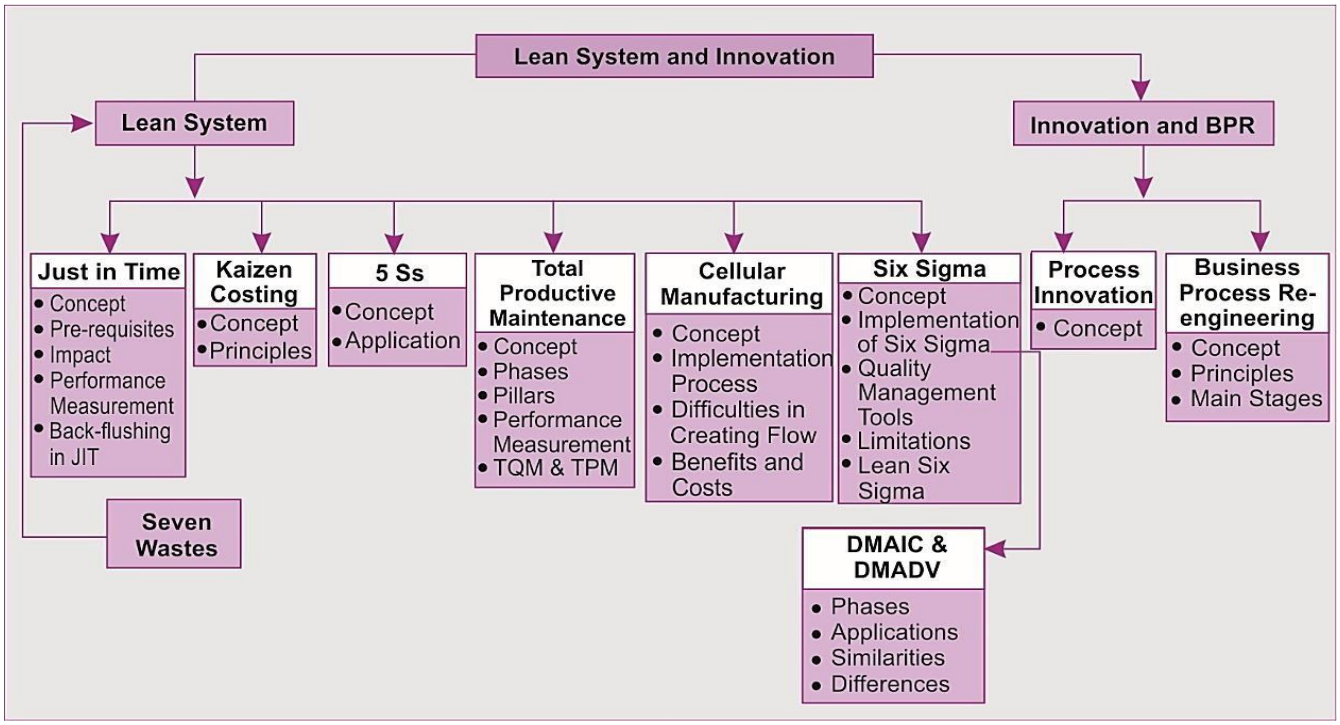
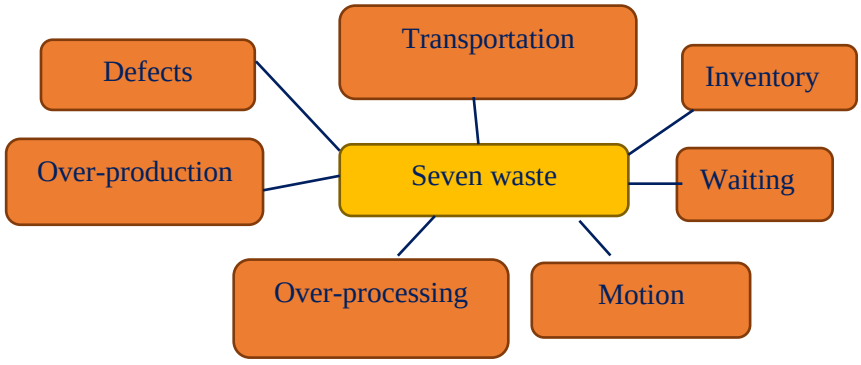
Revision Class no-3(Part-1), 3(Part-2)

Lean System & Innovation

LEAN SYSTEM



Lean System is an organized method for waste minimization without sacrificing productivity within a manufacturing system. Lean implementation emphasizes the importance of optimizing work flow through strategic operational procedures while minimizing waste and being adaptable. Waste is any step or action in a process that is not required to complete a process successfully (called "Non-Value Adding"). When Waste is removed, only the steps that are required (called "Value-Adding") to deliver a satisfactory product or service to the customer remain in the process. There are generally 7 type of wastes:



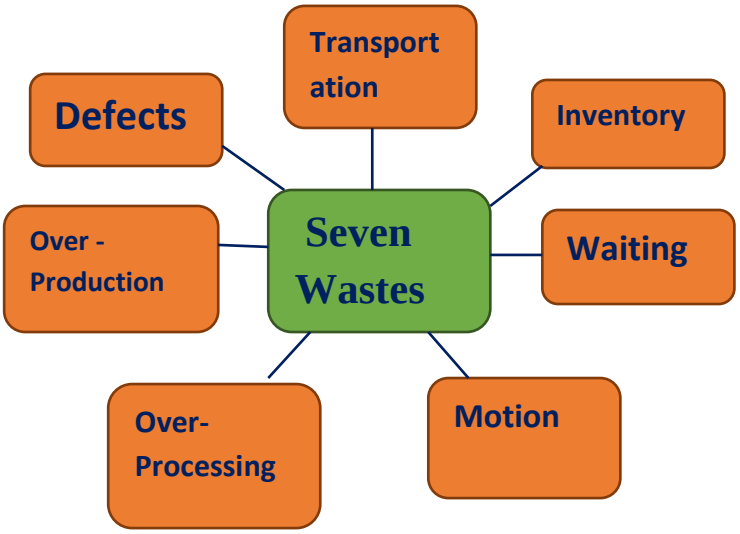
Most of these applications are based on following principles:

- Perfect first-time quality
- Waste minimization
- Continuous improvement
- Flexibility

The characteristics of Lean manufacturing:

- Zero waiting time
- Zero inventory
- Pull processing
- Continuous flow of production
- Continuous finding ways of reducing process time.

SEVEN WASTE



The Seven Wastes expended are:

Overproduction: Producing ahead of demand.

Inventory: Having more inventory than is minimally required at any point in the process, including end-product.

Waiting: waiting includes products waiting on the next production step.

Motion:- People or requirement moving or walking more than is required to perform the process.

Transportation: Moving products that is not actually required to perform the process.

Rework from defects: Non- right first time.

Over Processing: Unnecessary work elements (non-value added activities).

Many large manufacturing companies like General Motors and Toyota are into lean manufacturing. Lean manufacturing involves a shift in traditional thinking, from batch and queue to product-aligned pull production. Instead of producing a lot of parts, the focus is on different types of operations conducted adjacent to each other in a continuous flow.

Some of the techniques are:

- Just-in-Time (JIT)
- Kaizen Costing
- 5 S
- Total Productive Maintenance (TPM)
- Cellular Manufacturing/ One-Piece Flow Production Systems
- Six Sigma (SS)

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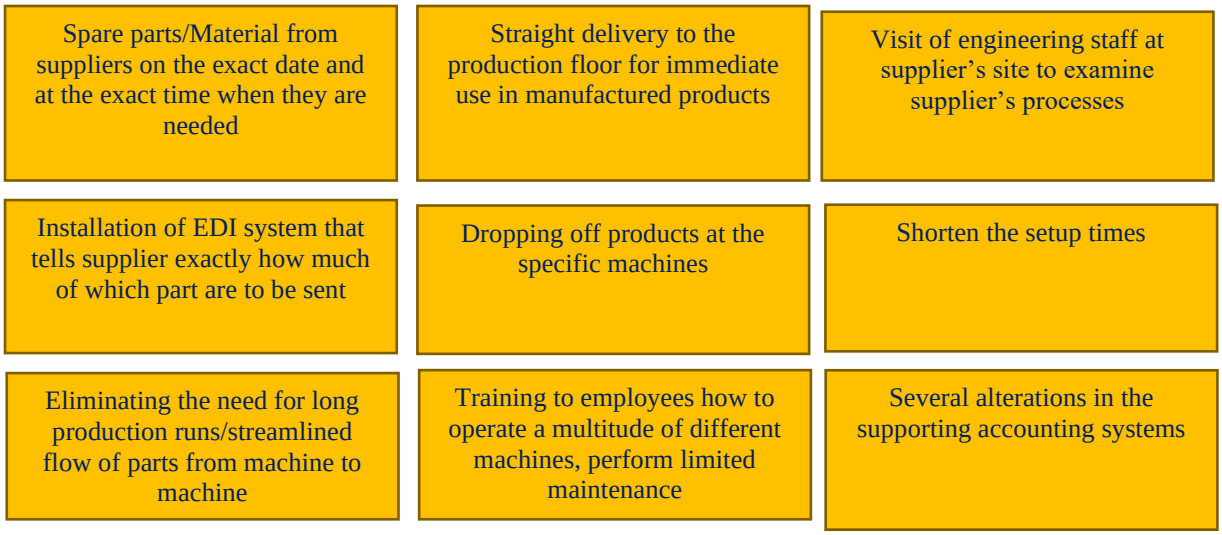
JUST-IN-TIME (JIT)

A just in time approach is a collection of ideas that streamline a company's production process activities to such an extent that wastage of all kinds viz., of time, material, and labour is systematically driven out of the process. JIT has a decisive, positive impact on product costs.

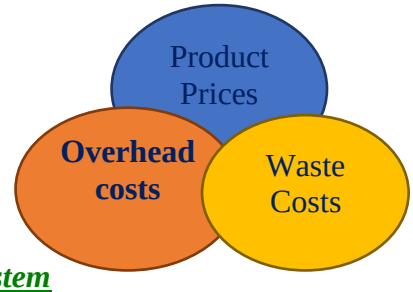
A complete JIT system begins with production, includes deliveries to a company's production facilities, continues through the manufacturing plant, and even includes the types of transactions processed by the accounting system.

Features



Main Features: (5 Features)

1. Organize production in manufacturing cells, a grouping of all the different types of equipment used to make a given product. Materials move from one machine to another where various operations are performed in sequence. Material-handling cost are reduced.
2. Hire and retain workers who are multi-skilled so that they are capable of performing a variety of operations, including repairs and maintenance tasks. Thus, Labour idle time gets reduced.
3. Apply TQM to eliminate defects. As, there are tight link stages in the production line, and minimum inventories at each stage, defect arising in one stage can hamper the other stages, JIT creates urgency for eliminating defects as quickly as possible.
4. Place emphasis on reducing set-up time which makes production in smaller batches economical and reducing inventory levels. Thus company can respond to customer demand faster.
5. Carefully selected suppliers capable of delivering high quality materials in a timely manner directly at the shop-floor, reducing the material receipt time.



Essential Pre-requisites of a JIT system

- Low variety of goods
- Vendor reliability
- Good communication
- Demand stability
- TQM
- Defect free materials
- Preventive maintenance

Impact of JIT System on

Waste Costs: When fully installed, a JIT system vastly reduce all these types of waste. When this happens, there is a sharp drop in several aspects of a product's costs.

Overhead Costs: The costs of material handling, facilities, and quality inspection decline when a JIT system is installed.

Product Prices: When a company achieves a higher level of product quality, along with ability to deliver products on the dates required, customers may be willing to pay a premium.

Performance Measurements in a JIT System

Many of the performance measurement measures used under a traditional accounting system are not useful in a JIT environment, while new measures can be implemented that take advantage of the unique characteristics of this system.

Machine utilization measurements can be discarded under JIT environment.

Another inappropriate measurement is any type of piece rate tracking for each employee:

Any type of direct labour efficiency tracking is highly inappropriate in a JIT system:

Installing a JIT system does not mean that there should be a complete elimination of operational measures.

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Takt time is the maximum available time to meet the demands of the customer, This will help to decide the speed off at manufacturing facility.

TAKT time is the average time between the start of production of one unit and the start of production of the next unit when these production starts are set to match the rate of Customers demand.

$$Takt\ Time = \frac{Available\ Production\ Time}{Total\ Quantity\ Requried}$$

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Back-flushing

Back Flush required no data entry of any kind until a finished product is completed. At that time the total

amount finished is entered into the computer system, which multiplies it by all the components listed in the bill of material for each item produced. This yields a lengthy list of components that should have been used in the production process and which are subtracted from the beginning inventory balance to arrive at the amount of inventory that should now be left on hand. Given the large transactions volumes associated with JIT, this is an ideal solution to the problem. However, there are some serious problems with back-flushing that must be corrected before it will work properly. They are:—

Production Reporting: The total production figure entered into the system must be absolutely correct, or else the wrong component types and qualities will be subtracted from stock. This is a particular problem when there is high turnover or a low level of training to the production staff that records this information, which leads to errors.

Scrap reporting: All abnormal scrap must be diligently tracked and recorded; otherwise these materials will fall outside the black-flushing system and will not be charged to inventory. Since scrap can occur anywhere in a production process, a lack of attention by any of the production staff can result in an inaccurate inventory. Once again, high production turnover or a low level of employee training increases this problem.

Lot tracing: Lot tracing is impossible under the back-flushing system. It is required when a manufacturer need to keep records of which production lots were used to create a product in case all the items in a lot must be recalled. Only a picking system can adequately record this information. Some computer system allows picking and back-flushing system to coexist, so that pick transactions for lot tracing purpose can still be entered in the computer. Lot tracing may then still be possible if the right software is available; however, this feature is generally present only on high-end systems.

Inventory accuracy: The inventory balance may be too high at all times because the back-flushing transaction that relives inventory usually does so only once a day, during which time other inventory is sent to the production process; this makes it difficult to maintain an accurate set of inventory records in the warehouse.

Of all the issues noted here, the worst is a situation where the production staff is clearly incapable of providing sufficiently accurate scrap or production reporting for the back flushing system. If there is an easily traceable cause, such as less capable workers on a particular shift, moving a few reliable employees into these positions can provide immediate relief from the problem. It may even be possible to have an experienced shift supervisor to collect this information. However where this is not possible for whatever reason, computer system users experience back-flushing garbage in, garbage out (GIGO)-entering inaccurate information rapidly eliminates any degree of accuracy in the inventory records, requiring many physical inventory counts to correct the problem. Consequently the success of a back-flushing system is directly related to a company's willingness to invest in a well-paid, experienced well–educated production staff that undergoes little turnover.

Back-flushing in a JIT System

Back-flushing requires no data entry of any kind until a finished product is completed.

KAIZEN COSTING

This philosophy implies that small, incremental changes routinely applied and sustained over a long period result in significant improvements.

KAIZEN COSTING:—

1. Cost reduction technique.
2. Small Investment/Continuous improvement.
3. Require trainee procedure on regular basis.
4. Not restricted to shop floor employee but to Top management to low level (every employee must participate).

5. No Compromise with the quality crystal clear, duties & responsibility.
6. Different from Target Costing (Design) (Production Stage)
7. Standards are being set on very shortly weekly/Daily.
8. Management should interact with staff/Labour to reduce the Labour cost per unit/Variable Cost.
9. Gradually reduction.
10. Consumption of Per unit low, Labour & Labour related cost can be reduce on continuous basis.

Kaizen Costing Principles

- The system seeks gradual improvements in the existing situation, at an acceptable cost.
- It encourages collective decision making and application of knowledge.
- There are no limits to the level of improvements that can be implemented.
- Kaizen involves setting standards and then continually improving these standards to achieve
- long-term sustainable improvements.
- The focus is on eliminating waste, improving systems, and improving productivity.
- Involves all employees and all areas of the business.

Applicability of Kaizen Costing

"Kaizen" is a Japanese word which means "Change for Better". In business parlance, Kaizen is used to refer to small and continuous improvement across all functions, processes and employees. Kaizen costing is a cost reduction system. Yashihuro Modern defines Kaizen Costing as "the maintenance of present cost levels for products currently being manufactured via systematic efforts to achieve the desired cost level.

Toyota Production System is considered as a pioneer in Kaizen Costing. Though the model was used for eliminating wastage from production at factory initially, the concept can be applied in any of the processes in a business. Since Kaizen is a continuous improvement process, a radical change or disruptive innovation is not expected in Kaizen costing.

The following are the key features of Kaizen—

- Kaizen processes focus on eliminating waste in the systems and processes of an organisation, improving productivity and achieving sustained continual improvement.
- Application of small, incremental changes routinely applied and sustained over a long period can lead to significant improvements.
- It aims to involve workers from multiple functions and levels in the organisation.
- A value chain analysis helps to quickly identify opportunities to eliminate wastage
- Although incremental changes can often be too small to be seen, Kaizen can be very effective in the long run. An airline which identified that 75% of its flyers would leave the olive from salad, the airline decided to remove it from its servings. This saved the airline $ 40,000 per year. Another example is where an airline stopped printing its logo in the rubbish bags as it did not add value saved over $ 300,000 per year.

The CEO is referring to Kaizen costing when he mentions minor improvements to save costs over time. Kaizen costing takes into consideration various costs such as costs of supply chain, manufacturing costs, marketing, sales, distribution costs etc.

Benefits of Kaizen Costing

- Kaizen reduces waste in areas such as employees waiting time, transportation, excess inventory etc., which leads to improved efficiency in overall business processes and systems.
- A company applying Kaizen philosophy can achieve cost reduction through small incremental

improvements and cost savings.

- Kaizen looks at functions and processes at all levels of organisation and requires participation of all employees and massive as well as open communication system. This participative approach improves teamwork across the organisation.
- Product improvement using Kaizen is likely to result in less number of defective products leading to customer satisfaction and reduction in warranty related costs.
- The reduction in wastage, improved efficiency and cost reduction improves the overall profitability of the company.

Implementation of Kaizen

The implementation of Kaizen as a cost reduction techniques can take several forms. The key question to ask for implementation is - "Can we eliminate waste?". The waste can take several forms like—

- Unnecessary movement of material and men - Travelling for meeting in cases where a video conferencing could help.
- Unwanted part in a product which if removed is not likely to impact the performance of the product. (Nano Sim card has reduced a significant portion of use fiber boards as compared to the traditional sim cards.)
- Defects which involve extra cost in terms of reworks.
- *Waiting time* - A simple example could be locating for files in your computer which has not be arranged properly. This leads to waste of time.

The above is just an indicative list where improvements can be made. However, an important point to note is that reduction of waste should not be done by compromising the quality of product. Apple launched iPhone 5c as a budget phone by using plastic material instead of Aluminum. The market did not like the product as it was considered to be an inferior product as compared to iPhone 5s.

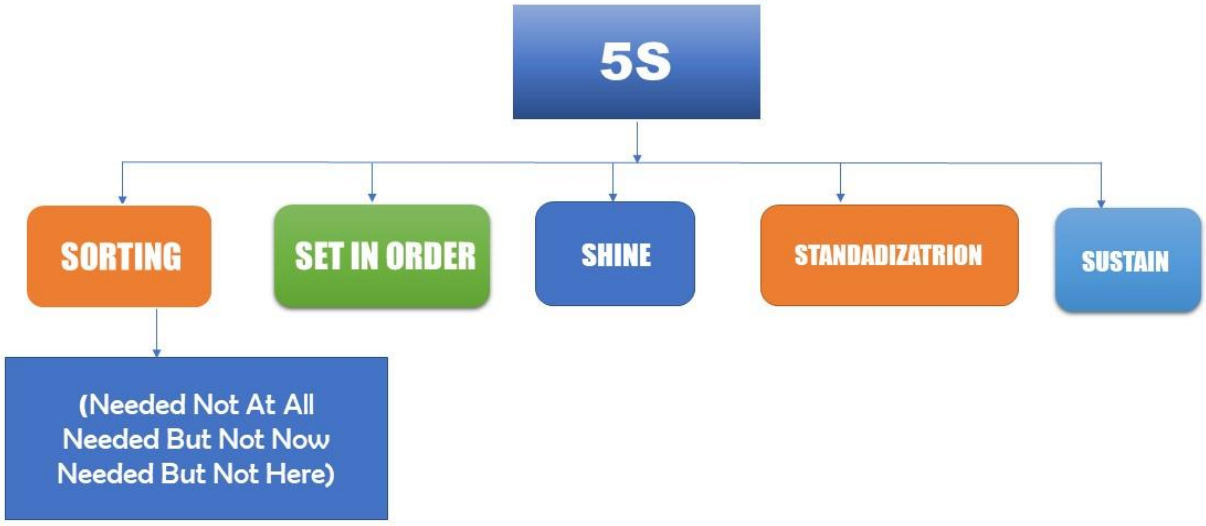
Another way of looking at Kaizen is asking following questions -

- Can we eliminate functions from the production process without compromising the quality and utility of end products? - Removing unnecessary movements of material and men.
- Can we eliminate some durability? - Use of unbreakable plastic for producing disposable glasses would be waste of resources
- Can we minimise design? - e.g. use of Nano Sims.
- Can we substitute parts of the product being manufactured? − Can we take supplier's assistance to get better quality parts?
- Is there a better way? - This is a question which must be asked continuously to ensure that the improvement is not a one-time exercise.

A business process consists of a collection of activities that are linked together in a co-ordinates manner to achieve a specific objectives. Business process re-engineering involves examining business processes and radically redesigning these processes to achieve cost reduction improved quality and customer satisfaction.BPR is all about major changes to how business processes operate.

Material handling is an example of a business process and may consist of the following separate activites, material requisitioning purchases requisitioning processing purchase orders, inspecting materials storing materials and paying suppliers. This process could be re-engineered by sending the material requisitions directly to an approved supplier and entering into an agreement which entrails delivering high quality material in accordance with the production requirements. This change in business process could reduction by the elimination of the administration involved in placing orders the need for material inspection and storage By re-engineering the material handling business process the company will reduce costs without compromising the quality of the products delivered to customers.

Concept of 5S'



5S is the name of a workplace organization method that uses a list of five Japanese words: Seiri, seiton, seiso, seiketsu and shitsuke. It explains how a work space should be organized for efficiency and

effectiveness by identifying and storing the items used, maintaining the area and items and sustaining the new order.

Sort (Seiri) work easier by eliminating obstacles and evaluate necessary items

Set in Order (Seiton) Arrange all necessary items into their most efficient and accessible arrangements

Shine (Seiso) Clean your workplace on daily basis completely or set cleaning frequency.

Standardize (Seiketsu) Standardize the best practices in the work area.

Sustain (Shitsuke) Not harmful to anyone, training and discipline, to maintain proper order.

5S methodology is being applied to a wide variety of industries including Manufacturing, Health care, Education & Government.

5S

Office processes often have huge amounts of paperwork, and this not only makes processes slower but also allows errors to be introduced. 5S is a method of both cleaning out the working area and maintaining the cleanliness to improve process quality. The 5S process is based on:

SORT (Seiri)

This is sorting and removal of unnecessary files, papers, books and documents in the work area. Sorting is designed to make the work area neat, organized and arranged so that relevant items can be found easily. If

an item is not relevant for the work, then it should not be in the work area.

Set in Order (Seiton)

Set in order

Set in order means systematic arrangement of things i.e. arrange all necessary items into most efficient and accessible arrangement so that they can be easily be identified for use. It is advisable to have proper indexing of files and proper documentation i.e. proper index should be made and pasted on each file about its contents and in that pattern of contents, documents should be kept inside the files so that specific document can easily be traced and withdrawn on time. Even inside cupboard paper of indexing about files with its name should be pasted so that specific file can easily be traced. Same can be done w.r.t folders in computer right file should be saved in right folder with identifiable name so that anyone can easily find any file. Frequent use items should be close by and infrequent use items can be further away in a central area. All storage areas should be clearly labeled to allow items to be put in the correct place, e.g. where did I leave the office stamp again?

Shine (Seiso)

After sorting and simplifying it is necessary to keep the work area clean and safe Shinng is also an inspection process for the area i.e. is everything in good condition. It is desirable to involve employees for 15-20 minute each day to clean the work area so that they can have the habit of cleanness. In the same way unimportant files either in desktop or any driver should be permanently deleted.

Standardize (Seiketsu)

A clean and tidy work area allows the process to be standardized and examined for quality or process improvements. Best practices are documented and rolled out across the work area, standards and process measures are established and displayed in the work area.

For example red file can be standardized for very important files (can be required anytime), green file important files and yellow file for unimportant files.

Sustain (Shitsuke)

It means to maintain discipline, this can only be achieved by auditing work areas and processes to make sure that the 5S Standards are maintained. It is worthwhile to apply 5S, standards continuously i.e. daily basis and check for any up gradation, If needed, so that firm can have good management in terms of documentation, cleanness, time saving of partners as well as clients.

Overall 5S in offices streamlines the work (low to reduce arrors as well as improving process times) and employee satisfaction.

CASE STUDY BASED ON 5S

Y&E Chartered Accountants offers a wide range of specialized, multi –disciplinary professional services that meet the immediate as well as the long-term business needs of clients. One of partner ‘E’ was upset with office documentation. ‘E’ argued that a document management solution is needed to maximize efficiency within the firm. The senior partner ‘Y’ has recently attended a seminar on lean system and heard the ‘5S’. He said that old files hide the key files from the eye and forces staff to ask which to use.
Accordingly, he desires to implement ‘5S’.’

Required

ADVISE on implementation of ‘5S’ in Y & E.

Solution:

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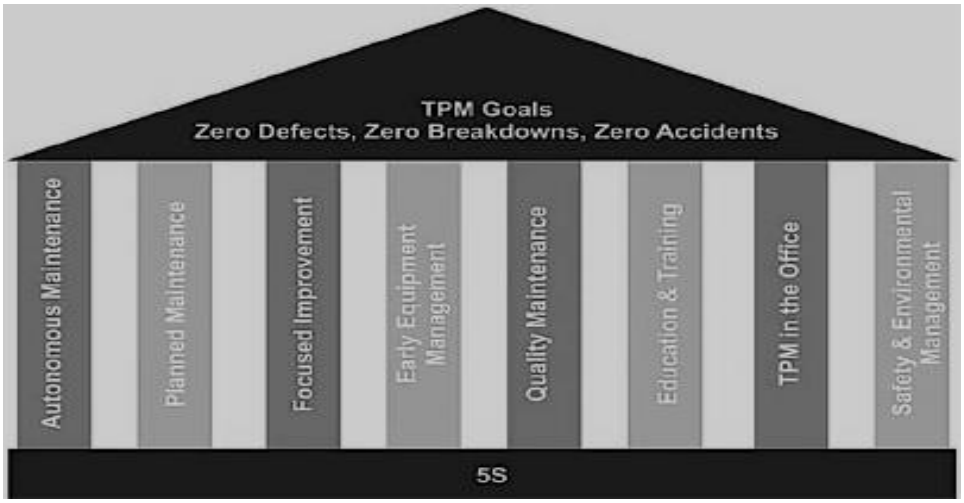
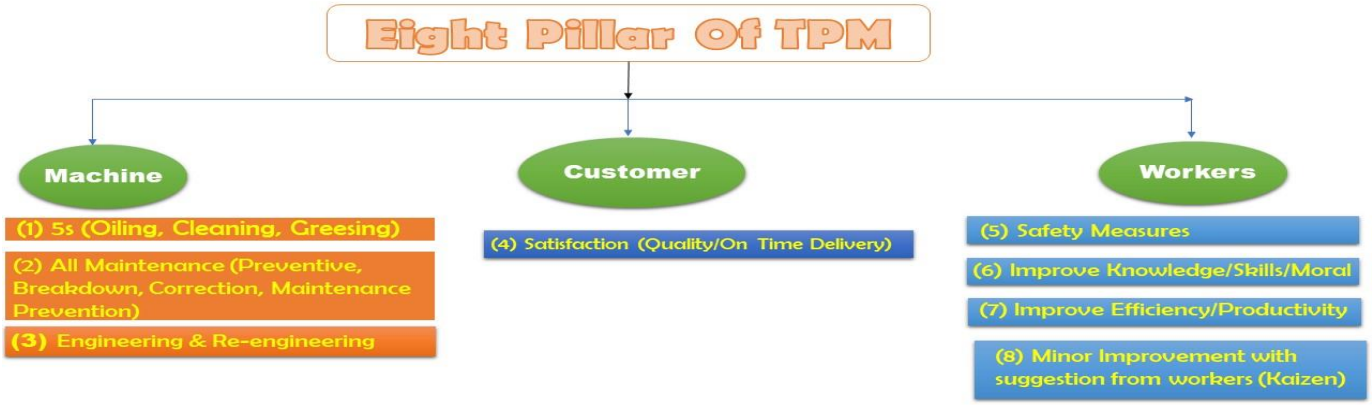
TOTAL PRODUCTIVE MAINTENANCE (TPM)

Total Productive Maintenance (TPM) is a system of maintaining and improving the integrity of production and quality systems. This is done through the machines, equipment, processes, and employees that add to the value in Business Organisation. This concept was first introduced by M/s Nippon Denso Co. Ltd. of Japan, a supplier of M/s Toyota Motor Company.

TPM helps in keeping all equipment in top working condition so as to avoid breakdowns and delays in manufacturing processes.





Foundation & Pillars	About	Techniques
Foundation:-5S	TPM starts with 5S. It deals with organizing a workplace which helps to recognize the uncover problems.	Seiri (Sor), Seiton(Set in order), Seiso, (Shine), Seiketsu (Standardize), Shitsuke, (Sustain).
P-1:- Autonomous Maintenance	Operation of equipment without breakdown and eliminating the defects at source through active employee participation	Cleaning, Lubricating, Visual Inspection, Tightening of Loosened Bolts etc.
P-2:- Focused Improvement (Kaizen)	This pillar is about the minor improvements made on continous basis.This pillar aims to reduce losses in the workplace that affect efficiencies.	Kaizen Register, kaizen Summary Sheet, Why-Why Analysis, Summary of Losses.
P-3:- Planned Maintenance	This is proper maintenance system adopted for improvement in reliability and maintainability of equipment. It aims to have zero breakdown and optimum	Preventive Maintenance, Breakdown Maintenance, Corrective Maintenance, and Maintenance Prevention.

	maintenance cost.	
P-4:- Early Management	This focuses on shortening the time requried for product and equipment development.	Engineering and Re-engineering Processes.
P-5:- Qualty Maintenance	This is towards achieving cusotmer satisfaction through delivery of highest quality product.	Root Cause Analysis, Customer Data Analysis.
P-6:- Education & Training	It aims to improve knowledge/skills and enhance morale of employees.	Training Calender, Policies for Education and Training , On-site Training Etc.
P-7:- Office TPM	This refers to application of TPM techniques in administration to improve productivity and efficiency in the functions with elimination of losses.	Analyzing processes and procedure towards increased office Automation.
P-8:- Safety, Health, and Environment	Above all the safety of worker is utmost importance. It aims to have zero accidents and zero health damages.	Drama, Safety slogans, Quizzes, Posters making to create awareness related to safety.

Performance Measurement in TPM

The most important approach to the measurement of TPM performance is known as Overall Equipment Effectiveness (OEE) measure. The calculation of OEE measure requires the identification of "six big losses"

Performance × Availability × Quality = OEE %

OEE may be applied to any individual assets or to a process. It is unlikely that any manufacturing process can run at 100% OEE. According to Dal et al (2000), Nakajima (1998) suggested that ideal values for the OEE component measures are:

Availability	> 90%
Performance	> 95%
Quality	> 99%

Accordingly, OEE at World Class Performance would be approximately 85%. Kotze (1993) contradicted, that an OEE figure greater than 50% is more realistic and therefore more useful as an acceptable target.

Connection Between TQM and TPM

The connection between TQM and TPM are summarized below:

TQM and TPM make company more competitive by reducing costs, importing customer satisfaction and slashing lead time.

Involvement of the workers into all phases of TQM and TPM is necessary.

Both Processes need fundamental training and eduction of participants.

TPM and TQM take ling time to notice sustained tangible benefits.

Cellular Manufacturing/One Piece Flow Production System

A Sub Section of JIT and Lean System is Cellular Manufacturing. It encompasses a grouptechnology. The goals of cellular manufacturing are:

- To move as quickly as possible,
- Make a wide variety of similar products,
- Making as little waste as possible.

In the assembly line multiple cells are used. Each cell comprises of one or more machines which accomplish a certain task. The Product moves from one cell to the next, each station completing part of the manufacturing process. U- Shaped design is given to these cells because this allows for the supervisor to move less and have the ability to more readily watch over the entire process.

Flexibility in operations is its biggest advantage. Changes are easy to make as the machine are automatic. Variety of product scaling is possible and minor changes to the overall design are made possible changing the overall design. Although boring the changes can be done precisely and quickly.

A cell is created by consolidating the processes required to create a specific output, such as a part or a set of instructions. Reduction is the extra steps are done in the process of creating the specific output, and facilitate quick identification of problems and encourage communication of employees within the cell in order to resolve issues that arise quickly. It gives massive Gains on implementation in productivity and quality while simultaneously reducing the amount of inventory, space and lead time required to create a product. It is for this reason that the one-piece-flow cell has been called “the ultimate in lean production”.

Implementation Process

In order to implement cellular manufacturing a number of steps must be performed.

First, the parts to be made must be grouped by similarity (in design or manufacturing requirements into families.

Then a systematic analysis of each family must be performed; typically in the form of production flow analysis (PFA) for manufacturing families, or in the examination of design/product data for design families. This analysis can be time consuming and costly, but is important because a cell needs to be created for each family of parts.

There are also a number of mathematical models and algorithms to aid in planning a cellular manufacturing center, which take into account a variety of important variables such as, “multiple plant locations, multi-market allocations with production planning and various part mix”.

Once these variables are determined with a given level of uncertainty, optimizations can be performed to minimize factors such as, “total cost of holding , inter-cell material handling, external transportation, fixed cost for producing each part in each plant, machine and labour salaries”.

Difficulties in Creating Flow

Following difficulties need to be considered and addresses to create efficient flow in cellular manufacturing:

- Exceptional Elements
- Machine Distances
- Bottleneck Machines and Parts
- Machine Location and Relocation
- Part Routing
- Cell Load variation
- Inter and Intracellular Material Transferring
- Cell Reconfiguring
- Dynamic Part demands and
- Operation and Completion Times

SIX SIGMA

The Value of the Defect Percentage under Various Sigma Levels

Sigma Level	Defects per Million Opportunity (DPMO)	Percentage Defective (%)	Percentage Yield (%)	Quality Profitability
1	6,91,462	69	31	Loss
2	3,08,538	31	69	Non-Competitive
3	66,807	6.7	93.3	Average Industries
4	6,210	0.62	99.38	Above Average
5	233	0.023	99.977	Below Maximum Productivity
6	3.4	0.0034	99.99966	Near Perfection

The Second last column (in above table) indicates the percentage of values that lie within the control limits. The more popular measure, the number of defects per million opportunities, is indicated in second column.

It is quality improvement technique whose objective to eliminate defects in any aspect that affects customer satisfaction. The premise of Six Sigma is that by measuring defects in a process, a company can develop ways to eliminate them and practically achieve “zero defects”. Six sigma can be used with balanced scorecard by providing more rigorous measurement system based on statistics.

Numerical Concept of Six Sigma

'Sigma' is a statistical term that measures how far a process deviates from perfection. The higher the sigma number, the closer the process is to perfection. The values of Defect Percentage Six Sigma are 3.4 defects per million opportunities or getting things right 99.99966% of the time. It is possible to develop ways of reducing defects by measuring the level of defects in a process and discovering the causes.

The Value of the Defect Percentage

Six Sigma is 3.4 defects per million opportunities or getting things right 99.99966% of the time. It is possible to develop ways of reducing defects by measuring the level of defects in a Process and discovering the causes.

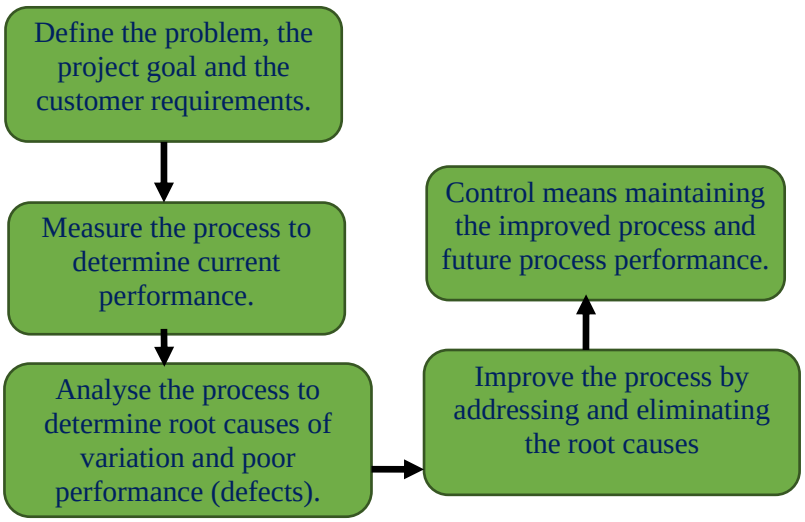
Limitations of Six Sigma

- Six Sigma focuses on quality only.
- Six sigma does not work well with intangible results.
- Substantial infrastructure investment is required.
- Six sigma is complicated for some tasks.
- Not all products need to meet Six Sigma standards.
- Six sigma focuses on specific type of process only.
- There are lot of real time barriers which needs to be resolved while translating the theoretical concepts into practical applications.

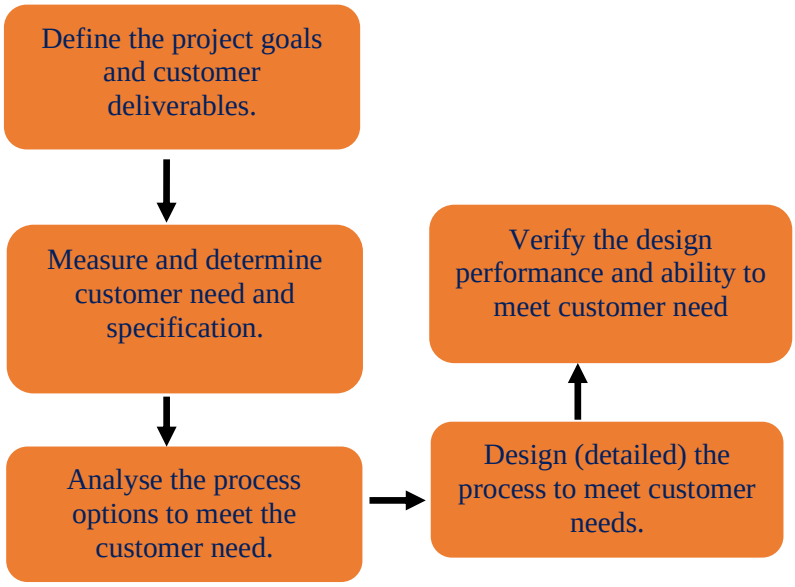
Implementation of Six Sigma

There are two methodologies for the implementation of Six Sigma—

DMAIC: This method is very robust. It is used to improve existing business process. To produce dramatic improvement in business process, many entities have used it successfully. It has five phases



DMADV: The application of these methods is aimed at creating a high-quality product keeping in mind customer requirements at every stage of the product. It is an improvement system which is used to develop new processes or products at Six Sigma quality levels. Phases are described in diagram:



Both DMADV and DMAIC are fundamental six sigma methodologies for improving quality of product/process. Broadly, DMAIC deals with improving some existing process to make it align with customer's needs while DMADV deals with new design or redesign.

Difference Between DMAIC and DMADV

DMAIC	DMADV
Review the existing processes and fixes problem(s)	Emphases on the design of the product and processes.
More reactive process	Proactive Process.
Increase the capability	Increase the capacity
Rupee benefits quantified rather quickly.	Rupee benefits more difficult to quantify and tend to

	be much more long term.
Examples of DMAIC problem- solving methods: • Reduce the cycle time to process a patent. • Reduce the number of errors in sales list. • Improve search time for critical information.	Examples of procedures that the DMADV development method is designed to address:\ • Add a new service • Create a real-time system. • Create a multiple-source lead tracking system.

Lean Six Sigma

Lean Six Sigma is the combination of Lean and Six Sigma which help to achieve greater results that had not been achieved if Lean or Six Sigma would have been used individually. It increases the speed and effectiveness of any process within any organization. By using lean Six Sigma, organisations will be able to Maximize Profits, Build Better Teams, Minimize Costs, and Satisfy Customers.

CASE STUDY: Six Sigma

Derby Grey is leading manufacturer of leather luggage bags (up to 62") for the style conscious people around the globe. It is made up of two independent divisions in New Delhi. The division 'Mx' performs all manufacturing and packaging operations. All sales are made through the division 'Rx' which has 11 retail stores in New Delhi, as well as through Derby Grey's own well- developed website. Derby Grey has also retail operations in Dubai, Kuala Lumpur, Bangkok as well as in Singapore. These overseas businesses operate as independent subsidiaries within the Division 'Rx'.

Derby Grey revolutionized the industry by offering cheap but stylish luggage bags. Derby Grey is able to keep its prices low by offering a very basic level of service. Luggage Bags are sold in boxes for customers to assemble themselves and all deliveries are made through third party distributor 'Çosta Cruise'.

Dr. Philips (Managing Partner) is bothered about increasing sales returns and massive complaints about product purchased from Derby Grey on social media. With this concern, Dr. Philips has appointed you as performance management expert to help the firm to execute six sigma technique to reduce number of sales returns and to evaluate firm's existing performance. Dr. Philips has heard that Six Sigma analysis involves large quantities of data. Dr. Philips stated–"I'm not confident on our current IT systems. I doubt whether system would be able to identify the required data related to cutting, preparation, closing, lasting etc. These manufacturing sub divisions may be the root causes of the problem. Further, quarterly compiled sales return data has not enough detail. We may need to do more analysis on customer satisfaction and manufacturing quality."

You have been given access to feedback given by customers for returning goods to measure existing performance in this area (refer below):

Difficult to assemble or pieces missing (47%) – Bags were not as demanded (24%) – Poor Quality (19%) –Arrived damaged (9%) – Arrived late (1%)

Required

ADVISE Managing Partner on Six Sigma implementation to reduce number of sales return using DMAIC method.

Solution

DMAIC is a methodology of Six Sigma used to improve existing business process. It is advisable to Managing Partner to execute following phases of DMAIC–

Define the process

This phase emphases exactly *what customer's requirements are?* In this case focus is precisely on *why bags are returned*. The objective of the process needs to be clear as in this case to *reduce the number of customer returns*. Customers expect certain minimum requirements from the manufacturing and packaging process, for example, that the bags are properly packed in boxes.

They also expect the goods be delivered undamaged within a reasonable time and delivered at the time and date when committed. Further, customer's perceptions of quality should coincide with the price paid, though different customers may have different expectations.

Measure the existing process

This phase measure the process to determine existing performance. In this case, the sales returns figures do not show complete picture as to why customers return bags, which of the class belong to 'poor packing', which one belong to 'defective item', which one belong to 'activities of other sub divisions' etc. The *ambiguity of the data and classification of definitions will need to be addressed* as to enable the process to be measured effectively.

Analyze

This phase *detects the root cause* of the problems. Possible root cause of sales return are as follows:

Difficult to assemble or pieces missing (47%) – Returns could be because the bags were not manufactured or packed properly in the 'Mx' division, but could also be due to poor design, customers losing pieces or simply being unable to assemble bag.

Bags were not as demanded and of poor quality (43%) – Returns could be due to defective manufacture or if the customer had merely changed their minds and no longer required the bag. In 'bags were not as demanded', the identification of 'defective items' are too vast. Arrived damaged (9%) – It may be that customers wrongly classified defective bags as damaged. Though bags may become damaged by the 'Çosta Cruise', only a small number of returns relate directly to them.

Arrived late (1%) – Reasons of arrived late could be either 'Costa Cruise' could not make delivery on time or 'Mx' division could not complete order on time and this causes only 1% of returns, is relatively insignificant.

Further, information could be analyzed, like country wise sales returns, product wise sale, or with *more clear definition of 'defective items' from customer's perspective*. By doing so, firm may easily get information related to areas of the business where sales returns are high and hence be able to focus on.

Improve

In this phase, recommendations are made to *minimize or eliminate the root cause* of the problem and then those recommendations are implemented to improve the process in a systematic manner. Derby Grey is required to *consider aspects of production or packaging which could be improved*, for example, timely repair and maintenance of equipment or training to existing staff etc. Further, *availability of resources* and *likely costs of making the improvements* need to be carefully considered.

Control

Here control means *maintaining the improved performance and future performance*. Derby Grey would be required to monitor the performance ongoing basis. If sales return reach above particular level, it should be reported to responsible person and he should act immediately.

In addition, Derby Grey need to redesign IT system in such a way so that it can provide required detail. Since this is continuous monitoring so it may also require revisiting of some phases in DMAIC.

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CASE STUDY: Six Sigma

CPT Limited manufactures furniture made of MDF board for domestic use and plywood for commercial use. It has three divisions – Furniture Division, Plywood Division and Retail Division.

(ICAI-Gujrat Paper, 2019)

The furniture division purchases raw materials from external suppliers and performs all manufacturing and packaging operations. All

sales of furniture are made through retail division which has 120 retail stores in India as well as through its own website. Furniture is sold in boxes for customers to assemble themselves. About 20% of the furniture sold by CPT limited is purchased already packaged from other manufacturers. All deliveries are outsourced through a third-party distribution company.

CPT Limited's objective is to maximize shareholders' wealth by producing new model functional furniture and plywood board at low cost. The CEO is concerned about increasing levels of returns of furniture made by the customers and increasing number of customers complaining on online forums about furniture purchased from CPT Limited. Not a single case of return of plywood board was reported in past three years.

Considering the impact of returns of its products, the CEO has approached you as a performance management expert to help the company in implementation of six sigma technique to reduce the number of products returned and define customers' requirements and measure existing performance of the company.

A team of managers has been recently trained in six Sigma. The returns data are compiled every six months along with the key performance indicators (KPIs) for customer satisfaction. The last compilation indicates that 92% of customers were satisfied with the manufacturing quality of furniture.

The following reasons are given by customers while returning furniture:

Category	Reasons for return of Furniture	% Responses
1	Difficult to assemble or parts missing	48%
2	Goods arrived damaged	13%
3	Goods were not as described or were defective	27%
4	Goods were of poor quality or no longer wanted	10%
5	Arrived late	2%
	Total	100%

Since last year the plywood division has also started to manufacture MDF board on pilot project basis in small quantity. Based on the feedback from the market the management of CPT Limited decided to manufacture MDF board at large scale in plywood division in the forthcoming year. CEO has also decided that for manufacture of Furniture, MDF boards should be purchased from plywood division. Details of Furniture and Plywood Divisions are given below:

Furniture Division:

35,000 MDF boards of standard size will be needed in the next year. External suppliers could supply at Rs.800 each.

Plywood Division:

It has the capacity to produce a total of 60,000 MDF boards of standard size per year. Budgeted details for the forthcoming year

are as follows:

- Budgeted sales volume – 60,000 units
- Selling price per unit of external sale – Rs.850
- Variable cost per unit of external sale – Rs.770

The variable cost per unit will be Rs.20 per unit lower in case of internal sale, due to cost saving in distribution and packaging. Maximum external demand for MDF boards is 30,000 units per year.

Required:

I. Advise the CEO how six sigma could be implemented using DMAIC methodology so as to reduce sales returns from customers (10 Marks)

II. Advise with the help of suitable calculations, the number of MDF boards that plywood division should internally supply to furniture division in order to maximize the group profit (6 Marks)

III. Recommend the transfer price at which the internal sales should be made (4 Marks)

Answer:-Part 1:

The DMAIC process is a technique used to implement six-sigma to improve existing processes and is split into five phases as described below.

- ***Define the process:***The CEO is concerned that the increase in returns from customers is increasing costs and threatens to affect the company's brand. Six sigma focuses closely on the requirements of the customer and it is important to be clear exactly what customers' requirements are and, in this case, specifically why products are returned. The objective of the project needs to be clear, in this case to reduce the number of customer returns. Customers will expect certain minimum requirements from the manufacturing and packaging process. Customers' perceptions of quality should correspond to the price paid, though different customers will have different expectations of this. Customers may be particularly pleased with furniture which is delivered early or at a time especially convenient to them, or which is robust, durable and 'well-made'. While products which significantly exceed customers' expectations will enhance the company's brand, it may also indicate a quality of manufacture which is too high and allow company to reduce manufacturing costs while still having mainly satisfied customers.
- ***Measure the existing process:*** The current returns figures do give some data to as to why products are returned, but its usefulness is limited as it is unclear which of the categories relates to defective manufacture, and which relate to activities of other divisions. The ambiguity of the data and category definitions will need addressing to enable the process to be measured effectively. Returns in Category 1 could be because the goods were not manufactured or packed properly in the manufacturing division, but could also be due to poor design, customers losing components or simply being unable to assemble furniture. Damaged goods in Category 2 probably do not arise because of defective manufacturing either, though customers may wrongly categories defective goods as damaged. For the other categories it is less clear. Though goods may become damaged by the distribution company, it seems that only a small number of returns relate directly to them. Returns in Categories 3 and 4 could be due to defective manufacture or if the customer had simply changed their minds and no longer wanted the product. In Category 3, the identification of 'defective' items is too broad. Returns in Category 5 which arrived late are clearly not due to manufacturing defects and as this causes only 2% of returns, is relatively insignificant. Currently 20% of company's sales are of products from other manufacturers. There is no

indication from the data given how many of the returns relate to these products, nor of the total number of returns relative to the number of items sold. Therefore, the existing data are insufficient to reliably measure existing performance and take no account of inputs such as raw materials. Only items which customers value should be measured. The CEO has suggested more detailed data are required, for example, on overall customer satisfaction with the manufacturing, but this is at 92% which already seems high and there is little point in incurring costs to measure what customers are already satisfied with. In the context of the six-sigma project, there is little that can be done to improve this particular area and such items should not be measured.

- ***Analyze the process:*** This stage is where the root causes of the problems are identified. Additional information may be needed, for example, to analyse customer returns by type of product, by country of sale or with a clearer definition of what is meant by 'defective'. By doing so, company may identify areas of the business where customer returns are particularly high and so be able to focus on these.
- ***Improve the process:*** At this stage the proposals for improving the process are implemented and availability of resources and likely costs of making the improvements need to be carefully considered. Company may need to consider which aspects of the production or packaging process could be improved, for example, by better maintenance or calibration of machinery. Additional training of staff may also be required.

Control: This is the on-going monitoring that the reduction in customer returns due to defective manufacturing is being maintained. Reporting on the number of returns may be done by exception if they reach a particular level. In CPT Limited, it seems likely that the data on customer returns used to manage this process will need to be redesigned to make it clearer in which responsibility centre the problems arise. The ongoing monitoring may indicate that some of the earlier stages in the DMAIC process need to be revisited.

Part 2 and Part 3: Decision on number of MDF boards to be transferred and fixation of transfer price:

Minimum Transfer Price	Variable cost + opportunity cost	
Maximum Transfer Price	External purchase price + change in cost	

Calculation of Minimum Transfer Price:

- Plywood division currently has capacity of 60,000 MDF boards and it has external demand for 30,000 boards. Therefore, it has idle capacity of 30,000 boards
- Transfer price for first 30,000 boards = Variable cost = Rs.750 [There will be no opportunity cost; Additionally, variable cost per unit is Rs.20 lower and hence the same would be Rs.750 per unit]
- Transfer price for balance 5,000 boards = Variable cost + Opportunity cost = Rs.750 + Rs.80 = Rs.830 per unit

Calculation of Maximum Transfer Price:

- External suppliers are currently supplying at prices of Rs.800 per unit and hence the maximum transfer price by Furniture Division would be Rs.800 per unit

Decision:

- Comparing the minimum and maximum transfer price, we can conclude that the company should go for transfer of 30,000 boards. The transfer price for 30,000 boards can be fixed between Rs.750 per unit to Rs.800 per unit
- Balance 5,000 boards cannot be transferred as minimum transfer price of Rs.830 per unit exceed maximum transfer price of Rs.800 per unit. This would indicate that a transfer is not feasible

PROCESS INNOVATION

Process Innovation means the implementation of a new or significantly improved production or delivery method (including significant changes in techniques, equipment and/or software). Changes, improvements, increase on product or service capability done by addition in manufacturing or logical system, ceasing to use a process, simple capital replacement or extension, changes resulting purely from changes in factor prices, customization, regular seasonal and other cyclical changes, trading of new or significantly improved products are not considered innovations.

The Process of innovating new solutions could fall into one of these areas:

- **Production:** This is related to processes, equipment and technology to enhance manufacturing or production processes. This includes computer software.
- **Delivery:** Delivery process innovations involve tools, techniques and software solutions to help in supply chain and delivery systems. This includes barcodes, tracking systems or shipping software.
- **Support Services:** Innovation in processes aren't limited to simply production or delivery, but also areas including purchasing, maintenance and accounting.

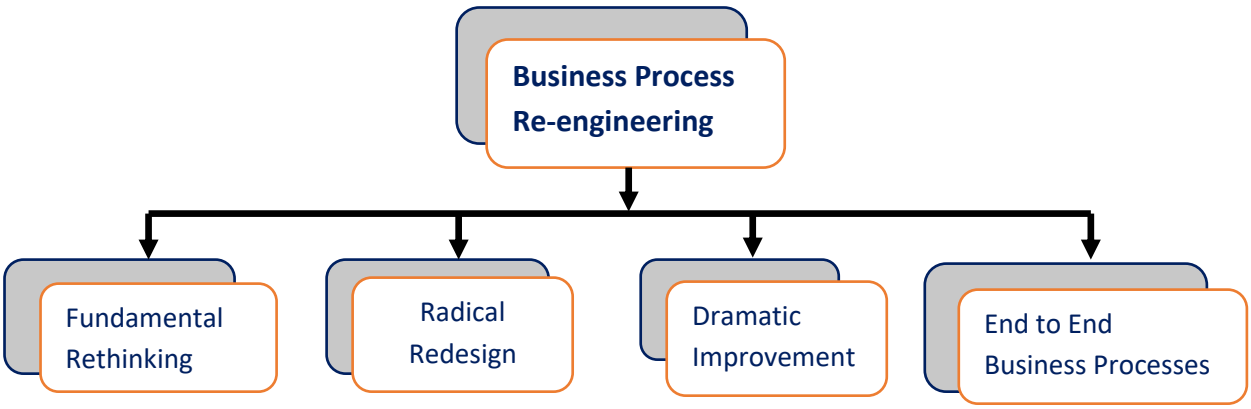
BUSINESS PROCESS REENGINEERING

Hammer defines Business Process Reengineering (BPR) (or simply reengineering) as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed."

Business Process Re-engineering (BPR) and Process Innovation (PI) are similar concepts that emerged in the early 1990s. BPR focuses on amending existing processes, while PI attempts to implement new processes into an organization. In many ways, PI is more radical than BPR, because it is changing the overall structure of an organization, whereas BPR is streamlining processes that are already in place.

BUSINESS PROCESS REENGINEERING

In 1989, Michel Hammer, an ex-MIT computer professor turned consultant, published an article in the Harvard Business Review titled, " Re-enginerring work; Don't Automate, Obliterate". Although several major companies had been experimenting with reengineering principles prior to that time. Hammer generally is created with first using the term "reengineering". Hammer defines Business Process Reengineering (BPR) (or simply reengineering) as ' the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed". Thus, the four key components of BPR are as follows:



Fundamental rethinking of business processes require management to challenge the very basic assumptions under which it operates and to ask such rudimentary questions as "Why do we do what we do? And "Why do we do it the way we do it?'.

Radical redesign relies on a fresh-start, clean-slate approach to examining an organization's business processes. This approach focuses on answers to the Question, " **If we were a brand-new business, how would we operate our company?"** The goal is to reinvent what is done and how it is done rather than to

tinker with the present system by making marginal, incremental, superficial improvements to what's already being done.

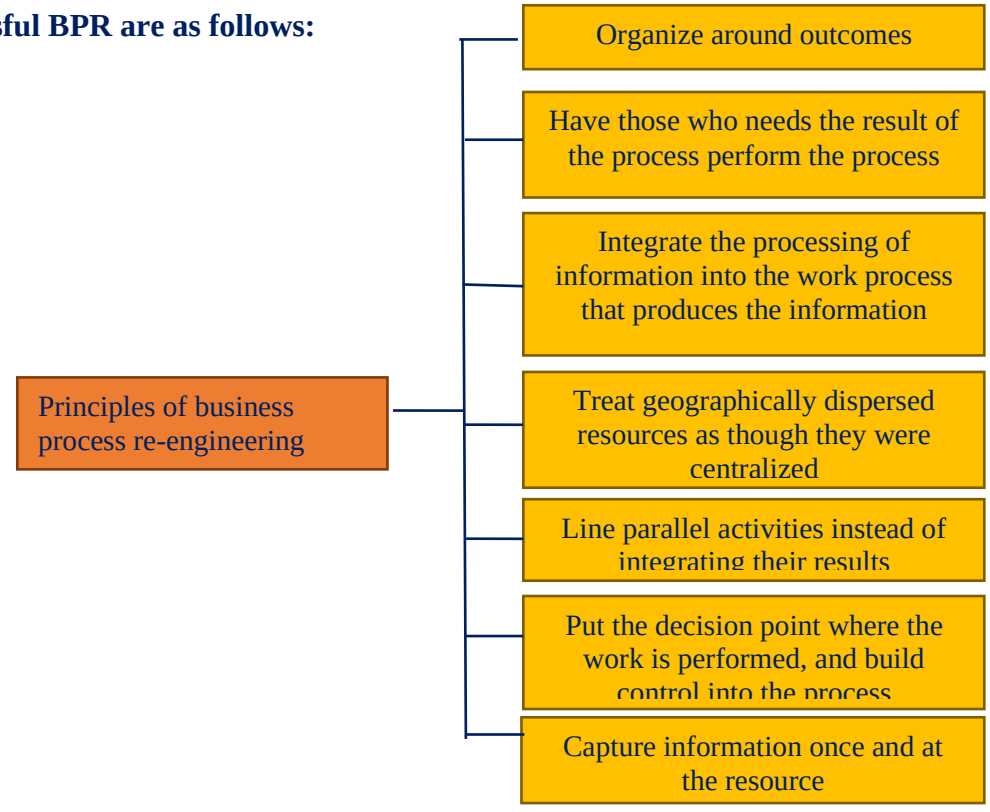
Achieving dramatic improvements in performance measurements is related to the preceding two elements. The fundamental rethinking and radical redesign of business processes are aimed toward making quantum leaps in performance, however measured. BPR is not about improvement in quality, speed, and the like that is on the order of 10%. Improvement of that order of magnitude often can be accomplished with marginal, incremental changes to existing processes. Reengineering , on the other hand, has much loftier objectives. For example, the reengineering of Ford's procurement process reduced the number of persons employed in the process by 75%.

Reengineering focuses on end-to-end business processes rather than on the individual activities that comprise the processes. Michael Hammer contents that the fragmented business processes and bureaucratic, hierarchical organization structures evident in most businesses today have their origins in the Industrial Revolution, when specialization of labour and economies of scale were the promised keys to success. He argues that mangers lose sight of their real objectives when processes are segmented into individual tasks, each task is assigned to a specialist and elaborate mechanisms are established to track and control the performance of those tasks. Instead, BPR takes a holistic view of a business process as comprising a string of activities that cuts across traditional departmental or functional lines. BPR is concerned with the results of the process (i.e with those activities that add value to the process). This cross-functional focus has been used for many years by manufacturing companies. Reengineering would apply that view to all business processes.

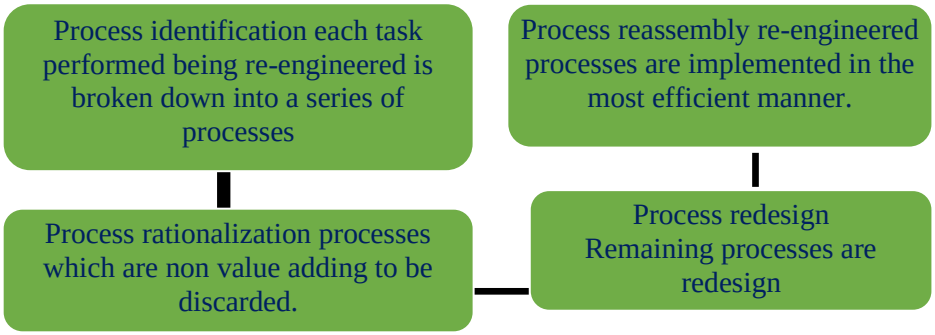
For example, consider the activities such as receiving a customer's order, checking the customer's credit, verifying inventory availability, accepting the order, picking the goods in the warehouse, and shipping the goods to the customer, as discrete activities, Reengineering would change our emphasis by breaking down the walls among the separate functions and departments. Instead of order taking, picking , shipping and so forth, the entire process of "Order fulfilment" would be examined and would concentrate on those activities that add value for the customer. The customer is not concerned with the individual tasks that an organization undertakes to fill an order nor is the customer concerned with how the company organizes itself to carry out those jobs. The customer is concerned only with getting the right goods, in the proper quantities, in satisfactory condition, and at the agreed-upon time and price.

Principles of BPR

The principles of successful BPR are as follows:



Main Stages of BPR



11Porter's Value Chain is commonly used in Business Process Re-engineering as a technique to identify and analyse processes that are of strategic significance to the organisation.

CASE STUDY: Business Process Reengineering "ANI"

ANI is a government-owned bank. The Bank has over 2,500 branches in country 'A' spread over all states/union territories including specialized branches. These branches are controlled through 27 Zonal Offices and 4 NBG Offices. As a government owned bank it has usually been the first preference for customers while choosing a bank. In the last six years, the Government has permitted a number of foreign banks to operate within the country in order to solve the problem of foreign exchange shortage and open up foreign trade as an instrument to promote economic development. These foreign banks offer diverse range of services such as direct access to executive management, a single point of contact to coordinate all banking needs, appointment banking to save time, free online banking services 24/7, free unlimited ATM access etc. In contrast, ANI has very elementary information systems, covering only for internal transaction handling and accounting activities. Customers have to visit banks to carry out transactions like- checking bank balance, cash deposit and withdrawals, transferring money from one account to another in operational hours. Often customers complain about the amount of time as the employees and clerical staff of the bank can attend only few customers at a time. Customer service evaluation has never been undertaken by ANI. Other processes, new account applications, are complex, requiring completion of many documents formalities. Board of Directors were worried from growing popularity of new style banks. The Board of Directors of ANI has recently held meeting to discuss the shortfalls in its current services and the need to re-engineer the ANI's business processes.

Required

ADVISE how Business Process Reengineering (BPR) can be used to improve ANI's current processes.

Solution

BPR is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvement in critical contemporary measures of performance, such as cost, quality, service and speed. In other words, BPR is concerned with the result of the process (i.e., with those activities that add value to the process). To implement BPR, firstly, each business process of ANI needs to be divided into a series of processes. Then each business process requires be documenting and analysing to find out whether it is essential, whether it

provides support to other valuable processes and whether it is adding value. Any process which does not add value or does not provide essential support to the value adding activities must be removed. Those processes that remain require to be re-engineered/re-structured so that can be *as efficient as possible*. For ANI, new technology should be introduced to improve these processes. However, ANI must ensure that the statutory compliances regarding these processes are not undermined.

ANI is facing a hyper-competitive marketplace where customers expect a superior experience. BPR activities would help ANI in understanding those processes which ANI's customers value the most and remove those that are not valued. Foreign banks are offering diverse range of services such as direct access to executive management, a single point of contact to coordinate all banking needs, appointment banking to save time, free online banking services 24/7, free unlimited ATM access etc. Clearly these are valuable business processes valued by the customer. ANI should incorporate all these facilities in their banking processes to enhance customer satisfaction and service level.

Opening of new accounts in ANI is complex processes since it requires multiple forms to be complied with. Through BPR, ANI would analyse the whole process and identify the need for only one form that contain all of the necessary customer information. Further, it is also possible to initiate opening of new account through the development of an online application form on ANI's website. Online entry would remove the possibility of forms being lost or incorrect, again enhancing customer satisfaction since customers need not to visit ANI's branch to open account.

There should also be online processing authentications/validations as to ensure that data fields are correctly filled by customers that would result in error reduction. This would also remove unnecessary staff activities in checking and re-processing forms.

It is likely that BPR may increase costs in short-term as investment in technology. However, this would also reduce substantial levels of manual activities and processes thereby providing speedy services to customers. In long term, this would result in high levels of efficiency, profitability and better levels of customer satisfaction and retention.

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CASE STUDY: (Business Process Re- engineering)

ANA is one of Country "I" s top footwear companies and other equipment. Since its foundation in 1988, ANA has been one of the all-inclusive footwear brand that is committed to nurturing the youth across the world through sports to contribute to society. Over more than three decades, the company inherits its value and provides own products while capturing the changes in the social environment. It's state-of-the–art production facilities are located strategically across the Country "I' and Produces all kinds of footware. ANA is best known for its high ethical standards towards its workers, suppliers and the environment and voluntarily publish CSR report every year.

Organizational Structure and Footware Market

ANA is organized into conventional functional departments such as procurement on order basis, sales and finance, most of which have their non-reliable excel sheet-based systems for planning and reporting. Consequently it often fails to generate accurate, timely and

consistent information to monitor its own performance, thus company faces failures in achieving the performance and delivery targets set by retail customers.

In Country "I" footwear market is competitive and Seasonal Retailers, who are ANA's customers, for footwear they have two main demands, they want—

(i) Footwear at lower prices to pass it on to consumers.

(ii) Suppliers to meet performance and delivery targets relating to lead times and quality.

In order to comply with the retailer's demands, ANA'S competitors have discontinued all their own manufacturing facilities and outsourced all production to suppliers, who have much larger production lines and lower costs. To reduce the shipment cost over distances, competitors have invested in advanced procurement software to consolidate orders so that each 40-foot shipping container gets fully loaded. Purchase invoice processing in also automated via the integration of information systems into the suppliers software.

Proposal of Outsourcing

In order to mitigate costs, it has been proposed to outsource the manufacture of footwear, to a Chinese Supplier 3,750 Km away. A comparison of the average cost of manufacturing and the cost of outsourcing footwear is given below-

Particulars	Manufacturing	Outsourcing
Average manufacturing cost per pair	BND625	---
Purchase cost per pair	---	CNY28

Notes:-

1. Country "I" is home currency is the BND.
2. Exchange Rate 1CNY=18 BND.
3. In addition to the purchase cost from the supplier, ANA will be subject to pay for shipping costs at the rate of BND 40,000 for each large, standard sized shipping container, regardless of the number of units in it. Each container contains 5,000 pairs when fully loaded.
4. Custom tariffs are expected to change soon, Footwear imports into ANI's home country might be subject to 10% basic custom duty (plus 10% social welfare surcharge on duty) on the assessable value of imports excluding shipping costs.

Therefore to implement the proposal restructuring of functional departments into multidisciplinary teams are needed to serve major buyer accounts. Each team is required to perform all activities, related to the buyer account management from order taking (Sales order) to procurement to arranging shipping and after sales service. Team members dealing with buyers will work in ANA's corporate office, while those like QC etc. managing quality and supplier audits, will work at the manufacturing site of Chinese Supplier. Teams will be given greater independence to selling prices to reflect market conditions or setting a price based on the value of the product in the perception of the customer. Many support staff will work as helper roles, or be offered new jobs opportunities overseas after the restructuring.

EXPERT ADVICE

Prof. WD, performance Management Consultant has advised ANA that the proposal has features of re-engineered processes and can be defined as business process re-reengineering

(BPR). Prof. advised for evaluating the proposal, ANA should consider software development for full front-end order entry, purchasing and inventory management solution which may be required along with ethical aspect of the proposed charges.

Required

(i) ADVICE on information system which would be required for the reengineering.

(ii) ASSESS the likely impact of reengineering on the ANA's high ethical standards and accordingly on business performance.

EVALUATE how the BPR proposal can improve ANA's performance in relation to retail customers.

Solution:

Advise on Information System

Combining several jobs into one, permitting workers to make more decision themselves, defining different versions of processes for simple cases vs complex ones, minimizing situations when one person check someone else's work, and reorganizing jobs to give individuals more understanding and more responsibility are characteristics of re-engineers processes.

In ANA outlays can we saved by rearranging staff into multidisciplinary teams, for example, reducing number of excess staff as different stages-cutting, preparation, finish etc. These savings can be utilized in additional costs such as investment in new information systems. Hammer and Champy stress the use of information technology as a catalyst for major changes.BPR organizes work around customer processes rather than functional hierarchies.

Presently ANA's departments have their own excel sheet-based systems for planning and reporting which is unreliable and inconsistent. They are inadequate to provide the accurate, timely and consistent data which ANA needs to meet its own performance and delivery targets. There must a shared database that should be accessible by all parts of the functional teams. This should have real time updating, so that employees in different time zones can use updated data. The database should include financial data and non-financial data, like cost information, data related to lead times and quality. Information systems must be features with all required reports like performance report, budget report etc.

In addition, ANA is required to invest in special system as advised by Prof. WD for full front-end order entry, purchasing and inventory management solution to minimize shipping costs by ensuring that the shipping containers get fully loaded and to integrate with supplier's information systems to automate purchase invoicing.

Overall, ANA must analyze that whether the benefits due to information technology are worthy.

(ii)Assessment of Likely Impact of Re-engineering on Ethical Standards

Workers

ANA is famous for its high ethical standards towards workers and staff. Because of adopting BPR proposal, manufacturing staff are likely to be unemployed. Competitors, have already shutdown their factories, these workers may not be able to find analogous jobs.

Employees who continue in work may become disappointed if they think the application of BPR to all products. This may reduce productivity, increase staff turnover or difficulties in

recruiting new staff. In addition they may also be demotivated if they are appointed in unfamiliar roles, or may not be willing to learn new skills.

Some of staff members may be motivated by the opportunity to perform new types of work, learn new skills or work outside India. This maybe enhances their individual performance.

Suppliers

Any association with non-ethical practices, for example, if the Chinese supplier is indulged in using non-acceptable working practices, could seriously spoil ANA's reputation for high ethical standards. This could undermine financial performance because customers may not buy its products, or possible investors might refuse from providing capital. Staff members located at the manufacturing site is responsible for suppliers audits, which may assist to mitigate this risk.

Environment

ANA should consider the environmental impact of importing goods from long distances. The environmental related credentials of the Chinese Supplier are not known. Since, ANA voluntarily publishes a corporate sustainability report, any distortion in its performance on environmental issues might undermine the financial performance.

(iii) Evaluation of BPR Proposal in relation to Retailer's Demand

Lower Prices

In order to sell footwear at lower prices, there is proposal to reduce costs by outsourcing production to supplier of manufacturing is BND 625.00 per unit. The cost of purchase from an external supplier is BND 512, which is BND 504 (CNY18 × BND28) purchase cost, plus BND 8(BND 40,000/5,000) Shipping cost. This 18.08% (113/625) saving is a substantial improvement in financial performance, but not a dramatic one. It may be noted that BPR is a methodology that should be applied only when radical or dramatic change is required. Further, exchange rate movements may also slash the cost saving significantly. In the near future, expected changes to international trade tariffs will increase the unit cost to CNY30.83 (CNY28.00 × 110.10%) i.e. 554.94 in BND and reduce the cost saving to just 11.21% (70.06/625).

Meeting Performance Targets

Lead times

Current lead times for customer orders are not ascertainable. Since the proposed Chinese Supplier is 3,750 Km away, consignment will take several weeks to be imported by sea. This may increase lead times substantially, although may be set off by faster production times in Suppliers plant.AS ANA's sales are seasonal ,retailers may order in advance, decreasing the long lead times. In order to decrease shipping costs, shipping containers must be full, meaning that deliveries must be larger quantities.

Quality

ANA is already known for manufacturing high quality footwear's. The quality of the new supplier's footwear needs to be checked. Any distortion in the quality of footwear will deteriorate its reputation and decrease long-term business performance since only few customers would order. Quality standards checking are more difficult while using outside suppliers, especially at long distance, than manufacturing in ANA's own factory. In BPR work is done where it makes most sense to do so. In this aspect, having employees

responsible for quality checking and supplier audits (working at the manufacturing site, abroad) will assist ANA in sustaining the best supplier relationship management.

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CASE STUDY: TOTAL PRODUCTIVE MAINTENANCE

Super Refineries Limited is a leading oil refining company operating in India. The company has three plants - one each situated in North, South and West. The company has a refining capacity of 30 million barrels. The company currently enjoys a 40% share of the domestic market. The plants run on all 365 days in a year and operate at 100% of the capacity. The company currently does not have any maintenance schedule in place for its plant and machinery. Any repair requirement of plant and machinery is carried out on ad-hoc basis.

The company has implemented Total Quality Management (TQM) to ensure that the company rolls out top quality products. The company did not receive any complaints from its customers regarding poor quality of products or products not meeting the specifications. The entire production team is quite excited with superior quality of products.

However, in the last three months, about 30% of the dispatches to customers were delayed. This comes at a time when the entire plant had to be shut for maintenance activity due to breakdown in the machineries for a week. The company also witnessed 20% rejection of the final products. The customers claimed that the products did not meet the specification agreed by them with the company. The Director of Refineries is worried about the worsening situation of production at plants. Another concern for the director is the increase in number of accidents and loss of productive time due to this.

The chairman of the company convened an urgent meeting of the Board of Directors to understand the impact and reasons of the situation at production plants. A key issue highlighted by plant supervisors is that the scheduled maintenance activity for plants was never carried out. The underlying assumption for not carrying out such maintenance activity was - “Since the plant is running smoothly, there is no requirement of preventive maintenance activity. Such activities cost a lot in terms of money and also cause loss of productive time which could otherwise be used for production”. The maintenance departments and production department functioned in silos with almost no co-ordination amongst themselves. The most critical parts of the plant were not maintained for a long time.

The chairman called you after the meeting and asked you to help him understand the current issue at the plant. “We had Total Quality Management (TQM) in place at all our plants. I understand from the production director that TQM is working as intended. Why are we facing the breakdown problem in spite of having a TQM in place”- said the Chairman.

Required

The Chairman has asked you to quickly prepare a note highlighting the following points—

(i) What could be the likely losses arising due to breakdown of machinery due to non-maintenance?

(ii) What kind of maintenance programme could address the issue being faced by the company?

(iii) EXPLAIN the key features of such programme.

(iv) COMPARE the programme identified above and TQM.

(v) What are the various types of maintenance practices that the company can implement.

Solution

Issue

Super Refineries Limited has implemented a Total Quality Management and is known for producing top quality products. The company enjoys 40% market share in the domestic market. The plants operate at 100% capacity and on all days of the year. This indicates that the company does not carry out preventive and corrective maintenance. The company has not received any complaints with respect to quality from its customers. This can be attributed a solid TQM in place.

However, in the last three months, the company has faced delayed in supplies and customer rejections. The delay in supplies could be attributed to the breakdown in the machineries. The production could have been of an inferior quality if the production managers would have rushed to meet the production deadlines due to loss of production time owing to breakdown.

The discussions at the board meeting indicate that the company has not prioritized preventive maintenance. Maintenance is being carried out on an ad-hoc basis with a proper preventive maintenance schedule. The company is concerned about costs of maintenance and hence no preventive maintenance was carried out. Further, there is no co-ordination between the production team and maintenance team.

Losses Arising Due to Breakdown

The following are the losses which can be associated with the breakdown of machinery at Super Refineries Limited -

- Equipment failure leading to unexpected loss of time - The production at plants was interrupted and the supplies to customers were delay in case of Super Refinery Limited.
- Idle waits and stoppages due to ad hoc maintenance requirements. Since the interruption is unplanned, the productive labour time is wasted.
- Production of inferior quality products causes financial losses. The company would also incur additional costs to remake the product without any additional revenues.
- The company would also incur losses in terms of additional set up costs. Every time a machine breaks down, a significant amount of time would be wasted in setting up the production processes again.

Total Productive Maintenance (TPM)

Based on the facts of the case, it is very clear that the company has not prioritized maintenance. The company can use TPM philosophy to address the issue.

TPM is a maintenance philosophy aimed at eliminating production losses due to faulty equipment. The objective of TPM is to keep equipments (plant, machinery etc) in such a position to produce expected quality products at the maximum capacity with no unscheduled stops. This also includes attaining:

- Zero breakdowns.
- Zero downtimes.
- Zero failures attributed to poor condition of equipment.
- No loss of efficiency or production capacity due to the equipment.

The concept was initially applied to equipment i.e., plant and machinery. Of late, the concept has also been extended to processes and employees. TPM focuses in keeping equipment and employees in top working condition to avoid any breakdowns and delays in manufacturing process.

Traditionally, maintenance work has been considered as a responsibility of the Maintenance Team which is different from the production team. Total Productive Maintenance seeks to involve workers in all departments and levels in ensuring the effective operations of the plant. When both the teams work in alignment, learning's can be shared with each other. The production team also takes ownership of maintenance requirement. A sole focus on higher production without taking care of maintenance requirement can hamper the long-term production requirements, as could be seen in the case of Super Refinery Limited.

Features

- Traditional maintenance is centered in the maintenance department. However, TPM seeks to involve workers at all departments and levels. There is a great amount of co-ordination between the production and maintenance team in TPM.
- Autonomous maintenance focuses on training operators to be able to take care of minor maintenance tasks. This relieves specialized maintenance staff to focus on critical issues.
- TPM focuses on achieving and sustaining zero loses with respect to minor stops, measurement and adjustments, defects, and unavoidable downtimes.
- Planned Maintenance is aimed to have trouble free machines and equipment producing defect free products for total customer satisfaction. The approach here is proactive maintenance instead of reactive maintenance. Super Refinery limited had a reactive approach to maintenance where maintenance was carried out on an ad hoc basis.
- TPM emphasizes on training of workers across all levels and departments. The ultimate objective is to have a factory full of skilled workers.

The issues faced by Super Refinery Limited due to unplanned shutdowns can be addressed using a Total Productive Maintenance philosophy.

The following are the Eight Pillars or Principles of TPM—

- Autonomous Maintenance
- Focused Improvement
- Planned Maintenance
- Early Equipment Management
- Quality Maintenance
- Education and Training

- Office TPM
- Safety, Health and Environment

TQM and TPM

Total Quality Management (TQM) and Total Productive Maintenance are often used interchangeably. However, TQM and TPM are considered as two different approaches. TQM attempts to increase the quality of goods, services and concomitant customer satisfaction by raising awareness of quality concerns across the organisation. In other words, TQM focuses on the quality of the product, while TPM focuses on the equipment used to produce the products. By preventing equipment break-down, improving the quality of the equipment and by standardising the equipment, the quality of the products increases. TQM and TPM can both result in an increase of quality. However, the approach of each is different. TPM can be seen as a way to help achieving the goal of TQM.

Super Refinery Limited has implemented TQM and is delivering high quality products to its customers. TQM focuses on the end product being supplied to the customer. In the process of producing high quality and volumes of products, the maintenance aspect of plant and machinery was ignored by all. This led to breakdowns and unplanned shutdown of the plant and machineries. The TPM philosophy would focus on the equipment which support production of high quality products under TQM.

Types of Maintenance under TPM

The following are the types of Maintenance Programmes which Super Refineries Limited can implement—

Breakdown Maintenance

No maintenance is carried out unless the equipment actually fails. This is the approach taken by Super Refineries Limited currently. This type of maintenance is used when the equipment failure does not impact the operations and production significantly and the only cost incurred is the cost of repair. This is not advisable in case of Super Refineries as breakdown of machineries have led to significant delays in deliveries and poor quality of production.

Preventive Maintenance

It is a daily maintenance (cleaning, inspection, oiling and re-tightening), designed to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. This can be compared with a routine and periodic maintenance activity of a vehicle.

Corrective Maintenance

Corrective maintenance focuses on making machines easier to clean and maintain. There could be reconfiguration of certain parts of the machines (say, a lubricating pipe) to ensure that the maintenance staff can carry out maintenance effectively and easily.

Maintenance Prevention

Through the analysis of maintenance data, the maintenance technicians can work with the designers of our machines to create machines that are more reliable. Maintenance and repairs that are required can be made as simple and as easy as possible to reduce time, save money and improve safety.

Autonomous Maintenance

In case of autonomous maintenance, minor and day to day repairs are carried out by the operators of plant themselves instead of waiting for technicians. Activities like lubricating, bolt tightening etc. are done along with minor repairs by the floor workers or operators. Maintenance team is called only when sophisticated and highly technical maintenance work is required. You may change the tires of your car on your own but to repair a puncture or wheel alignment, you visit a technician.

Conclusion

Super Refinery Limited should implement a TPM which would complement and support the TQM philosophy. This would also address the issue of the production team and maintenance team not working in co-ordination. Down time for maintenance should not be considered as a cost or unproductive activity. This should be an integral part of the overall manufacturing plan. This would ensure that emergency and unplanned downtime is kept to a minimum.

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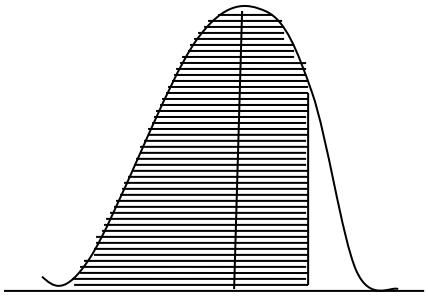
Area of a Cumulatively Probabilities for POSITIVE Z-Values



Cumulatively Probabilities for POSITIVE Z-Values

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.58080	0.5120	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5478	0.5517	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5871	0.5910	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6255	0.6293	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6628	0.6664	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6985	0.7019	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7324	0.7357	0.735	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7642	0.7673	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7939	0.7967	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8212	0.8238	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8461	0.8485	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8686	0.8708	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8888	0.8907	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9066	0.9082	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9222	0.9236	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9357	0.9370	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9474	0.9484	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9573	0.9582	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9656	0.9664	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9726	0.9732	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9783	0.9788	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9830	0.9834	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9868	0.9871	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9898	0.9901	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9922	0.9925	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936

2.5	0.9938	0.9941	0.9943	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9956	0.9957	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9967	0.9968	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9976	0.9977	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9983	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9997	0.9987	0.9988	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998