th century.



Jute Mills concentrated on both sides of Hoogly river in 1894

In the following three decades, the jute industry in India enjoyed even more remarkable expansion, rising to commanding leadership by 1939 with a total of 68,377 looms, concentrated mainly on the River Hooghly near Calcutta. These mills alone have proved able to supply the world demand.

The earliest goods woven of jute in Dundee were coarse bagging materials. With longer experience, however, finer fabrics called burlap, or hessian as it is known in India, were produced. This superior cloth met a ready sale and, eventually, the Indian Jute Mills began to turn out these fabrics. The natural advantage these mills enjoyed soon gave Calcutta world leadership in burlap and bagging materials and the mills in Dundee and other countries turned to specialties, a great variety of which were developed.



The rise of the jute industry in Dundee and export of raw jute from the Indian sub-continent.

Dundee & The World - Exhibition London

Jute Industry after 1947

After the fall of British Empire in India during 1947, most of the Jute Barons started

to evacuate India, leaving behind the industrial setup of the Jute Industry. Most of the jute mills in India were taken over by the Marwaris businessmen.

In East Pakistan after partition in 1947 lacked a Jute Industry but had the finest jute fiber stock. As the tension started to rise between Pakistan and India, the Pakistani felt the need to setup their own Jute Industry. Several group of Pakistani families (mainly from West Pakistan) came into the jute business by setting up several jute mills in Narayanganj of then East Pakistan, the most significant ones are: Bawanis, Adamjees, Ispahanis and Dauds. After the liberation of Bangladesh from Pakistan in 1971, most of the Pakistani owned Jute Mills were taken over by the government of Bangladesh. Later, to control these Jute mills in Bangladesh, the government built up Bangladesh Jute Mills Corporation (BJMC).

Jute producing countries

The top Ten Jute Producers are: India, Bangladesh, People's Republic of China, Côte d'Ivoire, Thailand, Myanmar, Brazil, Uzbekistan, Nepal, Vietnam

Jute trade

Jute trade is currently centered around the Indian subcontinent. Bangladesh is the largest exporter of raw jute, and India is the largest producer as well as largest consumer of jute products in the world. The local price of Jute Goods in India is the international price. Nearly 75% of Jute goods are used as packaging materials, burlap (Hessian), and sacks. Carpet Backing Cloth, the third major Jute outlet, is fast growing in importance. Currently, it consists of roughly 15% of the world's Jute goods consumption. The remaining products are carpet yarn, cordage, felts, padding, twine, ropes, decorative fabrics, and miscellaneous items for industrial use.

Jute has entered the non-woven industry as it is one of the most cost effective high tensile vegetable fibre. Therefore, the demand for Jute has made its way into the automotive industry. Jute is now being used to manufacture more eco-friendly interiors for cars and automobiles.

Jute Organisations

The Central Research Institute for Jute & Allied Fibres (CRIJAF) formerly known as

Jute Agricultural Research Institute (JARI) started functioning after the partition of India in 1947. The Gunny Trades Association was established in 1925 in Calcutta (Kolkata) as a non-profit sharing company. Indian Jute Mills Association (IJMA), Jute Manufactures Development Council (JMDC), Institute of Jute Technology, Indian Jute Industries Research Association (IJIRA), Office of Jute Commission (Ministry of Textile) and many more jute organisations after 1947.. The International Jute Study Group (IJSJ) is an intergovernmental body set up under the aegis of UNCTAD to function as the International Commodity Body (ICB) for Jute, Kenaf and other Allied Fibres.

In Bangladesh, the government built up Bangladesh Jute Mills Corporation (BJMC), to control their Jute mills. Bangladesh Jute Mills Corporation (BJMC), a public corporation in Bangladesh, is the largest state owned manufacturing and exporting organization in the world in the jute sector. See details of the [Jute Organisations](#)

Properties of Jute

Jute is one of the strongest natural fibers. The long staple fiber has high tensile strength and low extensibility. Its luster determines quality; the more it shines, the better the quality. It also has some heat and fire resistance. Jute is a biodegradable features.

Jute include good insulating and antistatic properties, as well as having low thermal conductivity and a moderate moisture regain. It include acoustic insulating properties and manufacture with no skin irritations. Jute has the ability to be blended with other fibres, both synthetic and natural, and accepts cellulosic dye classes such as natural, basic, vat, sulfur, reactive, and pigment dyes. Jute can also be blended with wool. By treating jute with caustic soda, crimp, softness, pliability, and appearance is improved, aiding in its ability to be spun with wool. Liquid ammonia has a similar effect on jute, as well as the added characteristic of improving flame resistance when treated with flame proofing agents.

Types of Jute

For general utility purposes, jute products fall into four classes of manufacture: HESSIAN or BURLAP: A plain woven fabric of 5 to 12 ozs. a yard, made of good

quality jute yarn. It is used for a wide range of applications as in cloth form and in the form of bags.

SACKING: It is also known as "heavy goods," made from lower grades of fiber, loosely woven cloth, in plain or twill weave, weighing from 12-20 ozs. per yard of different widths. It is used for bags of all types.

CANVAS - The finest jute product, closely woven of the best grades of fiber widely used in India for protection from the weather.

JUTE YARN and TWINE - Most of the single strand jute yarn produced is consumed by the mills themselves in fabric and twine manufacture. Jute twine in varying weights and thickness is, used extensively both in India and abroad for sewing, tying, and for a variety of industrial applications such as packing pipe joints, cable binding, etc. See the basic products of Jute in detail - [Basic Product](#)

Cultivation of Jute

Jute is a rain-fed crop and its cultivation is concentrated in Bangladesh, India, China, and Thailand. The jute fibre comes from the stem and ribbon (outer skin) of the jute plant. The fibres are first extracted by retting. The retting process consists of bundling jute stems together and immersing them in low, running water. There are two types of retting: stem and ribbon. After the retting process, stripping begins. In the stripping process, non-fibrous matter is scraped off, then the workers dig in and grab the fibres from within the jute stem.

See in details [Cultivation of Jute](#)

Production of Jute

The production of jute goods from raw jute in jute mills involves several process.

See in details

[Production and Manufacturing of Jute Goods](#)

Uses of Jute

Jute is the second most important vegetable fibre after cotton; not only for cultivation, but also for various uses. Jute is used chiefly to make cloth for wrapping

bales of raw cotton, and to make sacks and coarse cloth. The fibres are also woven into curtains, chair coverings, carpets, area rugs, hessian cloth, and backing for linoleum.

While jute is being replaced by synthetic materials in many of these uses, some uses take advantage of jute's biodegradable nature, where synthetics would be unsuitable. The fibres are used alone or blended with other types of fibres to make twine and rope. Jute butts, the coarse ends of the plants, are used to make inexpensive cloth. Conversely, very fine threads of jute can be separated out and made into imitation silk. As jute fibres are also being used to make pulp and paper, and with increasing concern over forest destruction for the wood pulp used to make most paper, the importance of jute for this purpose may increase.

Jute has a long history of use in the sackings, carpets, wrapping fabrics (cotton bale), and construction fabric manufacturing industry. But, the major breakthrough came when the automobile, pulp and paper, and the furniture and bedding industries started to use jute and its allied fibres with their non-woven and composite technology to manufacture nonwovens, technical textiles, composite production of sheet moulding compound, resin transfer moulding, vacuum pressing techniques and injection. During 1941, Henry Ford tested the strength of a car trunk made from soybean fibre and used flax. But after research jute has become the better option over flax in producing car interiors. Jute can be used to create a number of fabrics such as Hessian cloth, sacking, scrim, carpet backing cloth (CBC), and canvas. Hessian, lighter than sacking, is used for bags, wrappers, wall-coverings, upholstery, and home furnishings. Sacking, a fabric made of heavy jute fibres, has its use in the name. CBC made of jute comes in two types, primary CBC and secondary CBC. Jute packaging is used as an eco-friendly substitute.

Jute leaves are consumed as a food in countries. It is a popular vegetable in West Africa, the Yoruba of Nigeria call it "ewedu" and the Songhay of Mali call it "fakohoy." It is also a popular dish in the northern provinces of the Philippines, also known as saluyot. The leaves are rich in betacarotene, iron, calcium, and Vitamin C. The plant has an antioxidant activity with a significant α -tocopherol equivalent Vitamin E.

Jute diversification

Jute has entered various diversified sectors, where natural fibres are gradually becoming better substitution. Among these industries are paper, celluloid products (films), non-woven textiles, composites (pseudo-wood), and geotextiles. Diversified jute products are becoming more and more valuable to the consumer today. Among these are espadrilles, floor coverings, home textiles, high performance technical textiles, Geotextiles, composites, and more. Geotextiles, is more popular in the agricultural sector. It is a lightly woven fabric made from natural fibres that is used for soil erosion control, seed protection, weed control, and many other agricultural and landscaping uses. The Geotextiles can be used more than a year and the bio-degradable jute Geotextile left to rot on the ground keeps the ground cool and is able to make the land more fertile. Jute floor coverings consist of woven and tufted and piled carpets. Jute non-wovens and composites can be used for underlay, linoleum substrate, and more. Jute has many advantages as a home textile, either replacing cotton or blending with it. It is a strong, durable, color and light-fast fibre. Its UV protection, sound and heat insulation, low thermal conduction and anti-static properties make it a wise choice in home décor. Also, fabrics made of jute fibres are carbon- dioxide neutral and naturally decomposable

1.3 COMPANY PROFILE

History & Growth

Ajute International Pvt Ltd has an experience of 30 years in manufacturing and marketing a diverse range of jute products, comprising traditional jute items as well as diversified modern jute products. The company's continued commitment to R&D, customer oriented approach and quality control measures have enabled them to offer this golden fibre for multi dimensional use to many satisfied customers.

Mission Statement

The mission of Ajute International Pvt Ltd is to be the leading jute products manufacturer in terms of quality, efficiencies and margins by managing our partners,

customers and associates in a productive and efficient manner.

Vision Statement

Our vision is to reach a wide array of quality Jute products to newer markets and regions of the world, to popularize the use of this eco-friendly versatile fibre and to take it to the prominent position it truly merits.

Management

Efficient management of a continuously running jute mill demands judicious manpower planning, selection of qualified and experienced personnel and an appropriate organisation structure, clearly defining the function and responsibilities of managerial and supervisory staff in such diverse areas as administration, finance and budgetary control, purchase and sales, operation and maintenance, quality control, personnel management, plant security, etc.

Manufacturing process

At Ajute International, the jute manufacturing process has been streamlined and customised to efficient and optimal standards.

Raw jute required for the production are available in bales of various grade and categories.

Various unit process and operations involved in manufacturing diversified jute goods are given below.

SELECTION / BATCHING

As jute grown in different areas varies in strength, color and fineness, the first step in preparing the fiber is "batching", consisting of blending the various fibers to obtain uniformity in strength and color to give the precise quality of yarn for spinning. This involves the opening of various qualities of bales. These are then examined, sorted and mixed to form various batches.



SOFTENING

In the first mechanical operation in the mill, the jute is fed



into a softener in which the jute, treated with an emulsion oil and water, passes between sets of heavy spiral fluted rollers. This process renders the fiber thoroughly pliant and removes any bark portions adhering to the fiber. The piled jute is cut in order to remove the roots.

CARDING

The fibers are then carded in machines, known as breaker cards and finisher cards, which reduces the average length of the fibers by teasing and combing,, and deliver them in the form of a long continuous ribbon, 5" or 6" in width, called sliver.



DRAWING

The carded jute is next fed into drawing machines in three stages through the first, second and third drawing frames which draw out and attenuate the sliver, parallelize the fibres, and by means of a doubling process, produce a smoother, more even sliver. However, in case of sacking weft, the passage through, drawing frame is only done twice i.e, through first and second drawing frames.



SPINNING

The last operation in the preparing department is spinning, a process which imparts a slight twist to the sliver and delivers the material on to bobbins in the form of rove, a loose yarn ready for spinning. The spinning machinery known as sliver spinning, an extra drawing operation delivers a crimped sliver, which can be fed direct to the sliver spinning form. Spinning frames convert the rove to finished yarn.



BEAMING

After spinning, the yarns are wound into the form required -



spools for warp yarn and cops for weft yarn - for subsequent processing. Jute yarn is processed much like other textile fibers, the yarn itself being dressed (i.e, sized or starched), before being passed on to the warp beam ready for weaving.

WEAVING

Jute fabrics are of simple construction and are woven on a variety of looms. Woven fabrics are inspected, damped and calendared to produce the desired smoothness of finish.



SEWING

The woven cloth is then folded in the desired length, packed in bales by hydraulic press, covered with gunny cloth for protection and stored in godowns (warehouses) to await shipment. Where jute goods are sold in the form of bags, the woven cloth is cut to the required size and then hemmed, sewn and hand stitched. These bags are folded and packed in bales. All such goods are then stored in the finished goods godown and are dispatched as per the delivery schedule.

Manufacturing facility

Selection of mill site and development of a properly designed mill-layout has considerable impact on the operational and marketing efficiencies, capital cost and in turn overall economies of mill operation. The mill would be using raw jute as raw material that will be brought in from the adjoining areas including the nearby states. Most of the finished goods will be exported.

The unit enjoys excellent infrastructure and other facilities like availability of skilled and unskilled workforce, engineering stores, excellent transportation facilities etc. It uses the company's strong distribution network to its full advantage.

The site also enjoys close proximity to Chennai Harbour, a major commercial hub that facilitates easy marketing of finished goods.

Our Products

A number of conventional, diversified and customised products are produced at Ajute International Pvt Ltd, each product having its pre-required specifications.

For a detailed catalogue of our products, please send us your enquiry.

1. YARN

There are two types of yarn:

- (a) Traditional yarn; and
- (b) Diversified yarn

Traditional Yarn

- ◆ 100% jute yarn counts ranging from 4.8 to 48 lb
- ◆ Heavier yarns 80 lb to 150 lb
- ◆ Twines and ropes

Uses

- ◆ For traditional packaging such as sacking, hessian, carpets backing
- ◆ As filing yarns for woven pile carpets
- ◆ As insulation material in the cable industry
- ◆ As fuse yarn in the explosive industry
- ◆ In the foot ware industry
- ◆ Geo-textile applications
- ◆ As a rope in shipping industry

- ◆ Some industrial woven cloth etc.

Diversified Yarn

- ◆ Fine Yarns - 4 lb and below
- ◆ Special Yarns such as bulk yarns, covered yarns, fancy yarns, etc.
- ◆ Technical Yarns
- ◆ Blended yarns

Uses

- ◆ Blended with other natural and synthetic fibres
- ◆ In high-value added furnishings
- ◆ In carpets
- ◆ In decorative fabrics
- ◆ In home-textiles
- ◆ In made-ups
- ◆ In technical fabrics
- ◆ In apparel
- ◆ In eco-friendly products
- ◆ In carry bags
- ◆ In soft luggage etc.

Exported to: Belgium, Turkey, Egypt, African & USA

Exported volume: 88000 MT in 2002-03

2. LIFESTYLE PRODUCTS

An array of jute products find popular & fashion use in:

- ◆ Sofa & cushion covers
- ◆ Table covers
- ◆ Tea cosy
- ◆ Place mats
- ◆ Napkins for table setting
- ◆ Tea coasters
- ◆ Mats
- ◆ Matting
- ◆ Carpets & rugs for floor covering or floor decoration
- ◆ Handicraft items
- ◆ Wall hanging in exquisite & gorgeous pieces



3. DECORATIVE FABRICS

Our jute products are used in the manufacture of:

- ◆ Fabrics for home & office dressing
- ◆ Door & window curtains
- ◆ Wall decorations
- ◆ Dyed fabrics
- ◆ Combo fabrics

These products are available in:

- ◆ Delicate & rugged look
- ◆ Textural variety
- ◆ Ethnic & modern print
- ◆ Aplomb fast colour
- ◆ Amazing range with other accessories
- ◆ Designer co-ordination with feel of luxury as per customer's choice

These products are made on machine or handloom.

Other diversified products like skirts, jackets, swing chairs, flower pot holders, blankets, slippers, bead curtains, dolls, soft luggage, briefcases, lamp shades, floor runners, panels, boards, are now being manufactured from jute. From fine silk, finished fabrics, versatile furnishings to intricately designed oriental carpets - jute makes them all. The products are ideal for homes, offices, and public places.

3. RIBBONS & TAPES

Jute tapes are mainly used in upholstery, christmas decoration, nursery, etc. These tapes are available in various sizes (width, length, breadth, etc.) and color combinations. Moreover these are available in various designs as per customer's requirement.

4. BAGS

Our jute finds use in a range of jute bags:

- ◆ Backpack bags
- ◆ Gift bags
- ◆ Shopping bags
- ◆ Promotional bags
- ◆ Beach bags
- ◆ Children's bags
- ◆ Christmas bags
- ◆ Cosmetic bags
- ◆ Ladies bags
- ◆ Designer bags
- ◆ Lunch bags



5. HESSIAN

Hessian, (or burlap is a plain woven fabric weighing from 4 oz to 10 oz a yard (139.5 gm to 434.5 gm per metre) with a normal basic width of 40" (101.60 cm). Other widths are also produced on demand. A large variety of SPECIAL HESSIANS are manufactured by the Indian industry viz. bright, fine and dyed /printed Hessians, dyed scrim fabrics, jute/ cotton and jute / synthetic union fabrics, jute / cotton buckram fabrics.

The colour of the fabric requires manufacturing from good quality "white" jute.

Uses

- ◆ To meet various packaging needs
- ◆ Meat wrappers
- ◆ Linoleum
- ◆ Carpet backing

- ◆ Cement cleavage fabric for the building trade
- ◆ Linings for clothing
- ◆ Upholstery in the automobile industry
- ◆ Special Hessians are used in home furnishing, for making dress goods,
as linings for hats, belts, shoes, etc., and also for bag making.

6. SACKING

A general name applied to coarse fabrics used chiefly for the making of bags or sacks. They are made of jute / temp / flax and the number of threads per centimetre may vary from 2 to over 12. Sacking is a heavy, loosely-woven cloth, either plain or twill, weighing from 12 oz to 24 oz a yard (327 gm to 744.1 gm a metre) of different widths. The fabric is ordinarily made from the lower grades of fibre.

Uses: Bulk of the sacking exported is in the form of bags, which are used as containers for a variety of commodities.

Jute

When George Auckland an Englishman, set up the first jute spinning mill on banks of river Hooghly, West Bengal in 1855, little did he realise that he had planted the first seeds of a giant Indian industry. Since then, Indian jute has come a long way. The going has been tough, but today the industry can boast of a wide range of jute products available and are in huge demand in both the markets in India and abroad. The invention of new end-uses along with the preference for eco-friendly and bio-degradable products the world over has been an important factor for the increasing demand for the jute products.



Properties of Jute

- ◆ Jute is a vegetable based fibre plant, next in importance to cotton.
- ◆ Jute - the 'Golden Fibre' - is one of the most versatile fibres gifted to man by nature that finds various uses in the form of Handicrafts.
- ◆ In the trade, there are usually two names of jute - White and Tossa. *Corchorus capsularis* is called White Jute and *Corchorus olitorius* is called Tossa Jute.
- ◆ In India and Bangladesh, Roselle is usually called Mesta. Jute fibres are finer and stronger than Mesta and are, therefore, better in quality.
- ◆ Jute merges with the soil after sustained use. In turn, it enriches the soil with organic substance and helps to grow better crops.
- ◆ On combustion, its fumes are non-toxic and produce no residue.
- ◆ Depending on demand, price and climate, the annual production of jute and allied fibres in the world remains around 3 million tonnes.

Advantages of eco-friendly jute

-
- ◆ Jute is 100% bio-degradable and thus, environment-friendly.

- ◆ It is used extensively in manufacturing different types of packaging material for agricultural and industrial products.
- ◆ Jute is available in abundance in India, at competitive prices.
- ◆ Jute is now not just a major textile fibre, but is also a raw material for non-textile products, which help to protect the environment, which is an integral part of any development planning.
- ◆ Jute, characterized by its silky texture, high tensile strength and resistance to heat and fire is considered fit for use in industries as varied as fashion, travel and luggage, furnishings, carpets and floor coverings, decoratives, textiles and made-ups.

Some innovative uses of jute

-
- ◆ JRP (Jute Reinforced Plastic) is widely used to pack tea and fruits, especially for its excellent 'breathing properties'.
 - ◆ It effectively packs garments, cement, fertilizers and other products as well.
 - ◆ Jute has also proved to be the ideal replacement of wood.
 - ◆ The Indian jute sector, comprising the organized jute industry and a large number of decentralized/cottage units, has now reached the stage of producing materials, which are not only durable, but also attractive from the aesthetic sense.

1.4 NEED FOR THE STUDY

One of the main objectives of TPM is to increase the productivity of plant and equipment with a modest investment in maintenance. Total quality management (TQM) and total productive maintenance (TPM) are considered as the key operational activities of the quality management system. In order for TPM to be

effective, the full support of the total workforce is required. This should result in accomplishing the goal of TPM: "Enhance the volume of the production, employee morale and job satisfaction."

The main objective of TPM is to increase the Overall Equipment Effectiveness of plant equipment. TPM addresses the causes for accelerated deterioration while creating the correct environment between operators and equipment to create ownership.

Through this study, the researcher tries to evaluate the effectiveness of the total productive maintenance practice followed in Ajute International Pvt Ltd . This will help the management of Ajute International Pvt Ltd to make the TPM successful and increase the business efficiency.

1.5 SCOPE OF THE STUDY

TPM (Total Productive Maintenance) is an excellent method for meeting the demands continuous flow manufacturing places on equipment. TPM does the following:

- ☐ It increases OEE (Overall Equipment Effectiveness) using improvement activities.
- ☐ It establishes an autonomous maintenance program performed by equipment operators.
- ☐ It establishes a planned maintenance system.
- ☐ It requires training to improve operation and maintenance skills.
- ☐ It institutes a system for MP (maintenance prevention) design and early equipment management.
- ☐ Increasing Overall Equipment Effectiveness

1.6 OBJECTIVES

PRIMARY OBJECTIVE

To evaluate the effectiveness of the total productive maintenance practice followed in Ajute International Pvt Ltd

SECONDARY OBJECTIVES

1. To study the current status of TPM implementation in Ajute International Pvt Ltd
2. To know the effectiveness of maintenance and repair works carried out during th facility downtime condition.
3. To determine the efficiency of the TPM training programme for new employees
4. To identify the biggest hurdles for the effective implementation of TPM in Ajute International Pvt Ltd
5. To assess the impacts of TPM in Ajute International Pvt Ltd
6. To make suggestions to improve the effectiveness of total productive maintenance practice in Ajute International Pvt Ltd

1.7 LIMITATIONS OF THE STUDY:

For anything there should be some limitations like that my project also have certain limitations. The following are some limitations what I faced:

1. The information provided by Majority of the surveyed employees could also be biased or inaccurate. No independent verification of the data was possible.
2. Time is one major constraint, which limits the effective data collection.
3. Non-availability of data collection from all employees of Ajute International Pvt Ltd
4. The sample size is only 120 employees of Ajute International Pvt Ltd so the sample may not be truly representative of the total population
5. Reliability and accuracy of the analysis depends on the surveyed employees' openness and trueness towards each question in the questionnaire.

CHAPTER 2: REVIEW OF LITERATURE

1. TITLE

Implementing Total Productive Maintenance in Machine shop of Manufacturing Industry–A Case Study

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Abstract:

To evaluate the contributions of total productive maintenance (TPM) initiatives to improve manufacturing performance in the machine shop. Due to frequent failures and breakdowns occurred in machine, require more investment on maintenance due to which increased in maintenance cost and this results into different losses at work place which cause low availability, poor performance and low quality of the output ultimately cause low OEE of the machine. The correlations between various TPM implementation factors and manufacturing performance improvements have been evaluated and validated by employing overall equipment effectiveness (OEE) in machine shop. OEE of a machine plays an important role in present scenario because it provides the information about the effectiveness of the equipment. Results obtained through the detailed study reveals the varying trends in the Overall Equipment Effectiveness (OEE) and Total Productivity of the machines taken up for the study. The average values of OEE were found to lay between the ranges of 49% to 61% against world class standards of 85%. The results highlight the major causes resulting in the downtime and decrease in the productivity. In this paper, a comparative study between World Class industries where TPM has been implemented and industry which do not follow TPM identifies the various problems leading to decrease in the overall efficiency of the industry and provides valuable suggestions for the improvement and methodology for implementing TPM pillars in industry.

Conclusion

The need to develop an integrated maintenance model in organizations can contribute the manufacturing performance improvement. In this case study the Availability of the machine is less or more idle time of the machine affects the

schedule time of machine and hence to improve the productivity efforts must also be given to reduce the idle time of machine. Overall Equipment Effectiveness has improved from previous indicating the improvement in productivity and improvement in quality of product. Success of TPM depends on various pillars like,

- Autonomous Maintenance, Focused Maintenance, Planned Maintenance, Quality Maintenance, Education and Training, Safety, Health & Environment, Office TPM/Administrative Improvements, Development Management and 5-S. Successful TPM implementation can achieve better
- Result and accelerate the OEE result that would increase productive time which is profitable for the industry. The key factors for this implementation are workers
- Involvement and top management support. Still world class TPM implementation is possible by support at all the levels along with the proper implementation of TPM in the organization. The overall improvement of OEE by
- Implementation of TPM pillars through proposes model is satisfactory.

2. TITLE:

Total productive maintenance, total quality management and operational performance: An empirical study of Indian pharmaceutical industry

Author(s):

Sachin Modgil, (National Institute of Industrial Engineering (NITIE), Mumbai, India)

Sanjay Sharma, (National Institute of Industrial Engineering (NITIE), Mumbai, India)

Purpose

The purpose of this paper is to investigate the impact of total productive maintenance (TPM) and total quality management (TQM) practices on operational performance and their inter-relationship.

Design/methodology/approach

The present study includes three main constructs, namely, TPM, TQM and operational performance of pharmaceutical industry. Under TPM, four constructs, namely, disciplined maintenance, information tracking, housekeeping and operator involvement has been considered with the help of literature. In TQM, four constructs, namely, quality data and reporting, product innovation, research and development (R&D) management and technology management has been considered. Out of 410 Indian pharmaceutical plants contacted for survey, 254 responses have been used in the study for analysis. The factor analysis, path model and structural equation modeling has been used to analyze the proposed framework. The results for alternate models has been studied, interpreted and reported. Finally the direct and indirect effect of TPM and TQM on operational performance has been tested and checked for proving and disproving the hypotheses.

Findings

TPM practices have a significant impact on plant-level operational performance. When TPM and TQM practices are coming together to achieve operational performance, then TPM is having strong influence on operational performance. TQM is having significant support from TPM to achieve operational performance. TPM impact TQM and TQM in turn helps to achieve operational performance. TPM practices impact significantly R&D, product innovation and technology management, whereas quality data and reporting is the least contributor toward TQM. This may help industry to understand implications of implementation of TPM and TQM to achieve plant-level operational performance. TPM will help to reduce the cost of quality in terms of reduced scrap and less defective products.

Practical implications

The present study provides the useful insights to practicing managers. In literature it has been mentioned that TQM helps in TPM implementation. In practice TPM plays a great role to achieve quality in processes and therefore in products. In turn quality products, with reduced work in process inventory, less defective products and reduced scrap helps to achieve the operational performance at plant level. TPM practices will help the organization to improve the pace of product innovation and improvement in productivity, which is critical to pharmaceutical industry. The

continuous monitoring of TPM practices can help organizations to run day to day operations and maintenance requirement of each machine over a specified period of time.

Originality/value

The present study diagnoses the inter-dimensional linkage between TPM, TQM and operational performance. The pharmaceutical industry is complex system of advance equipment's and processes. After human resources, the health of machines/equipment's describe the strength of an organization. The machines require the regular maintenance to produce the products with desired specifications. The specifications in medicines are very tight, which can be achieved only if machines/testing equipment's are updated and maintained regularly. The TPM practices will help the plants to achieve the operational performance by having quality in process

3. TITLE:

A case study of total productive maintenance implementation at precision tube mills

Author(s):

I.P.S. Ahuja (University College of Engineering, Punjabi University, Patiala, India)

Pankaj Kumar (Total Quality Management Initiatives, Tata Steel, Jamshedpur, India)

Purpose

– The purpose of this paper is to investigate the contributions of successful total productive maintenance (TPM) initiatives to competitive manufacturing. It also seeks to critically examine the implications of strategic TPM implementation initiatives in an Indian manufacturing organisation.

Design/methodology/approach

– The study is carried out at a precision tube mill that has successfully implemented TPM and has reaped significant benefits as a result of TPM implementation, to study

the TPM implementation issues and achievements realised as a result of strategic TPM implementation. The approach is directed towards the justification of TPM implementation for its support to competitive manufacturing in Indian industries.

Findings

– The study reveals the exploits of Indian entrepreneurs with TPM practices and highlights the contributions of TPM in realising the overall organisational goals and objectives. The study reveals that strategic TPM initiatives can significantly contribute towards the improvement of manufacturing performance in the organisation, leading to the realisation of core competencies for meeting global challenges.

Research limitations/implications

– The study is conducted to develop an understanding of contributions of TPM initiatives towards building manufacturing competencies in Indian manufacturing industry. The present study endeavours to investigate the effect of an aggressive TPM implementation plan for strategically meeting global challenges and competition.

Practical implications

– The study highlights the contributions of strategic TPM initiatives to organisational performance and highlights the need for the successful management of TPM programmes for establishing sustained maintenance improvement initiatives.

Originality/value

– The study highlights the contributions made by holistic TPM implementation at a precision tube mills in an Indian manufacturing enterprise.

4. TITLE:

Total Productive Maintenance (TPM) Implementation in a Machine Shop

AUTHORS:

Ashish M. Gohil, Dhaval B. Shah, Sanjay Desai.

Abstract

Quality and Maintenance of manufacturing systems are closely related functions of any organization. Over a period of time two concepts have emerged which are Total Productive Maintenance (TPM) and Total Quality Management (TQM) along with other concepts to achieve World Class Manufacturing system. In this paper experience of implementing Total Productive Maintenance is shared and investigated for a company manufacturing automotive component. Concept is implemented in the machine shop having CNC turning centers of different capacity. Overall Equipment Effectiveness is used as the measure of success of TPM implementation. The losses associated with equipment effectiveness are identified. All the pillars of TPM are implemented in a phased manner eliminating the losses and thus improving the utilization of CNC machines.

Introduction

In today's industrial scenario huge losses/wastage occur in the manufacturing shop floor. This waste is due to operators, maintenance personal, process, tooling problems and non-availability of components in time etc. Other forms of waste includes idle machines, idle manpower, break down machine, rejected parts etc. are all examples of waste. The quality related waste are of significant importance as they matter the company in terms of time, material and the hard earned reputation of the company. There are also other invisible wastes like operating the machines below the rated speed, start up loss, break down of the machines and bottle necks in process. Zero oriented concepts such as zero tolerance for waste, defects, break down and zero accidents are becoming a pre-requisite in the manufacturing and assembly industry. In this situation, a revolutionary concept of Total Productive Maintenance (TPM) has been adopted in many industries across the world to address the above said problem. The goal of the any TPM program is to improve productivity and quality along with increased employee morale and job satisfaction. Earlier preventive maintenance was considered as non value adding process, but now it is essential requirement for longer life cycle of machines in an industry. TPM is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns, and promotes autonomous operator maintenance through day-to-day activities involving the total workforce.

Conclusion

Following conclusion is derived from implementation of TPM in the machine shop of automotive company:

1. Success of TPM depends on various pillars like 5-S, Jishu Hozen, Planned Maintenance, Quality maintenance, Kaizen, Office TPM and Safety, Health & Environment.
2. Overall Equipment Effectiveness has improved from 63% to 79% indicating the improvement in productivity and improvement in quality of product.
3. It is observed that most of the defective components are because of the previous process namely casting hence to improve the productivity efforts must also be given to previous process as well.
4. The key factors for this implementation are workers involvement and top management support. Still world class TPM implementation is possible with continual support at all the levels along with the supply of necessary resources.

5. TITLE:

Total Productive Maintenance Review: A Case Study in Automobile Manufacturing Industry

AUTHORS: Jagtar Singh A , Vikas Rastogi B and Richa Sharma

Abstract This paper will review all the Total Productive Maintenance (TPM) Pillars, TPM Implementation methodology and the contribution of TPM towards improving manufacturing performance.. It will also focus on calculating the Overall Equipment Effectiveness (OEE) in one of the two wheeler automobile Industry in India. The relationship between various TPM implementation dimensions and manufacturing performance improvements have been evaluated by applying OEE. The study establishes that focused TPM implementation over a reasonable time period can strategically contribute towards realization of significant manufacturing performance enhancements. Set of various techniques like Single Minute Exchange Die (SMED), computer maintenance management system, production planning were suggested to

the industry after calculating the overall equipment effectiveness to improve their maintenance procedures and improve the productivity.

Case Study in Automobile Manufacturing Organization

In this section, the TPM implementation is demonstrated through a case study in an automobile manufacturing organization. Section 6.1 gives a brief review of case organization and then the TPM implementation procedure is discussed in section 6.2

6.1 Automobile Manufacturing Organization The case study reported in this paper has been conducted at an automobile manufacturing two wheeler plant in SIDCUL, Haridwar. The management of the company observed that maintenance costs increased for 30-40 percent of the production costs and emergency repairs were three times more expensive than the same job done in pre-planned manner. Since the plant facilities and manufacturing processes were extremely equipment intensive and the data collection and analysis process revealed that the total idle time for the critical process equipment was observed to be extremely high which was not at all acceptable under the prevailing circumstances.

Thus, the need for fostering an efficient TPM implementation program was felt fundamentally necessary

TPM Implementation in Automobile Manufacturing

TPM implementation started with the selection of key model machines and measurement of TPM effectiveness with initiation of four activities – 5S Implementation, Autonomous Maintenance, focused improvement, planned maintenance and OEE have been implemented. A maintenance plan have also been prepared. (i) Selection of Machines The first step of this work is selection of machines on which the study is carried out. To start with TPM, a few machines have been selected for implementation of TPM, which is known as TPM model machine. In that Organization, there are seven shops. Four machines have been selected from Light Machine Shop (LMS) i.e. 2 Broaching machines, 1 Cylindrical Grinder and 1 Surface Grinder for TPM implementation. This section was named as TPM model section in Light Machine Shop. Shop. These machines are used in production of components like bull gear, shafts for power transmission etc. A code is assigned to each machine

for ease of identification. Each machine is studied thoroughly to identify each part and to understand the working of every component.

Conclusion

It can be seen that OEE has shown a progressive growth as shown in Table 5, which is an indication of increase in equipment availability, decrease in rework, rejection and increase in rate of performance. Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. TPM can be adapted to work not only in industrial plants, but also in construction, building maintenance, transportation, and in variety of other situations. Employees must be educated and convinced that TPM is not just another program of the month and that management is totally committed to the program and the extended time frame is necessary for full implementation. If everyone involved in a TPM program does his or her part, a usually high rate of return compared to resources invested may be expected. TPM success requires strong and active support from management, clear organizational goals and objectives for TPM implementation.

6. TITLE

A Case Study on Total Productive Maintenance in Rolling Mill

AUTHORS: Chetan S Sethia¹ , Prof. P. N. Shende , Swapnil S Dange

Abstract

TPM is a technique which helps us in maintaining and improving production system through machine, process, and employee which add a positive value to the organization. TPM has been developed to meet the new maintenance needs by keeping the equipment in top condition so as to avoid breakdown and delay in production. This paper focusing on calculating the overall equipment effectiveness in Rolling Mill, and it also discuss what called the big six losses in any industry (the quality, availability and speed). A case study has been taken in the rolling mill and the main objective of this is to study the manufacturing process and the problem occurs during the production process which causes stoppage. The data taken along fifteen working days. After calculating the OEE of the company a result company

achieved 93.48% in quality factor of overall equipment effectiveness equation and 70.90% in availability where in performance it got 90.03% and the result is compared with the World class OEE. Suggestion is given to company so as to improve their maintenance procedures and improve the productivity.

INTRODUCTION

In modern day manufacturing and service industries, improved quality of products and services increasingly depend upon the features and conditions of the organization's equipment and facility. In order to survive every industry has to strive for improving productivity in all spheres of activities. Hence it is logical to utilize the resources like machinery, men, and material as optimally as possible. Maintenance of facilities and equipment in good working condition is essential to achieve specified level of quality and reliability and efficient working. Plant maintenance is an important service function of an efficient production system. It helps in maintaining and increasing the operational efficiency of plant facilities and thus contributes to revenue by reducing the operating costs and increasing the effectiveness of production. TPM has been proven to be successful for helping to increase the productivity and overall equipment effectiveness. The concepts of TPM has been introduced and developed by Japanese in 1971. TPM is all about Total plant Maintenance. The Underlying concepts are, if you properly maintain plant machinery there will see a sharp decline in machine breakdowns, safety and quality problems. There is emerging need of TPM implementation in the Indian industry and need to develop TPM Implementation practice and procedures. TPM should promote better team working in the workplace, as the operator will be helping the maintenance team with their task. The aim of the TPM is to bring together management, supervisors and trade union members to take rapid remedial action as and when required. Hence, tpm can be considered as the medical science of machines.

Need of TPM in the contemporary Manufacturing scenario

- The following aspects necessitate implementing TPM in the contemporary manufacturing scenario;
- To become world class, satisfy global customers and achieve sustained organizational growth.
- To improve productivity and quality

- To improve organizations works culture and mindset.
- To make the job simple and safer.
- Need to change and remain competitive.
- Need to critically monitor and regulate work-in-process of manufacturing process.
- Regulating inventory levels and production lead-times for realizing optimal equipment available time.
- Ensuring more effective use of human resource through adequate training and mulit-skilling.
- Refining preventive and predictive maintenance activities

A CASE STUDY

A case study has been conducted in one of the leading manufacturing of the TMT Bar in the Rolling mill industry. The company is an integrated plant with a facility to produce Sponge Iron, Power, Billet and Structural Steel (TMT Bars). It is the large scale industry which has set up modern production facilities to meet the customer requirements for quality structural. (Thermo Mechanically Treated) TMT bar is rolled out in one of the most modern and fully automatic Rolling Mills and further processed in the world's proven "Thermex®" technology. The Thermex® TMT process involves 3 stages of treatment for imparting the superior strength and quality to the ribbed bars - Quenching, Self-tempering and Atmospheric Cooling. The study conducted along the 15 days, the company produces different size of TMT bar and uses different size of billet as per requirement. Finally, the aim of this case study is to measure the overall equipment efficiency of the company and find out the bottleneck which causes stoppage of production. There are some of the standard from the industry: Three shift each shift eight hours and timing per shift is shift A 6:00-2:00, shift B 2:00-10:00, shift C 20:00-6:00

- The target for production of TMT Bar for each day is 400 ton and for each shift is equal to 133.33 tons.
- The product time process, the production line can operate at speed of 16.75 tons per hour, this speed is theoretical speed.

Problem Identify

Major industry losses were identify which are shut down, production adjustment, equipment failure, process failure, normal production loss, abnormal production loss, quality defect and reprocessing. Following are some of the losses listed which occurs during the production process: 1. Miss roll of TMT Bar. 2. Cooling Bed jam. 3. Tool break of crop and cobble shear system. 4. Jamming of material in the furnace. 5. Reduction Gear Box Problem (due to, oil contamination, low oil level, teeth damage). 6. Section change problem. 7. Wear of Roller. 8. Ejector jam. 9. Sprocket and chain fails. 10. V belts fail. 11. Pulley. 12. Guiding and transportation system

CONCLUSIONS

A Manufacturing Process and the Resources available for producing TMT Bar have been studied and also the breakdown such as mechanical, electrical and other which occur during operation have been analyzed. From the calculation of overall equipment effectiveness it is seen that the performance of the Rolling Mill come to be 60.33% in which the availability of the line is 70.90% of the production time and the performance rate is 91.03% while the quality rate comes to be 93.48%. When this i.e. (A, P, Q) of the Rolling Mill is compared with the World Class Measurement it come to be very less, According to the World Class Manufacturing OEE should be 85% and the Rolling Mill Equipment Efficiency is reduced by 25%. Therefore it is necessary / very much important to implement the TPM in Rolling Mill so as to improve the productivity and Efficiency of the Equipment of the Rolling Mill by eliminating most of the waste.

Benefits of Total Productive Maintenance (TPM)

Productivity Improvement – Productivity is improved through fewer losses in the company

Quality Improvement – Quality is improved as a result , that the failures and malfunctions is reduced

Cost Reduction – THE cost is reduced because the losses and other not value added work is reduced

Employee Ownership – Ownership of equipment by operators through Autonomous Maintenance

Employee Confidence – “Zero failure”, “zero defect” and “zero accident” conditions

builds employee self-confidence

Improved working environment – Clean working conditions provides a good working environment

Increased Plant Reliability

Customer Satisfaction – TPM leads to high delivery performance and customer satisfaction

Six Big Losses of Total Productive Maintenance (TPM)

1. Breakdown losses
2. Setup and adjustment losses
3. Idling and minor stoppage losses
4. Speed losses
5. Quality defects and rework losses
6. Start-up/ yield losses

Overall Equipment Effectiveness (OEE)

The six big losses are combined into one measure of overall equipment effectiveness

(OEE) :

$OEE = \text{Equipment availability} \times \text{Performance Efficiency} \times \text{Rate of Quality Products}$

How To Improve Overall Equipment Effectiveness (OEE) ?

Improve the 3 components of OEE by:

1. Equipment availability: Improved by eliminating breakdowns, setup/ adjustment losses, and other stoppage losses
2. Performance Efficiency: Improved by eliminating speed losses, minor stoppages, and idling
3. Rate of Quality Products: Improved by eliminating quality defects in process and during start-up

Eight Pillars of Total Productive Maintenance (TPM)

1. Focus Improvement
2. Autonomous Maintenance
3. Planned Maintenance
4. Training
5. Early Equipment Management (EEM)
6. Quality Maintenance
7. Efficient Administration
8. Safety & Environment

Nine Essentials of Total Productive Maintenance (TPM)

1. Self maintained work place
2. Elimination of the 6 big losses
3. Zero breakdowns
4. Zero defects
5. Optimal life and availability of tools
6. Self-improvement
7. Short production-development time and low machine life cost
8. Productivity in indirect departments
9. Zero Accidents

TPM is aimed at eliminating the so-called “six big losses:”

- ☐ Breakdown losses
- ☐ Setup and Adjustment Losses
- ☐ Idling and Minor stoppage losses
- ☐ Speed losses

- Quality defects and rework
- Start-up/yield losses (reduced yield between machine start-up and stable production)

Overall equipment effectiveness (OEE) is the key metric in determining how well equipment is performing with regards to the big six losses. OEE measures equipment effectiveness in terms of availability, performance, and product quality. Availability tells us what percentage of time the equipment is actually running when we need it. It is calculated as follows:

$$\text{Availability} = \text{Operating Time} / \text{Loading Time} \times 100\%$$

where:

$$\text{Operating Time} = \text{Loading Time} - \text{Downtime}$$

Loading Time: The daily or monthly time available for operation minus planned stops (breaks in the production schedule, stops for planned maintenance, meetings, etc.)

Downtime: total time for unscheduled stops (breakdowns, re-tools, adjustments)

Performance is based on two factors: Operating Speed Rate and Net Operating Time. The Operating Speed Rate tells us how fast a machine is running compared to its designed/ideal speed. The Net Operating Time is the time during which equipment is being operated at a constant speed within a specified period. Performance is calculated as follows:

$$\text{Performance Rate} = \text{Net Operating Time} \times \text{Operating Speed Rate}$$

where:

$$\text{Net Operating Time} = (\text{units of output} \times \text{actual cycle time per unit}) / (\text{loading time} - \text{downtime}) \times 100\%$$

$$\text{Operating Speed Rate} = \text{ideal cycle time} / \text{actual cycle time per unit} \times 100\%$$

Quality rate is simply the rate of quality products or 100% - defect rate.

Finally, we calculate OEE:

Overall Equipment Effectiveness (OEE) = Availability X Performance Rate X Quality Rate

After the above metrics are calculated for each piece of equipment, equipment improvement project teams determine which losses have the greatest impact on equipment effectiveness, and then prioritize improvement efforts accordingly.

Autonomous Maintenance Program

An autonomous maintenance program stabilizes equipment and halts accelerated deterioration. The program makes operators responsible for cleaning and inspection, lubrication, precision checks, and other light maintenance tasks. In carrying out these activities, operators learn more about their equipment and become better equipped to detect problems early. To implement such autonomous maintenance, operators are systematically trained in a step-by-step program.

Planned Maintenance System

Planned maintenance improvement is led by the maintenance department. The maintenance department will handle all of the planned maintenance tasks that are beyond the scope of the autonomous maintenance program. These are tasks that require special skills, significant disassembly, special measuring techniques and tools, etc. As equipment operators improve their skills, the maintenance group will perform fewer and fewer planned maintenance activities and will focus their efforts on improvements designed to reduce the maintenance required on equipment.

Maintenance Prevention (MP) Design and Early Equipment Management

MP Design involves discovering weak points in currently used equipment and feeding back this information to equipment design engineers. Similar to design for manufacturability, MP design takes the following factors into consideration:

- ☐ Ease of autonomous maintenance (operator maintenance)
- ☐ Ease of operation

- ☐ Improving quality
- ☐ Improving maintainability
- ☐ Safety
- ☐ MP Design can be applied to develop criteria for selecting “off-the-shelf” equipment as well.

Early Equipment Management is a system for dealing with problems that surface during test-running, commissioning, and start-up of new equipment. During this period, production and maintenance engineering people must correct problems caused by poor selection of materials at the design stage, errors occurring during fabrication of the equipment, or installation errors. In an ideal world, Early Equipment Management should not be very complicated (particularly if MP Design is properly applied at the design stage.)

Each of the elements of TPM are significant parts of a foundation for lean manufacturing. Most importantly, they work together to increase Overall Equipment Effectiveness (OEE). Without sufficiently high OEE, lean success becomes much more difficult to achieve.

CHAPTER 3: RESEARCH METHODOLOGY

Fundamental to the success of any formal marketing research project is a sound research design. A good research design has the characteristics of problem definition, specific methods of data collection and analysis, time required for research project and estimate of expenses to be incurred. The function of a research design is to ensure that the require data are collected accurately and economically.

A research design is purely and simply the framework or plan for an analysis of data. It is a blue print that is followed in completing a study. It resembles the architect's blue-print (map) for constructing a house. It may be worthwhile to mention here that a research design is nothing more than the framework for the study ensures that the study will be relevant to the problem and the study will employ economical procedures.

Claire seltizetal defines Research Design as "Research design is a catalogue of the phases and facts relating to the formulation of a research effort. It is the arrangement of collection and analysis of data in a manner that aims to combine relevant to the research purpose with economy in procedure".

Three important about research design are

1. The design of investigation should stem from the problem
2. Whether the designs are productive in a given problem setting depends on how imaginatively they are applied. An understanding of the basic design is needed so that they can be modified to suit specific purpose
3. The three basic design are as follows
 - i. Exploratory Research design
 - ii. Descriptive Research design
 - iii. Casual Research design

The Research design used in the study is descriptive research design

3.1 RESEARCH DESIGN

Descriptive research design is also called explanatory design. This is the one that simply describes something such as demographic characteristics. The descriptive study is typically concerned with determining frequency with which something occurs or how two variables vary together.

3.2 SAMPLE SIZE

It refers to the number of elements of the population to sample. The sample size chosen for the survey is 120 employees of Ajute International Pvt Ltd

3.3 DATA SOURCES

After identifying and defining the research problem and determining specific information required to solve the problem, the researcher's task is to look the type and sources of data which may yield the desired results. Data sources are of two types through which data is collected.

Data sources may be classified as

1. Primary data
2. Secondary data

PRIMARY DATA

Primary data is the original data collected by the researcher first hand. It is collected for the first time through field survey. These are those that are gathered specifically, for the problem at hand. The various sources for collecting primary data are questionnaire, observation, interview etc. The primary source used for the study is questionnaire.

SECONDARY DATA

Secondary data is the information which is already available in published or unpublished form. When the needed information is collected from the census of population available in a library means then it is a secondary data. It is also used for collecting historical data. The various sources of secondary data are books, periodicals, journals, directories, magazines, statistical data sources etc. The secondary source used for this study is company profile, scope, need, review of literature.

3.4 RESEARCH INSTRUMENTS

Research instrument are the instruments which is used for gathering or collecting information. The instruments used in the study are

1. Direct questions
2. Close end questions
3. Dichotomous questions
4. Multiple choice questions

DIRECT QUESTIONS

Direct questions are just what their names indicate. They explicitly ask for the desired data. However the directness of the question also relates to the way a response is interpreted.

CLOSE END QUESTIONS

Such questions are also called fixed alternative questions they refer to those questions in which the respondent is given a limited number of alternative response frame which he/she is to select one that most closely matches his/her opinion or attitude.

DICHOTOMOUS QUESTIONS

A dichotomous question refers to one which offers the respondent a choice between only two alternatives and reduces the issue to its simple terms. The fixed alternatives are of the type, yes/no, agree/disagree, true/false etc.

MULTIPLE CHOICE QUESTIONS

A multiple choice question refers to one which provides several set alternatives for its answers. Thus, it is a middle ground between free answers and dichotomous question.

3.5 SAMPLING

Collecting data about each and every unit of the population is called census method. The approach, where only a few units of population under study are considered for analysis is called sampling method. There are two main categories under which various sampling method can be put.

The two categories are

1. Probability sampling
2. Non-probability sampling

The sampling method adopted for the study is convenience sampling under non-probability sampling.

NON-PROBABILITY SAMPLING

In non-probability sampling, the chance of any particular unit in the population being selected is unknown, since randomness is not involved in the selection process. But this does not mean that the findings obtained from non-probability sampling are of questionable value. If properly conducted their findings can be accurate as those obtained from probability sampling. The three frequencies used non-probability designs are

1. Judgment sampling
2. Convenience sampling
3. Quota sampling

3.6 CONVENIENCE SAMPLING:

In this method, the sample units are chosen primarily on the basis of the convenience to the investigator. The units selected may be each person who comes across the investigator.

3.7 SAMPLE FRAME:

A Sample frame may be defined as the listing of the general components of the individual units that comprise the defined population.

3.8 SAMPLE DESIGN

Sample design is the theoretical basis and the practice means by generalizing from characteristics of relatively few of the comprising population. It is the method by which the sample is chosen.

3.9ANALYTICAL TOOLS

ANALYSIS USING KARL PEARSON'S CORRELATION:

Correlation analysis is the statistical tool used to measure the degree to which two variables are linearly related to each other. Correlation measures the degree of association between two variables. The Pearson product-moment correlation coefficient is a measure of the strength and direction of association that exists between two variables measured on at least an interval scale. It is denoted by the symbol r .

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \sqrt{N\sum Y^2 - (\sum Y)^2}}$$

CHI- SQUARE TEST I – (Ψ^2)

A chi-squared test, also referred to as chi-square test or χ^2 test, is any statistical hypothesis test in which the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true, or any in which this is asymptotically true, meaning that the sampling distribution (if the null hypothesis is true) can be made to approximate a chi-squared distribution as closely as desired by making the sample size large enough.

The χ^2 test was first used by Karl Pearson in the year 1980. The quantity χ^2 describes the magnitude of the discrepancy between theory and observation. It is calculated using:

$\chi^2 = \sum [(O_i - E_i)^2 / E_i]$ with $(n - 1)$ degrees of freedom. Where, O_i refers to the observed frequency & E_i to the expected frequencies. χ^2 was used as a test of independence and goodness of fit.

PERCENTAGES

Percentages refer to a special kind of ratio. Percentages are used in making comparison between two or more series of data. Percentages are used to describe relationships, it is expressed as.

Percentage = (no of employees/total no of employees) 100

CHARTS:

Charts are graphic displays of data for easy understanding of relative positions that is not always possible with descriptive words or numbers. Types of charts commonly used in business data presentation are: Bar and pie.

BAR CHARTS:

The bar chart is commonly used for presentation of qualitative data. The data can be continuous or discrete data, which are plotted against discrete data intervals. The vertical bar diagram, also called bar chart where the length or height of bars represent the numerical value of the event or measurement. Width or gap between the bars is of no significance to the bar chart data, but they are uniform in a diagram.

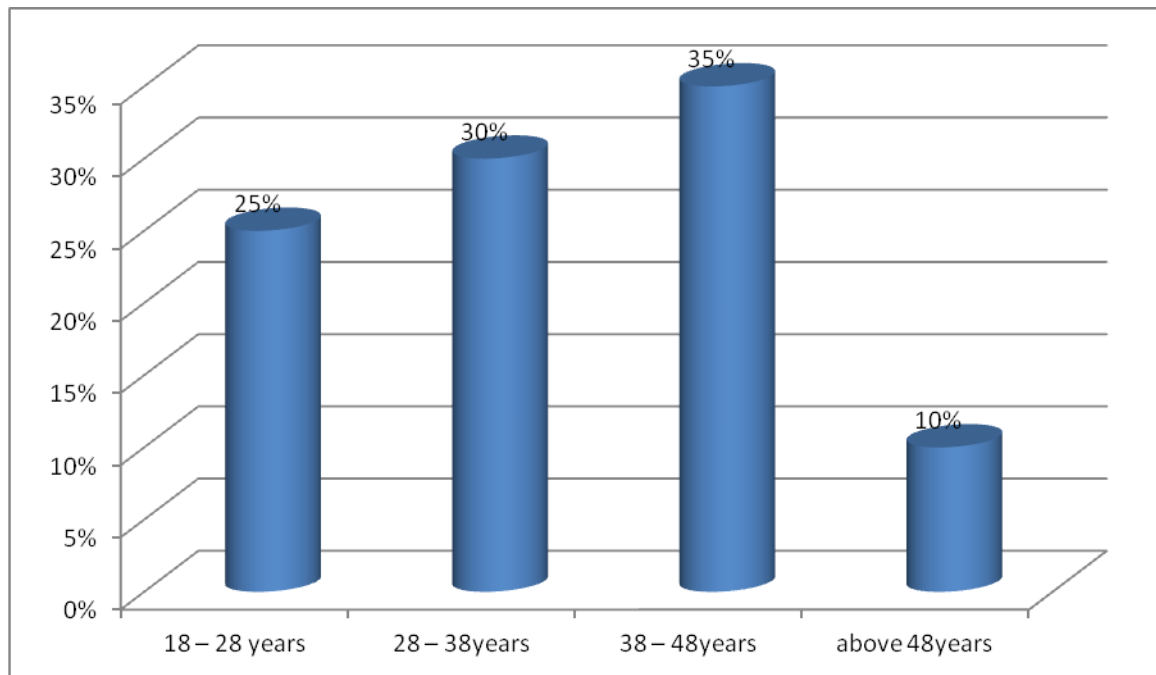
CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

TABLE: 1 AGE

Particulars	No Of Surveyed employees	No Of Percentage
18 – 28 years	30	25%
28 – 38years	36	30%

38 – 48years	42	35%
above 48years	12	10%
Total	120	100%

Chart: 1



INFERENCE

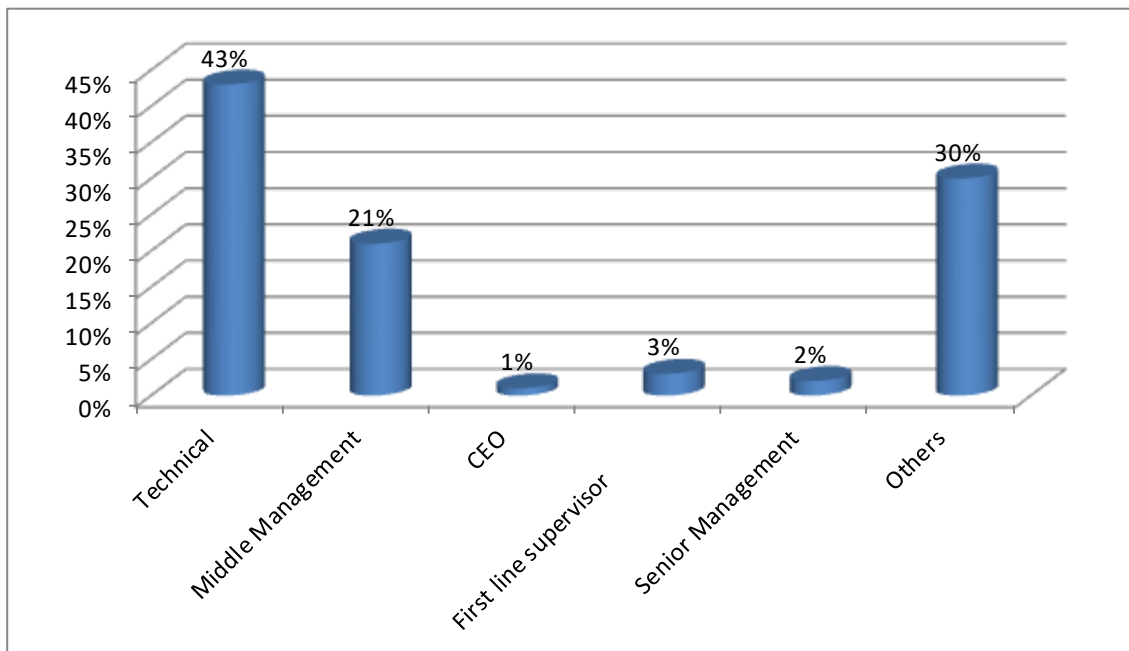
35% of the surveyed employees are at the age between 38-48 years, 30% of the surveyed employees are at the age between 28-38 years, 25% of the surveyed employees are at the age between 18-28 years, 10% of the surveyed employees are at the age above 48 years.

Therefore 35% of the surveyed employees are at the age between 38-48 years.

TABLE: 2 POSITIONS IN ORGANISATION

Particulars	No Of Surveyed employees	No Of Percentage
Technical	52	43%
Middle Management	25	21%
CEO	1	1%

First line supervisor	4	3%
Senior Management	2	2%
Others	36	30%
Total	120	100%



INFERENCE

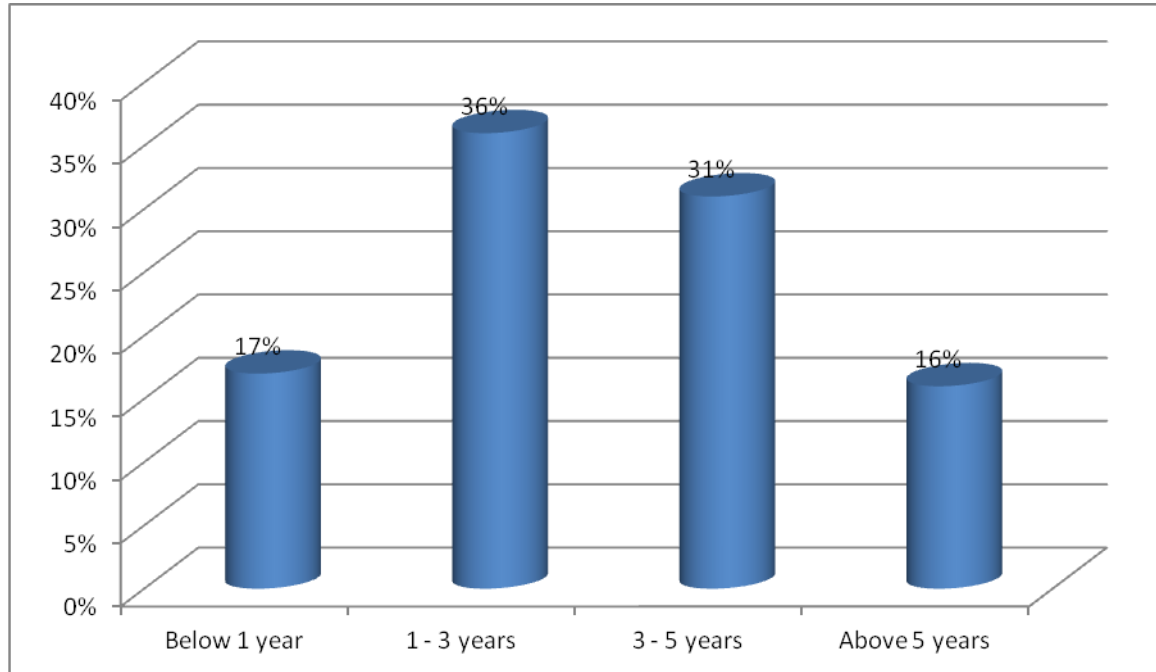
43% of the surveyed employees are in technical position at the organization, 30% of the surveyed employees are in others position at the organization, 21% of the surveyed employees are in middle management position at the organization, 3% of the surveyed employees are in first line supervisor position at the organization, 2% of the surveyed employees are in senior management position at the organization 1% of the surveyed employees are in CEO position at the organization.

Therefore 43% of the surveyed employees are in technical position at the organization.

TABLE: 3 EXPERIENCE

Particulars	No Of Surveyed employees	No Of Percentage
Below 1 year	21	17%
1 - 3 years	43	36%

3 - 5 years	37	31%
Above 5 years	19	16%
Total	120	100%



INFERENCE

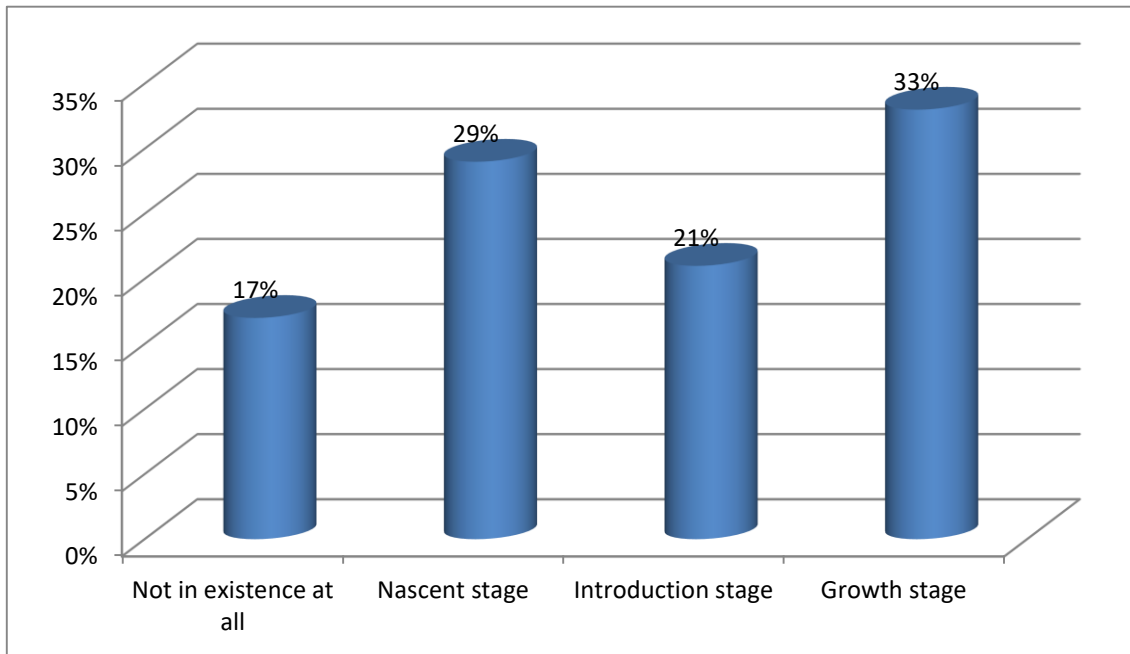
36% of the surveyed employees have 1-3 years of experience, 31% of the surveyed employees have 4-5 years of experience, 17% of the surveyed employees have below 1 year of experience, 16% of the surveyed employees have above 5 years of experience.

Therefore 36% of the surveyed employees have 1-3 years of experience.

TABLE: 4 CURRENT STATUS OF TPM IMPLEMENTATION IN AJUTE INTERNATIONAL PVT LTD

Particulars	No Of Surveyed employees	No Of Percentage
Not in existence at all	20	17%
Nascent stage	35	29%
Introduction stage	25	21%
Growth stage	40	33%

Total	120	100%
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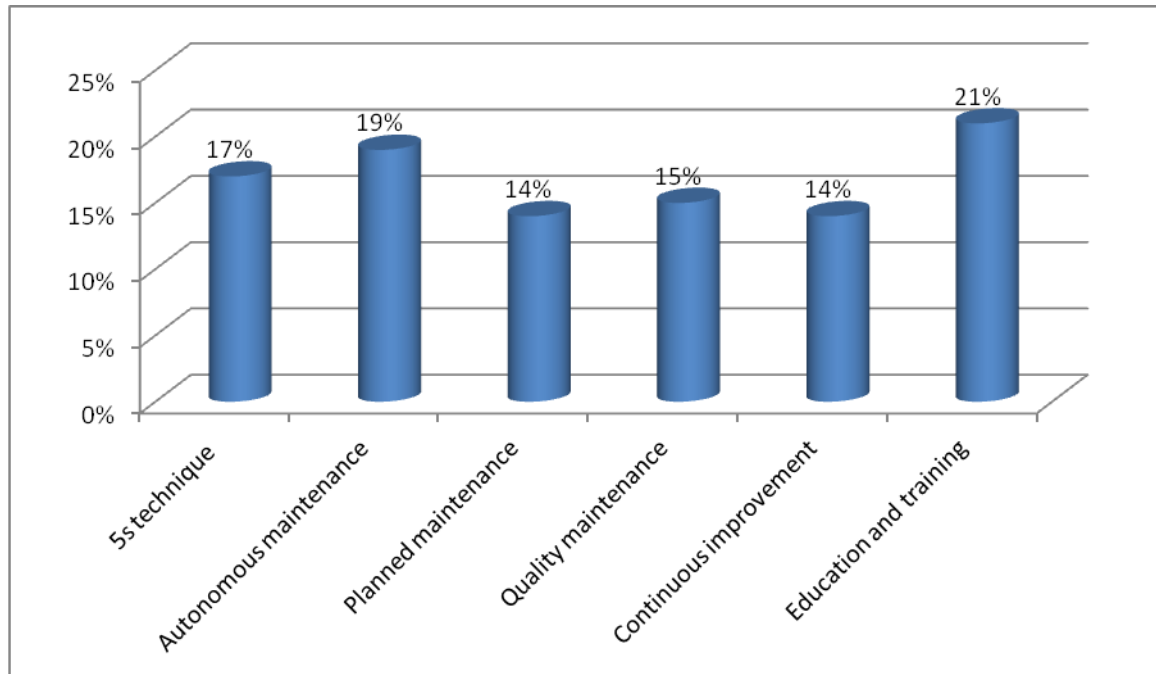
INFERENCE

33% of the surveyed employees current status of TPM implementation in Ajute International Pvt Ltd are at growth stage, 29% of the surveyed employees current status of TPM implementation in Ajute International Pvt Ltd are at Nascent stage, 21% of the surveyed employees current status of TPM implementation in Ajute International Pvt Ltd are at introduction stage, 17% of the surveyed employees current status of TPM implementation in Ajute International Pvt Ltd are not in existence at all. Therefore 33% of the surveyed employees current status of TPM implementation in Ajute International Pvt Ltd are at growth stage.

TABLE: 5 SEGMENTS BEING PRACTICED AT INDUSTRY

Particulars	No Of Surveyed employees	No Of Percentage
5s technique	20	17%
Autonomous maintenance	23	19%
Planned maintenance	17	14%
Quality maintenance	18	15%

Continuous improvement	17	14%
Education and training	25	21%
Total	120	100%



INFERENCE

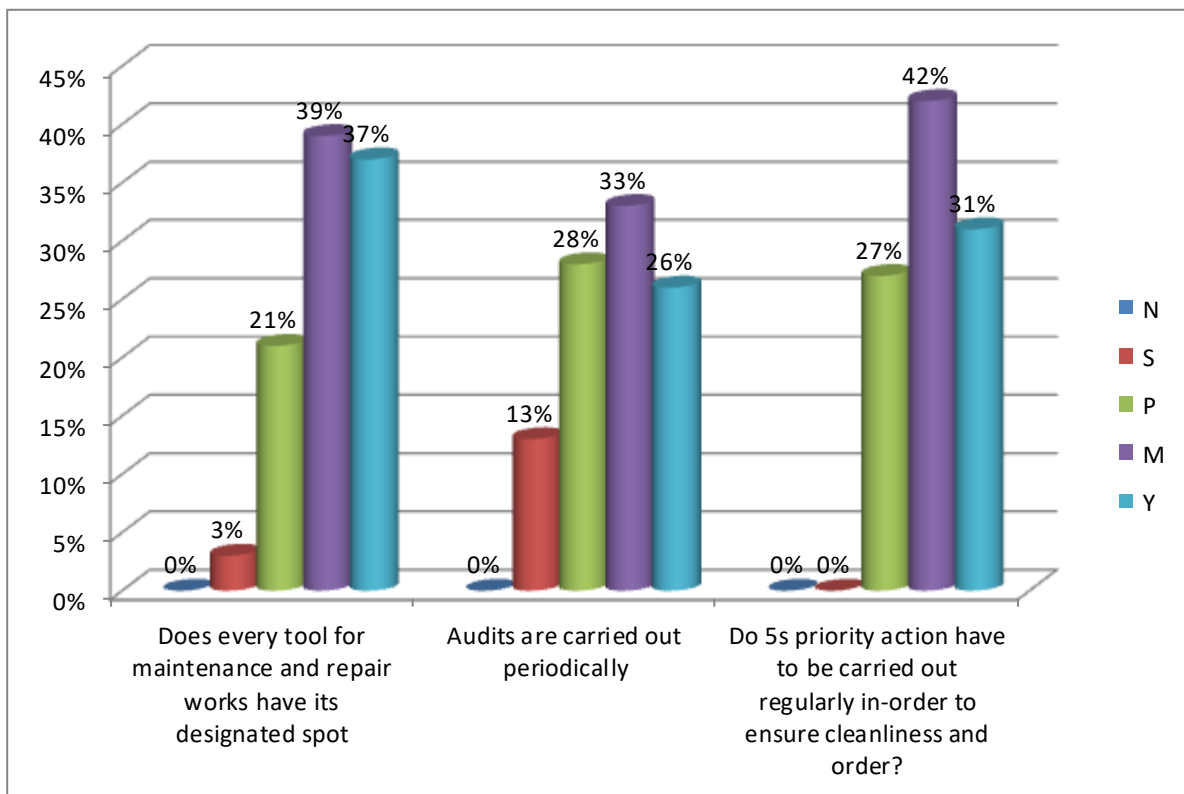
21% of the surveyed employees are in Education and training segment at industry, 19% of the surveyed employees are in autonomous maintenance segment at industry, 17% of the surveyed employees are in 5s technique segment at industry, 15% of the surveyed employees are in quality maintenance segment at industry, 14% of the surveyed employees are in planned maintenance segment at industry, 14% of the surveyed employees are in continuous improvement segment at industry.

Therefore 21% of the surveyed employees are in Education and training segment at industry.

TABLE: 6 5S TECHNIQUE

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
Does every tool for maintenance and	0	0%	4	3%	25	21%	47	39%	44	37%	120

repair works have its designated spot											
Audits are carried out periodically	0	0%	16	13%	33	28%	40	33%	31	26%	120
Do 5s priority action have to be carried out regularly in-order to ensure cleanliness and order?	0	0%	0	0%	33	27%	50	42%	37	31%	120



INFERENCE

39% of the surveyed employees tool have its designated spot for maintenance and repair.

33% of the surveyed employees audits are carried out periodically.

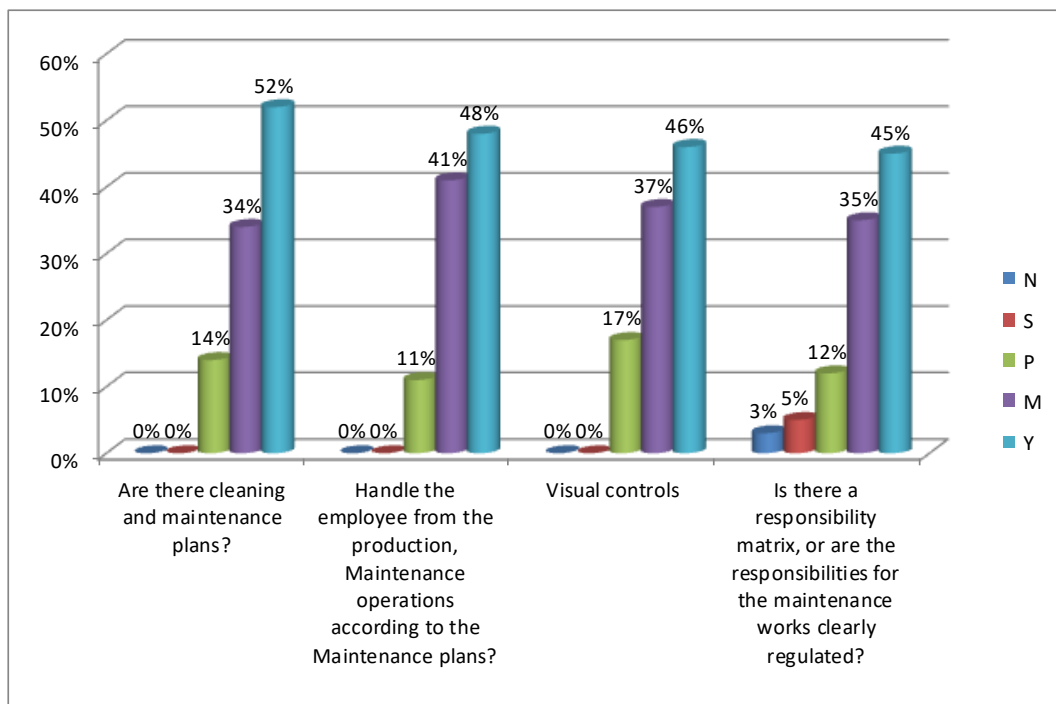
42% of the surveyed employees regularly carried out the 5s priority action to ensure cleanliness and order.

Therefore 42% of the surveyed employees regularly carried out the 5s priority action to ensure cleanliness and order.

TABLE: 7 AUTONOMOUS MAINTENANCE

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
Are there cleaning and maintenance plans?	0	0%	0	0%	17	14%	41	34%	62	52%	120

Handle the employee from the production, Maintenance operations according to the Maintenance plans?	0	0%	0	0%	13	11%	49	41%	58	48%	120
Visual controls	0	0%	0	0%	20	17%	45	37%	55	46%	120
Is there a responsibility matrix, or are the Responsibilities for the maintenance works clearly Regulated?	4	3%	6	5%	14	12%	42	35%	54	45%	120



INFERENCE

52% of the surveyed employees say yes for cleaning and maintenance plans.

48% of the surveyed employees say yes for handling the employee from the production, Maintenance operations according to the Maintenance plans.

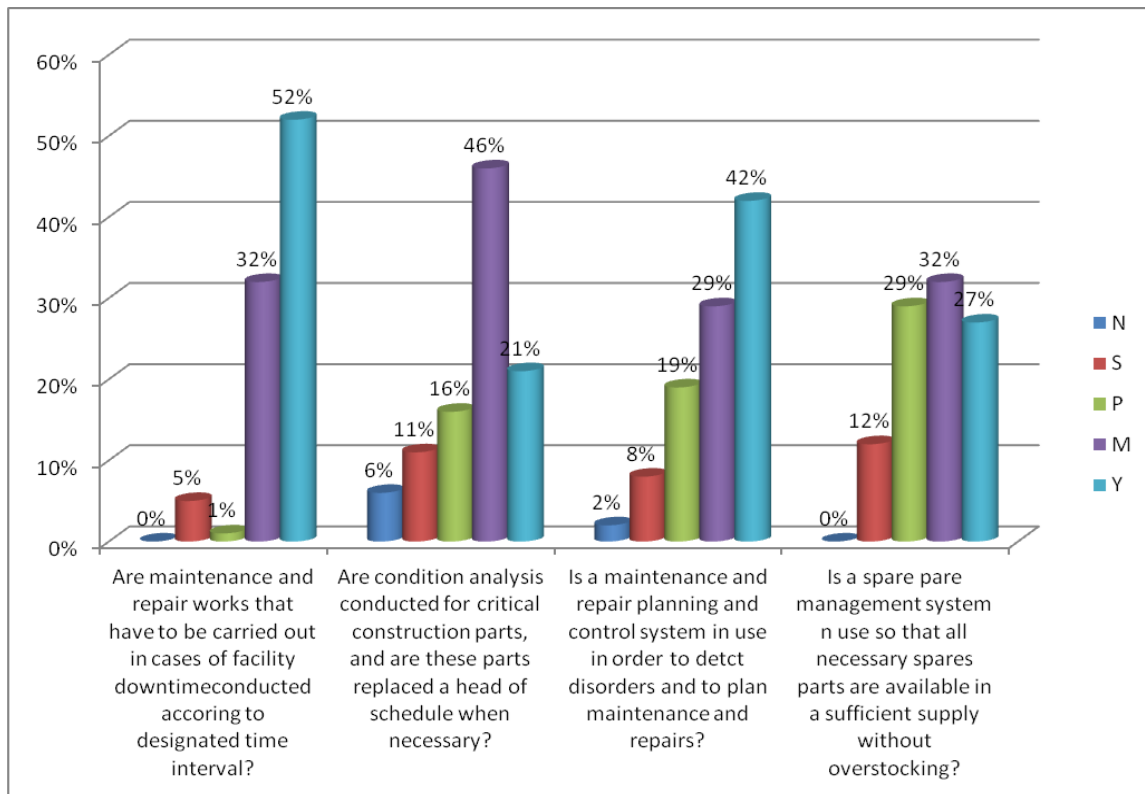
46% of the surveyed employees say yes for visual controls.

45% of the responsibilities say yes by mentioning that the responsibilities for the maintenance works clearly regulated.

Therefore 52% of the surveyed employees say yes for cleaning and maintenance plans.

TABLE: 8 PLANNED MAINTENANCE

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
Are maintenance and repair works that have to be carried out in cases of facility downtime conducted according to designated time interval?	0	0%	6	5%	13	11%	39	32%	62	52%	120
Are condition analyses conducted for critical construction parts, and are these parts replaced ahead of schedule when necessary?	7	6%	13	11%	20	16%	55	46%	25	21%	120
Is a maintenance and repair planning and control system in use in order to detect disorders and to plan maintenance and repairs?	2	2%	10	8%	23	19%	35	29%	50	42%	120
Is a spare part management system in use so that all necessary spare parts are available in a sufficient supply without overstocking?	0	0%	14	12%	35	29%	39	32%	32	27%	120



INFERENCE

52% of the surveyed employees say yes for maintenance and repair works that have to be carried out in cases of facility downtime conducted according to designated time interval.

46% of the surveyed employees mainly mention that the condition analyses conducted for critical construction parts, and are these parts replaced ahead of schedule when necessary.

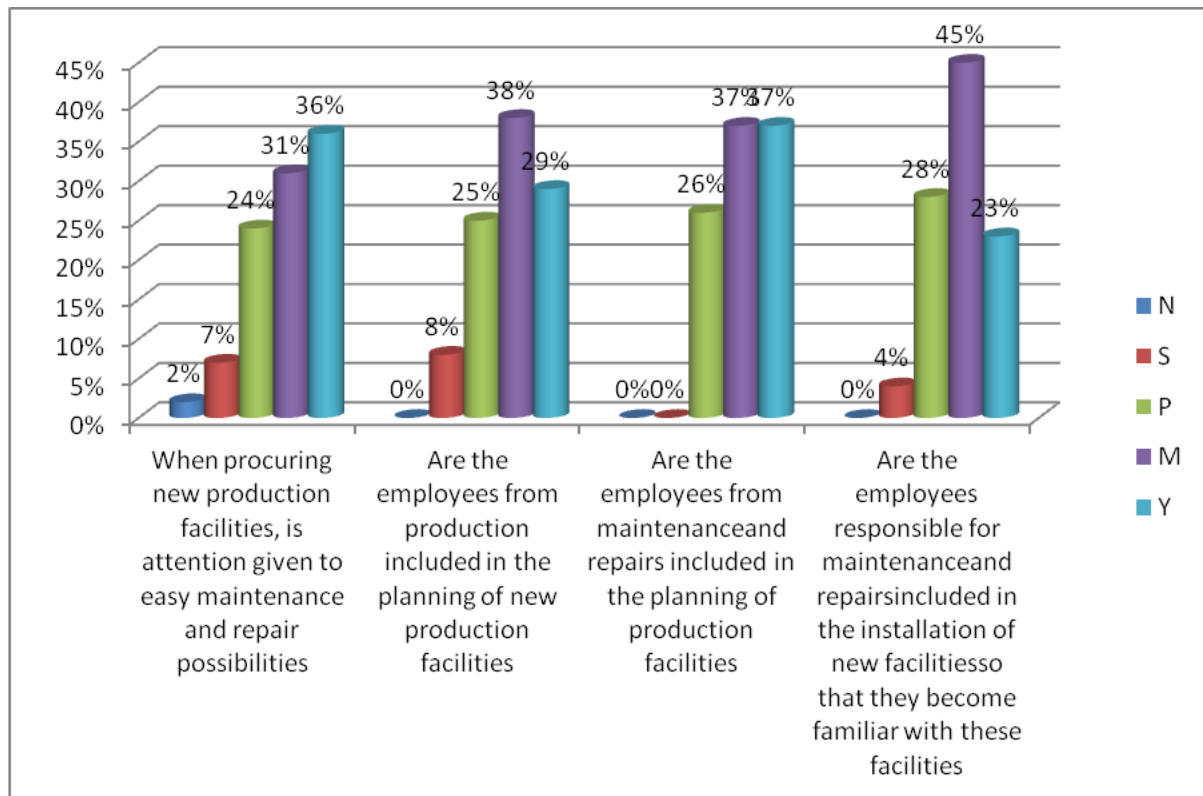
42% of the surveyed employees say yes for maintenance and repair planning and control system in use in order to detect disorders and to plan maintenance and repairs.

32% of the surveyed employees mainly mention that the spare part management system in use so that all necessary spare parts are available in a sufficient supply without overstocking.

Therefore 52% of the surveyed employees say yes for maintenance and repair works that have to be carried out in cases of facility downtime conducted according to designated time interval.

TABLE: 9 MAINTENANCE PREVENTION

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
When procuring new production facilities, is attention given to easy maintenance and repair possibilities?	2	2%	9	7%	29	24%	37	31%	43	36%	120
Are the employees from production included in the planning of new production facilities?	0	0%	10	8%	30	25%	45	38%	35	29%	120
Are the employees from maintenance and repairs included in the planning of production facilities?	0	0%	0	0%	32	26%	44	37%	44	37%	120
Are the employees responsible for maintenance and repairs included in the installation of new facilities so that they become familiar with these facilities?	0	0%	5	4%	33	28%	54	45%	28	23%	120



INFERENCE

45% of the surveyed employees mainly mention that the employees responsible for maintenance and repairs included in the installation of new facilities so that they become familiar with these facilities.

38% of the surveyed employees mention mainly that the employees from production are included in the planning of new production facilities.

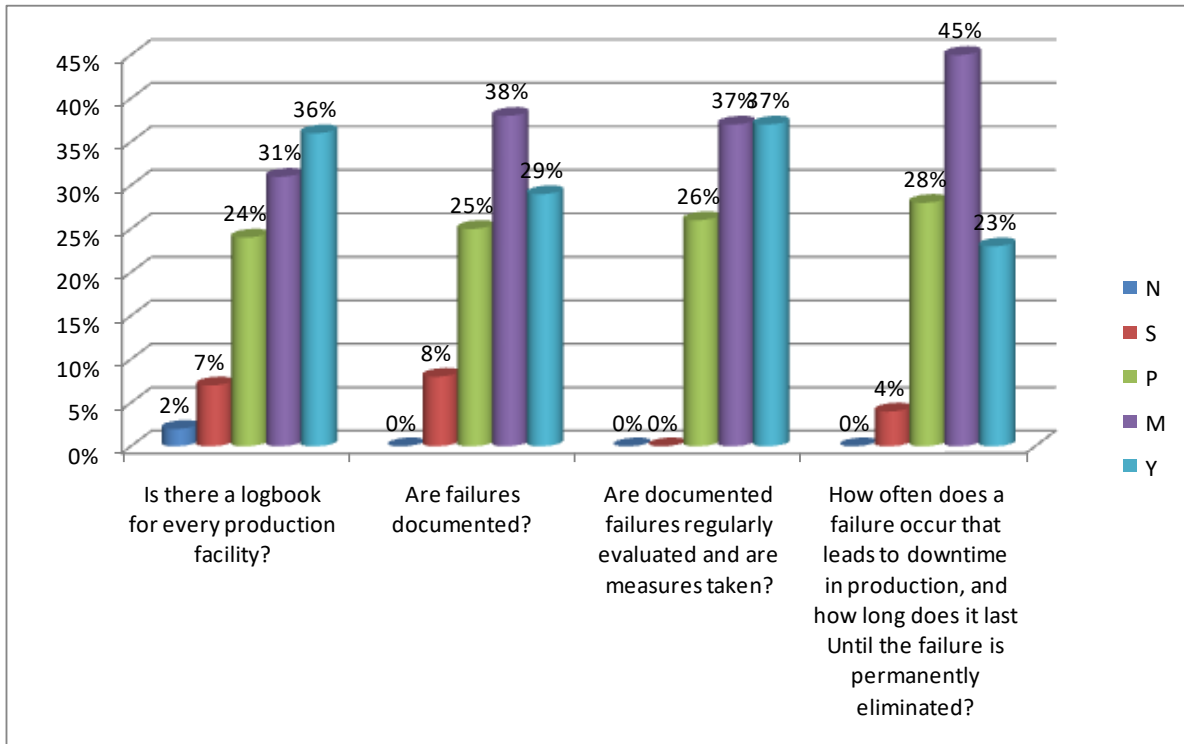
37% of the surveyed employees mainly say yes that the employees from maintenance and repairs are included in the planning of production facilities.

36% of the surveyed employees say yes for procuring new production facilities and attention given to easy maintenance and repair possibilities.

Therefore 45% of the surveyed employees mainly mention that the employees responsible for maintenance and repairs included in the installation of new facilities so that they become familiar with these facilities.

TABLE: 10 ELIMINATION OF MAIN PROBLEMS

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
Is there a logbook for every production facility?	2	2%	9	7%	29	24%	37	31%	43	36%	120
Are failures documented?	0	0%	10	8%	30	25%	46	38%	34	29%	120
Are documented failures regularly evaluated and are measures taken?	0	0%	0	0%	32	26%	44	37%	44	37%	120
How often does a failure occur that leads to downtime in production, and how long does it last Until the failure is permanently eliminated?	0	0%	5	4%	33	28%	54	45%	28	23%	120



INFERENCE

37% of the surveyed employees say yes by mentioning that the document failures regularly evaluated and are measures taken.

36% of the surveyed employees say yes by mentioning that there is a logbook for every production facility.

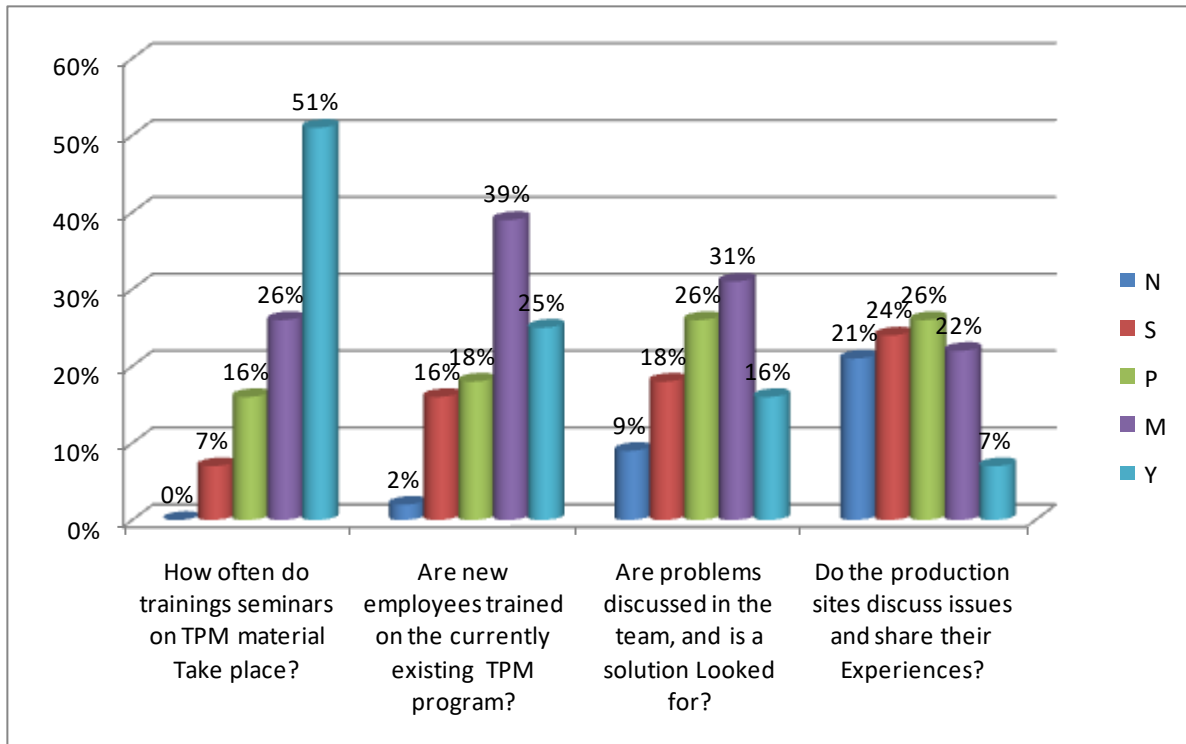
29% of the surveyed employees say yes by mentioning that there are failures documented.

23% of the surveyed employees say yes for failure that occur which leads to downtime in production and failure is permanently eliminated.

Therefore 37% of the surveyed employees say yes by mentioning that the document failures regularly evaluated and are measures taken.

TABLE: 11 EDUCATIONS AND TRAINING

Particulars	N	%	S	%	P	%	M	%	Y	%	No Of Surveyed employees
How often do trainings seminars on TPM material Take place?	0	0%	9	7%	19	16%	31	26%	61	51%	120
Are new employees trained on the currently existing TPM program?	2	2%	19	16%	22	18%	47	39%	30	25%	120
Are problems discussed in the team, and is a solution Looked for?	11	9%	22	18%	31	26%	37	31%	19	16%	120
Do the production sites discuss issues and share their Experiences?	25	21%	29	24%	31	26%	27	22%	8	7%	120



INFERENCE

51% of the surveyed employees say yes for training seminars on TPM material takes place.

39% of the surveyed employees mainly mention that the new employees trained on the currently existing TPM program.

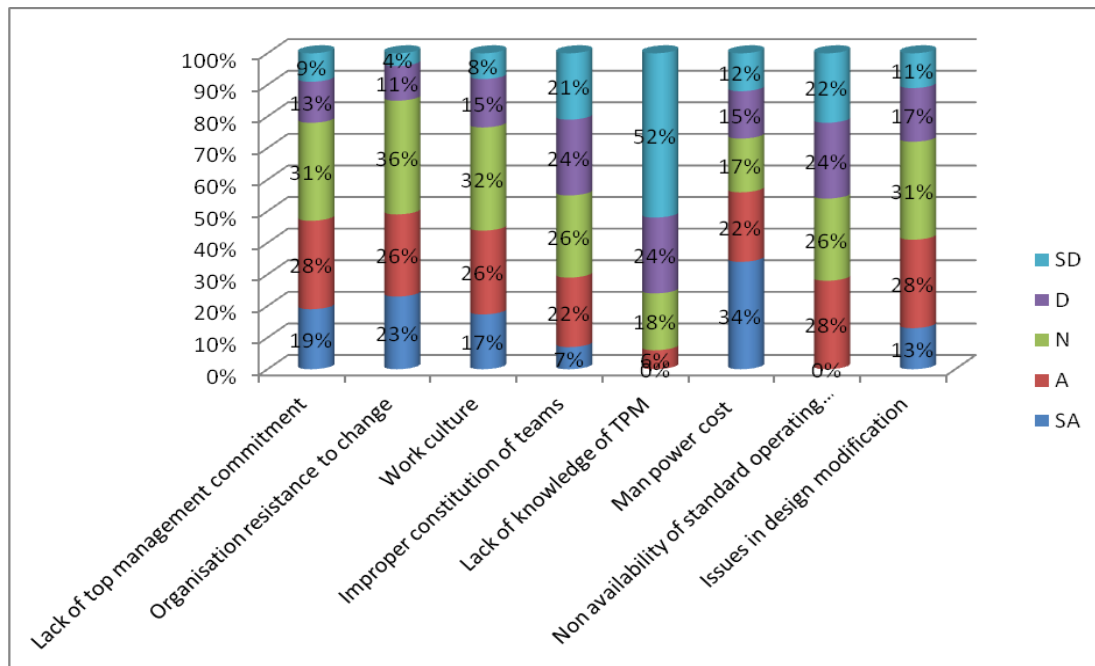
31% of the surveyed employees mainly mention that the problems are discussed in the team and the solution is looked for.

26% of the surveyed employees partially mentioned that the production sites discuss about the issues and share their experiences.

Therefore 51% of the surveyed employees say yes for training seminars on TPM material takes place.

TABLE: 12 THE BIGGEST HURDLES FOR THE EFFECTIVE IMPLEMENTATION OF TPM IN AJUTE INTERNATIONAL PVT LTD

Particulars	SA	%	A	%	N	%	DA	%	SD	%	No Of Surveyed employees
Lack of top management commitment	23	21%	33	24%	37	26%	16	22%	11	7%	120
Organisation resistance to change	28	23%	31	26%	43	36%	13	11%	5	4%	120
Work culture	21	17%	32	26%	39	32%	18	15%	10	8%	120
Improper constitution of teams	8	7%	27	22%	31	26%	29	24%	25	21%	120
Lack of knowledge of TPM	0	0%	7	6%	22	18%	29	24%	62	52%	120
Man power cost	41	34%	26	22%	21	17%	18	15%	14	12%	120
Non availability of standard operating procedures	0	0%	34	28%	31	26%	29	24%	26	22%	120
Issues in design modification	16	13%	34	28%	37	31%	20	17%	13	11%	120



INFERENCE

52% of the surveyed employees strongly disagree about the lack of knowledge of TPM.

36% of the surveyed employees neutrally mentioned that the organisation resistance to change.

34% of the surveyed employees strongly agree about the manpower cost.

32% of the surveyed employees neutrally agreed about the work culture.

31% of the surveyed employees neutrally agreed that the issues in design modification.

31% of the surveyed employees neutrally agreed about the lack of top management commitment.

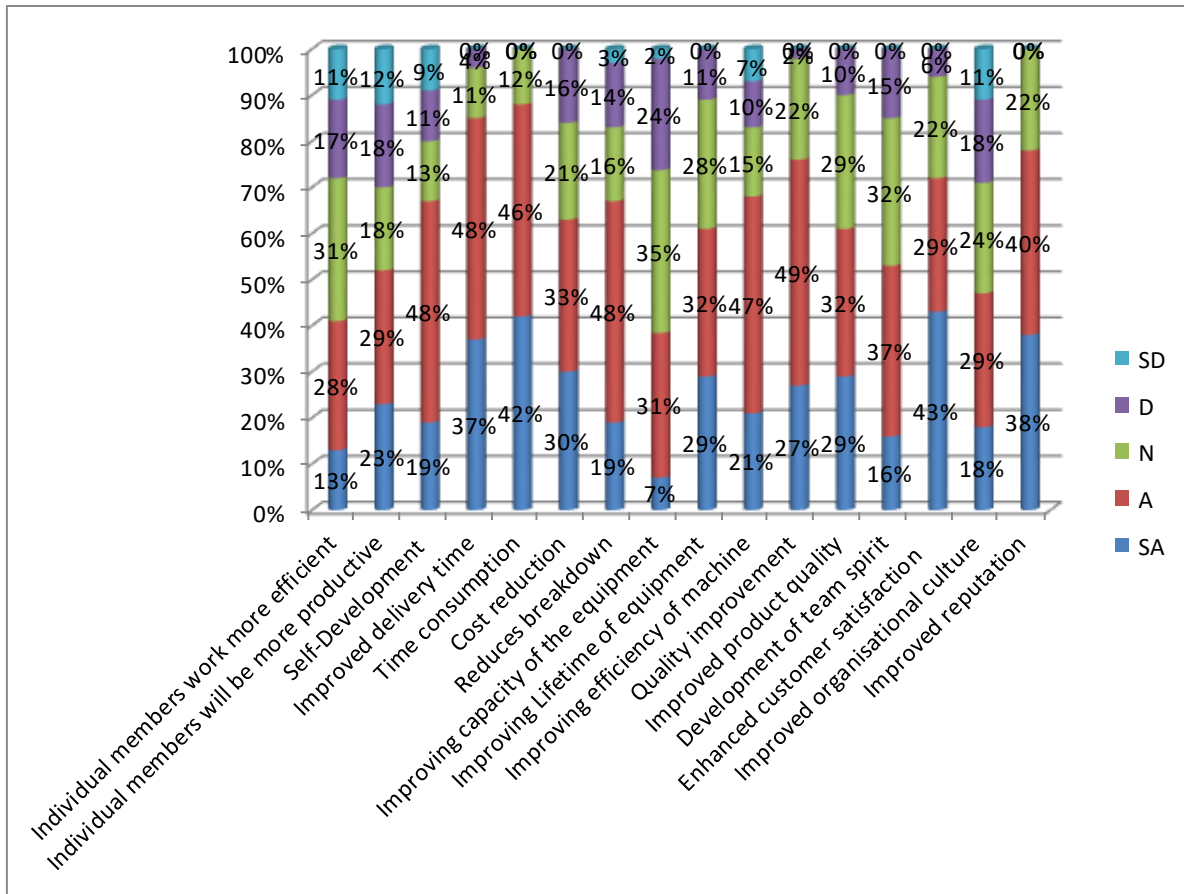
28% of the surveyed employees agreed that Non availability of standard operating procedures.

26% of the surveyed employees neutrally agreed about the Improper constitution of teams.

Therefore 52% of the surveyed employees strongly disagree about the lack of knowledge of TPM.

TABLE: 13 IMPACTS OF TPM IN INDUSTRIES

Particulars	SA	%	A	%	N	%	DA	%	SD	%	No Of Surveyed employees
Individual members work more efficient	16	13%	34	28%	37	31%	20	17%	13	11%	120
Individual members will be more productive	27	23%	35	29%	22	18%	22	18%	14	12%	120
Self-Development	23	19%	57	48%	16	13%	13	11%	11	9%	120
Improved delivery time	44	37%	58	48%	13	11%	5	4%	0	0%	120
Time consumption	51	42%	55	46%	14	12%	0	0%	0	0%	120
Cost reduction	36	30%	40	33%	25	21%	19	16%	0	0%	120
Reduces breakdown	23	19%	58	48%	19	16%	17	14%	3	3%	120
Improving capacity of the equipment	8	7%	37	31%	42	35%	30	24%	3	2%	120
Improving Lifetime of equipment	35	29%	38	32%	34	28%	13	11%	0	0%	120
Improving efficiency of machine	25	21%	56	47%	18	15%	12	10%	9	7%	120
Quality improvement	32	27%	59	49%	26	22%	3	2%	0	0%	120
Improved product quality	35	29%	38	32%	35	29%	12	10%	0	0%	120
Development of team spirit	19	16%	44	37%	39	32%	18	15%	0	0%	120
Enhanced customer satisfaction	52	43%	35	29%	26	22%	7	6%	0	0%	120
Improved organisational culture	22	18%	35	29%	28	24%	22	18%	13	11%	120
Improved reputation	46	38%	48	40%	26	22%	0	0%	0	0%	120



INFERENCE

31% of the surveyed employees are Neutral agreed that Individual members work more efficient.

29% of the surveyed employees are agreed that Individual members will be more productive.

48% of the surveyed employees are agreed that Self-Development.

48% of the surveyed employees are agreed that Improved delivery time.

46% of the surveyed employees are agreed that Time consumption.

33% of the surveyed employees are agreed that Cost reduction.

48% of the surveyed employees are agreed that Reduces breakdown.

35% of the surveyed employees are Neutral agreed that Improving capacity of the equipment.

32% of the surveyed employees are agreed that Improving Lifetime of equipment.

47% of the surveyed employees are agreed that Improving efficiency of machine.

49% of the surveyed employees are agreed that Quality improvement.

32% of the surveyed employees are agreed that Improved product quality.

37% of the surveyed employees are agreed that Development of team spirit.

43% of the surveyed employees are Strongly agreed that Enhanced customer satisfaction.

29% of the surveyed employees are agreed that Improved organisational culture.

40% of the surveyed employees are agreed that Improved reputation.

Therefore 43% of the surveyed employees are strongly agreed that Enhanced customer satisfaction

STATISTICAL TOOLS AND ANALYSIS

CHI- SQUARE TEST I – (χ^2)

Chi-square is the sum of the squared difference observed (o) and the expected (e) data (or the deviation, d), divided by the expected data in all possible categories.

Null hypothesis (Ho):

There is a relationship between the Occupation and Experience.

Alternate hypothesis (H1):

There is no relationship between the Occupation and Experience.

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Occupation * Experiences	120	100.0%	0	.0%	120	100.0%

Occupation * Experiences Crosstabulation

		Experiences				Total
		Below 1 year	1 - 3 years	3 - 5 years	Above 5 years	
Occupation Technical	Count	17	26	1	0	44
	% within Occupation	38.6%	59.1%	2.3%	.0%	100.0%
	% within Experiences	100.0%	72.2%	3.2%	.0%	44.0%
	% of Total	17.0%	26.0%	1.0%	.0%	44.0%
Middle Management	Count	0	10	10	0	20
	% within Occupation	.0%	50.0%	50.0%	.0%	100.0%

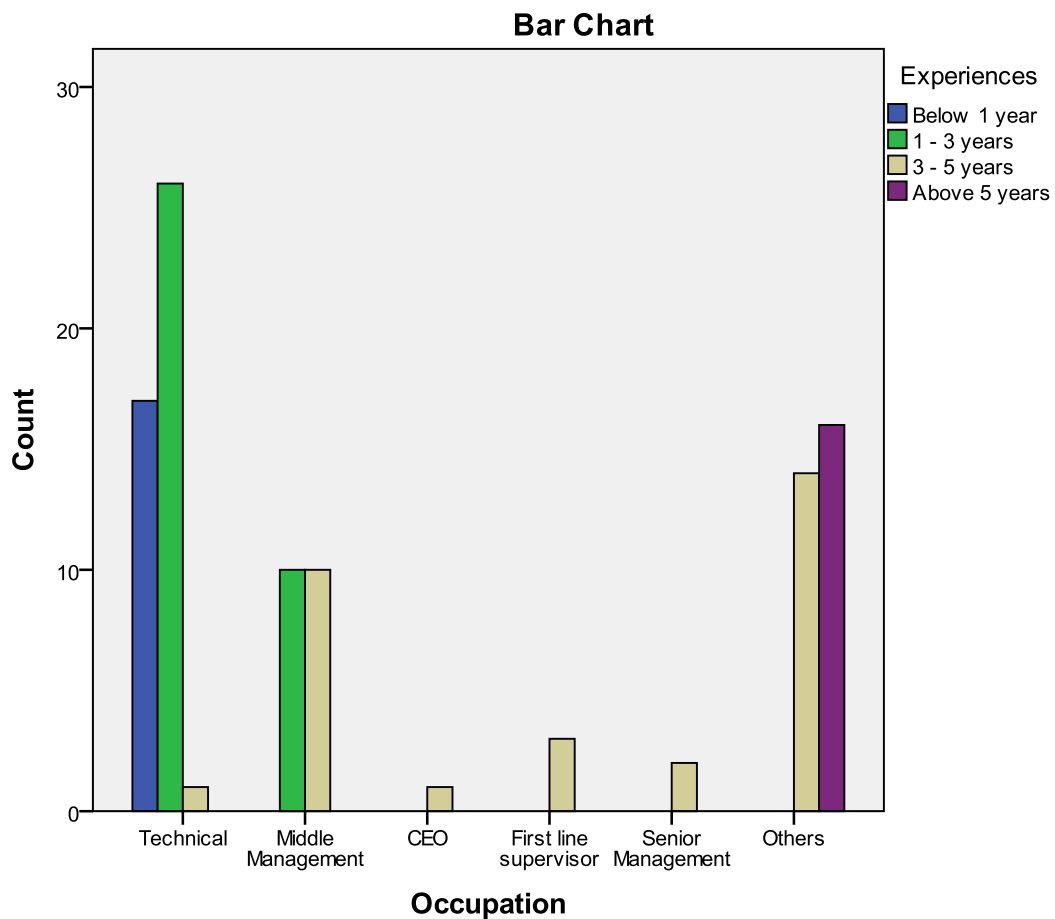
		% within Experiences	.0%	27.8%	32.3%	.0%	20.0%
		% of Total	.0%	10.0%	10.0%	.0%	20.0%
	CEO	Count	0	0	1	0	1
		% within Occupation	.0%	.0%	100.0%	.0%	100.0%
		% within Experiences	.0%	.0%	3.2%	.0%	1.0%
		% of Total	.0%	.0%	1.0%	.0%	1.0%
	First line supervisor	Count	0	0	3	0	3
		% within Occupation	.0%	.0%	100.0%	.0%	100.0%
		% within Experiences	.0%	.0%	9.7%	.0%	3.0%
		% of Total	.0%	.0%	3.0%	.0%	3.0%
	Senior Management	Count	0	0	2	0	2
		% within Occupation	.0%	.0%	100.0%	.0%	100.0%
		% within Experiences	.0%	.0%	6.5%	.0%	2.0%
		% of Total	.0%	.0%	2.0%	.0%	2.0%
	Others	Count	0	0	14	16	30
		% within Occupation	.0%	.0%	46.7%	53.3%	100.0%
		% within Experiences	.0%	.0%	45.2%	100.0%	30.0%
		% of Total	.0%	.0%	14.0%	16.0%	30.0%
	Total	Count	17	36	31	16	100
		% within Occupation	17.0%	36.0%	31.0%	16.0%	100.0%
% within Experiences		100.0%	100.0%	100.0%	100.0%	100.0%	
% of Total		17.0%	36.0%	31.0%	16.0%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	105.168 ^a	15	.000
Likelihood Ratio	128.622	15	.000
Linear-by-Linear Association	67.811	1	.000
N of Valid Cases	120		

a. 15 cells (62.5%) have expected count less than 5.

The minimum expected count is .16.



Degree of Freedom= $(r-1) * (c-1)$

$$= 5 * 3 = 15$$

Calculated value = 105.168

Tabulated value = 24.996

$Z = Z_{cal} > Z_{tab}$

$$Z = 105.168 > 24.996$$

Hence, the Alternate hypothesis [H1] is accepted

INFERENCE:

Since the calculated value is greater than the tabulated value, we accept the alternate hypothesis and hence there is no relationship between the Occupation and Experience.

ONE-WAY ANOVA CLASSIFICATION

Null hypothesis (Ho):

There is a significance difference between the Current Status of TPM Implementation in Ajute International Pvt Ltd and Enhanced customer satisfaction.

Alternate hypothesis (H1):

There is no significance difference between the Current Status of TPM Implementation in Ajute International Pvt Ltd and Enhanced customer satisfaction.

Descriptives

Current Status of TPM Implementation in Ajute International Pvt Ltd

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
SA	43	2.67	.969	.148	2.38	2.97	1	4
A	29	2.41	1.476	.274	1.85	2.98	1	4
N	22	3.05	.844	.180	2.67	3.42	2	4
D	6	3.00	.000	.000	3.00	3.00	3	3
Total	120	2.70	1.106	.111	2.48	2.92	1	4

Test of Homogeneity of Variances

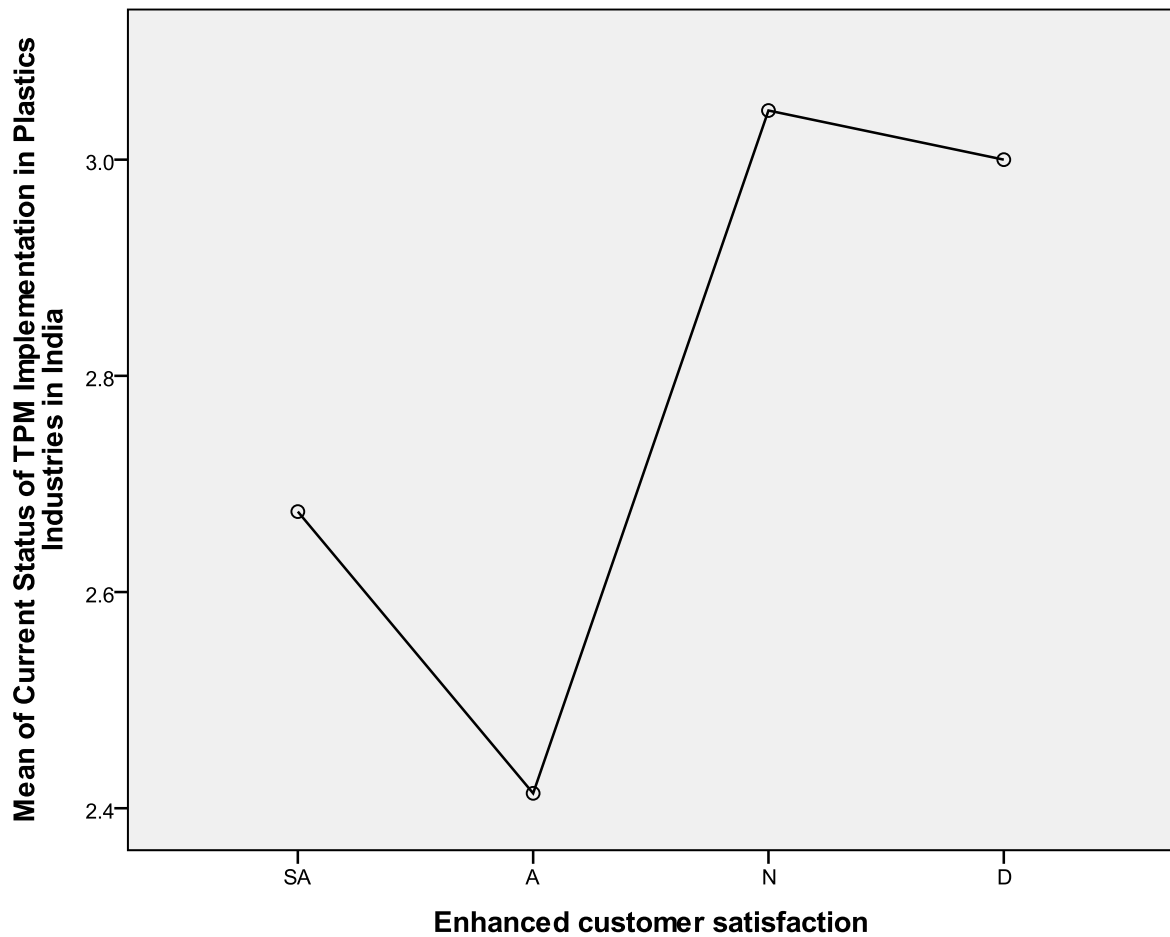
Current Status of TPM Implementation in
Ajute International Pvt Ltd

Levene Statistic	df1	df2	Sig.
30.515	3	96	.000

ANOVA

Current Status of TPM Implementation in Ajute International Pvt Ltd

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.569	3	1.856	1.544	.208
Within Groups	115.431	96	1.202		
Total	121.000	99			



Calculated value = 1.544

Tabulated value = 2.70

$F = F_{cal} > F_{tab} \quad F=1.544 > 2.70$

Hence, the Alternate hypothesis [H1] is accepted.

INFERENCE:

The calculated value of F is greater than the tabulated value. Hence, we reject the null hypothesis and conclude that there is no significance difference between the Current Status of TPM Implementation in Ajute International Pvt Ltd and Enhanced customer satisfaction.

ANALYSIS USING KARL PEARSON'S CORRELATION

Correlation analysis is the statistical tool used to measure the degree to which two variables are linearly related to each other. Correlation measures the degree of association between two variables.

Null hypothesis (H0):

There is positive relationship between the segments being practiced at industry and Current Status of TPM Implementation in Ajute International Pvt Ltd.

Alternate hypothesis (H1):

There is negative relationship between the segments being practiced at industry and Current Status of TPM Implementation in Ajute International Pvt Ltd.

Correlations

	Current Status of TPM Implementation in Ajute International Pvt Ltd	segments being practiced at industry
Current Status of TPM Implementation in Ajute International Pvt Ltd	1	.055
Pearson Correlation Sig. (2-tailed)		.583
N	120	120
segments being practiced at industry	.055	1
Pearson Correlation Sig. (2-tailed)	.583	
N	120	120

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2} \sqrt{N\sum Y^2 - (\sum Y)^2}}$$

$$r = .055$$

INFERENCE:

Since r is positive, there is positive relationship between the segments being practiced at industry and Current Status of TPM Implementation in Ajute International Pvt Ltd.

Chapter 5

5.1 FINDINGS

- **35% of the surveyed employees are at the age between 38-48 years.**
- **Therefore 43% of the surveyed employees are in technical position at the organization.**
- **36% of the surveyed employees have 1-3 years of experience**
- 33% of the surveyed employees current status of TPM implementation in AJUTE International Pvt Ltd are at growth stage.
- 21% of the surveyed employees are in Education and training segment at industry.
- 42% of the surveyed employees regularly carried out the 5s priority action to ensure cleanliness and order.
- 52% of the surveyed employees say yes for cleaning and maintenance plans.
- 52% of the surveyed employees say yes for maintenance and repair works that have to be carried out in cases of facility downtime conducted according to designated time interval.
- 45% of the surveyed employees mainly mention that the employees responsible for maintenance and repairs included in the installation of new facilities so that they become familiar with these facilities.
- 37% of the surveyed employees say yes by mentioning that the document failures regularly evaluated and are measures taken.
- 51% of the surveyed employees say yes for training seminars on TPM material takes place.
- 52% of the surveyed employees strongly disagree about the lack of knowledge of TPM.
- 43% of the surveyed employees are Strongly agreed that Enhanced customer satisfaction.

5.2 SUGGESTIONS

1. Ajute International Pvt Ltd can take proper measures to reduce document failures that happens on a regular
2. Advanced technologies can be used to maximize the benefit of total productive maintenance. Automated system to monitor the process and procedure has to be used across in Ajute International Pvt Ltd
3. Few respondents are not clear the various impact of TPM to them and to their company. This need to be eradicated to improve the overall effectiveness and the impact of
4. Some are dissatisfied with the total productive maintenance training because the it is given only once in a year. Management of Ajute International Pvt Ltd can conduct periodical training on TPM
5. There is an inadequate in the effectiveness of training materials on TPM. So Ajute International Pvt Ltd can provide adequate training materials to employees to remind about the process and procedures

5.3 CONCLUSION

As with the entire body of lean manufacturing systems, Total productive maintenance originated in Japan. An organization called the Japan Institute of Plant Maintenance (JIPM) formed in 1961 under a different moniker and unveiled the TPM concept a decade later. The Japanese automotive supplier Nippondenso is credited with first utilizing the process, and Seiichi Nakajima of JIPM established eight management pillars, for which TPM is well-known today.

TPM aims to increase productivity, efficiency and safety by empowering operators and team leaders to play a proactive role in day-to-day lubrication, inspection and cleaning. Management is tasked with creating a “buy-in culture” to support continuous activities through eight pillars of activity.

This study has been undertaken to understand the overall effectiveness of the total productive maintenance in Ajute International Pvt Ltd . For this purpose, responses from the employees of Ajute International Pvt Ltd have been collected and analyzed. Advanced technologies can be used to maximize the benefit of total productive maintenance. Automated system to monitor the process and procedure has to be used in Ajute International Pvt Ltd . Based upon the findings out of the research, few valuable suggestions have been given to the management of Ajute International Pvt Ltd to improve the overall effectiveness of the total productive maintenance

ANNEXURE

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WEB SITES:

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4. <http://www.leanmanufacturingconcepts.com/DefinitionTotalQualityManagement.html> dated 24.05.2011.
5. <http://www.scribd.com/doc/7312218/TQM-and-innovation-a-literature-review-and-research-framework> dated 26.05.2018.
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QUESTIONNAIRE

EVALUATING TOTAL PRODUCTIVE MAINTENANCE PRACTICE IN AJUTE INTERNATIONAL PVT LTD

QUESTIONNAIRE

(This information will be used only for project study and I assure it will be kept confidential)

Please put a tick mark [] in the appropriate box wherever required.

1. Name of the Industry :

2. Name :

3. Age :

a. 18 – 28 years []

b. 28 – 38 years []

c. 38 – 48 years []

d. above 48 years []

4. What position are you in your organisation?

a. Technical [] d. First line supervisor []

b. Middle Management [] e. Senior Management []

c. CEO [] f. Others []

5. How long have you been in the Organization?

a. below 1 year [] b. 1 - 3 years []

c. 3 - 5 years [] d. Above 5 years []

6. What is the current status of TPM implementation in Ajute International Pvt Ltd ?

- a. Not in existence at all ☐
- b. Nascent stage ☐
- c. Introduction stage ☐
- d. Growth stage ☐

7. What are all the following segments being practiced at your industry?

- a. 5s technique ☐
- b. Autonomous maintenance ☐
- c. Planned maintenance ☐
- d. Quality maintenance ☐
- e. Continuous improvement ☐
- f. Education and training ☐

8. 5S TECHNIQUE

- | | N | S | P | M | Y |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a. Does every tool for maintenance and repair works | | | | | |
| Have its designated spot? | ☐ | ☐ | ☐ | ☐ | ☐ |
| b. Audits are carried out periodically | ☐ | ☐ | ☐ | ☐ | ☐ |
| c. Do 5s priority action have to be carried out regularly | | | | | |
| In-order to ensure cleanliness and order? | ☐ | ☐ | ☐ | ☐ | ☐ |

9. AUTONOMOUS MAINTENANCE

	N	S	P	M	Y
a. Are there cleaning and maintenance plans?	☐	☐	☐	☐	☐
b. Handle the employee from the production, Maintenance operations according to the Maintenance plans?	☐	☐	☐	☐	☐
c. Visual controls	☐	☐	☐	☐	☐
d. Is there a responsibility matrix, or are the responsibilities for the maintenance works clearly regulated?	☐	☐	☐	☐	☐

N – NO, S - SPORADICAL, P- PARTIALLY, M – MAINLY, Y – YES

10. PLANNED MAINTENANCE

	N	S	P	M	Y
a. Are maintenance and repair works that have to be carried out in cases of facility downtime conducted according to designated time interval?	☐	☐	☐	☐	☐
b. Are condition analyses conducted for critical construction parts, and are these parts replaced ahead of schedule when necessary?	☐	☐	☐	☐	☐
c. Is a maintenance and repair planning and control system in use in order to detect disorders and to plan maintenance and repairs?	☐	☐	☐	☐	☐

d. Is a spare part management system in use so that
all necessary spare parts are available in a sufficient
supply without overstocking? ☐ ☐ ☐ ☐ ☐

11. MAINTENANCE PREVENTION

	N	S	P	M	Y
a. When procuring new production facilities, is attention given to easy maintenance and repair possibilities?	☐	☐	☐	☐	☐
b. Are the employees from production included in the planning of new production facilities?	☐	☐	☐	☐	☐
c. Are the employees from maintenance and repairs included in the planning of production facilities?	☐	☐	☐	☐	☐
d. Are the employees responsible for maintenance and repairs included in the installation of new facilities so that they become familiar with these facilities?	☐	☐	☐	☐	☐

12. ELIMINATION OF MAIN PROBLEMS

	N	S	P	M	Y
a. Is there an logbook for every production facility?	☐	☐	☐	☐	☐
b. Are failures documented?	☐	☐	☐	☐	☐
c. Are documented failures regularly evaluated and are measures taken?	☐	☐	☐	☐	☐
d. How often does a failure occur that leads to					

downtime in production, and how long does it last

until the failure is permanently eliminated? ☐ ☐ ☐ ☐ ☐

13. EDUCATION AND TRAINING

N S P M Y

a. How often do trainings seminars on TPM material

take place? ☐ ☐ ☐ ☐ ☐

b. Are new employees trained on the currently existing

TPM program? ☐ ☐ ☐ ☐ ☐

c. Are problems discussed in the team, and is a solution

looked for? ☐ ☐ ☐ ☐ ☐

d. Do the production sites discuss issues and share their

experiences? ☐ ☐ ☐ ☐ ☐

SA – STRONGLY AGREE, A – AGREE, N – NEITHER, D – DISAGREE, SD – STRONGLY DISAGREE

14. What are the biggest hurdles for the effective implementation of TPM in Ajute International Pvt Ltd ?

SA A N DA SD

a. Lack of top management commitment ☐ ☐ ☐ ☐ ☐

b. Organisation resistance to change ☐ ☐ ☐ ☐ ☐

c. Work culture ☐ ☐ ☐ ☐ ☐

d. Improper constitution of teams ☐ ☐ ☐ ☐ ☐

e. Lack of knowledge of TPM	☐	☐	☐	☐	☐
f. Man power cost	☐	☐	☐	☐	☐
g. Non availability of standard operating procedures	☐	☐	☐	☐	☐
h. Issues in design modification	☐	☐	☐	☐	☐

15. What are the impacts of TPM in your Industries?

	SA	A	N	DA	SD
a. Individual members work more efficient	☐	☐	☐	☐	☐
b. Individual members will be more productive	☐	☐	☐	☐	☐
c. Self-Development	☐	☐	☐	☐	☐
d. Improved delivery time	☐	☐	☐	☐	☐
e. Time consumption	☐	☐	☐	☐	☐
f. Cost reduction	☐	☐	☐	☐	☐
g. Reduces breakdown	☐	☐	☐	☐	☐
h. Improving capacity of the equipment	☐	☐	☐	☐	☐
i. Improving Lifetime of equipment	☐	☐	☐	☐	☐
j. Improving efficiency of machine	☐	☐	☐	☐	☐
k. Quality improvement	☐	☐	☐	☐	☐
l. Improved product quality	☐	☐	☐	☐	☐
m. Development of team spirit	☐	☐	☐	☐	☐
n. Enhanced customer satisfaction	☐	☐	☐	☐	☐
o. Improved organisational culture	☐	☐	☐	☐	☐
p. Improved reputation	☐	☐	☐	☐	☐

16. YOUR COMMENTS

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