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Six Sigma Maintenance Analyses in Operational Management

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ABSTRACT:

Six Sigma is a datadriven technique that is often used in operational management to boost overall quality, minimise faults, and improve process performance. This investigation looks at how Six Sigma is used in operational contexts for maintenance management. It looks at the value of Six Sigma for identifying and fixing maintenancerelated problems, streamlining maintenance procedures, and raising operational effectiveness.This technique is concerned with the management of an organization's physical assets throughout their existence. EAM is used to plan, optimize, execute, and track maintenance tasks, as well as the related priorities, skills, materials, tools, and information.

KEYWORDS:

Analysis, Defect Reduction, Data Analysis, Operational Management, Root Cause Analysis, Six Sigma.

I. INTRODCUTION

The implementation of six sigma concepts in maintenance. Six sigma is a method that focuses on lowering variance in commercial manufacturing processes. A corporation may obtain tighter control over its operating systems by minimizing variance, enhancing cost effectiveness and driving productivity breakthrough.Six sigma is a phrase used by Motorola to define the objective and method of achieving revolutionary levels of quality improvement. Sigma is the Greek symbol for the six standard deviations used by statisticians. Six sigma is a process variation measurement six standard deviations that correlates to an error or defect rate of 3.4 parts per million.

To attain six sigma quality performance, unique sets of quality improvement procedures and statistical tools were established. These procedures and statistical tools are taught to a limited number of employees known as six sigma champions, who are given fulltime responsibility for defining, measuring, analysing, improving, and controlling process quality. They also make the upgrading process easier by reducing organisational barriers. Six sigma approaches enhance any existing business process by continually assessing and finetuning it.

Six sigma employs a process known as DMAIC Define opportunities, Measure performance, Analyze opportunity, Improve performance, Control performance to accomplish this. This sixsigma procedure is also known as the DMAIC process.Six sigma focuses largely on statistical approaches to decrease failures, and it includes basic business, statistics, and engineering ideas and practises. Six sigma approaches may also be used to build a whole new business process from the ground up utilising design for six sigma concepts[1]–[3].

Six Sigma Maintenance Process

Six sigma maintenance follows the same phases as the DMAIC approach. To implement six sigma in maintenance, work groups with a thorough grasp of preventative maintenance practises, as well as a strong leadership commitment, are required. Six sigma contributes to the maintenance cost equation in

two ways: reducing or eliminating the requirement for maintenance equipment dependability, and improving the efficacy of the resources required to complete maintenance. The steps involved inside the six sigma maintenance process are as follows.

Enterprise Asset Management (EAM)

Enterprise asset management is an information management system that integrates various divisions and disciplines inside a firm. Computerized maintenance management system is another name for EAM. It is the systematic and orderly tracking of an organization's physical assets, such as its plant, equipment, and facilities. EAM strives to make the greatest use of its physical assets. It guarantees the development of highquality data and the timely flow of information across the company. EAM eliminates paper effort, increases information quality, quantity, and timeliness, and provides information to technicians at the point of performance. It also provides employees with access to taskspecific information on the job site.

Lean Maintenance

The implementation of the lean concept in maintenance contexts is known as lean maintenance. In maintenance, the lean method recognises seven types of waste. Overproduction, waiting, transportation, process waste, inventory, waste motion, and faults are some of them. These wastes are discovered in lean maintenance, and attempts are made to enhance the process continuously by removing the wastes. As a result, lean maintenance maximises yield, productivity, and profitability[4]–[6].Lean maintenance is primarily concerned with equipment dependability and lowers the need for maintenance troubleshooting and repairs. Lean maintenance safeguards equipment and systems against the sources of malfunctions, breakdowns, and downtime stress. Uptime may be increased and maintenance costs reduced by eliminating waste sources.

Computer Aided Maintenance

A welldesigned system is a necessary instrument for the proper fulfilment of the maintenance role. Such systems are useful decisionmaking aids in maintenance planning and execution. A significant number of data related to workers, money, and equipment must be managed in order to optimise maintenance scheduling. This is a challenging task to complete by hand.Computers are required for a planned and improved maintenance system. Here, programmes are prepared for the computer to process accessible inputs. A computerbased system of this type can be employed as and when necessary for the successful completion of maintenance duties.There are several software packages available on the market for various sorts of maintenance systems.The following elements are included in a computerised maintenance system:

1. Creation of a database
2. Study of previous records.
3. Maintenance schedules are created.
4. Maintenance supplies are readily available.

Some computerbased maintenance systems that can be deployed are as follows:System of job cards: It is critical to create a task card for each unit to record the maintenance work completed or to be completed. The job card displays the plant code, equipment code, job code, type of the jobs, start and completion time of the card, manhour spent, and so on. The use of computers helps the distribution of work cards, the recording of employment history, and the management of labour.This system records information on a spare part, such as its description, expected life, and date of installation in equipment. When a specific sparepart is changed through breakdown failures or regular maintenance, this information is updated in their relevant computer files. This aids in the preparation of the following reports: The repeatability of spare parts in diverse machines indicates the performance of such spare components.

Comparisons between the actual and estimated lives of spare components. System for tracking spare parts: The majority of the time is spent on the acquisition of spare components. The total time necessary

to repair the breakdown is the sum of the time required to identify the reason for the breakdown, time to calculate the spare component needs, time to purchase replacement parts, and time to repair the failure. The spare component tracking system in a computerized system is essential in receiving necessary material as soon as possible. A spare part file is prepared that includes the material code, spare part identification number, assembly or subassembly number, and location where the spare component is used. This assists in knowing the present status of a certain spare component and permits timelynecessity for future demands.

II. DISCUSSION

Total Productive Maintenance (Tpm)

Total productive maintenance TPM is a care programme based on a newly defined concept for the upkeep of plants and equipment. The TPM program's purpose is to significantly boost output while also improving staff morale and work satisfaction. It is also referred to as machine medicine[7]–[9].TPM emphasises maintenance as a required and critical component of the company.It is no longer considered a charitable activity. Maintenance downtime is planned as part of the manufacturing day, and in certain situations, as an inherent element of the manufacturing process.

1. The objective is to limit emergency and unplanned maintenance.
2. TPM was implemented to meet the following goals. The most significant are given below.
3. In a rapidly changing economic climate, avoid wastage.
4. Manufacturing items while maintaining product quality.
5. Minimize your expenses**.**

Waste Management

Industrial trash and scrap, which includes ruined raw materials, rejected components, faulty parts, garbage from manufacturing departments, and other items, has some economic worth. They should be disposed of on a regular basis, with due credit given in the books of accounts.As a result, waste management plays a significant part in operations management. Trash can be classified as outdated, excess, or junk.

1. Outdated Items: These are products and equipment that are not damaged and have economic value but are no longer effective for the Company's operations due to a variety of factors such as changes in product line, method, materials, and so on.

2. Surplus Items: These are supplies and equipment that are no longer in use but have accumulated as a result of poor planning, forecasting, and purchasing. Nonetheless, they will be useful in the future.

3. Scrap: Process waste such as turnings, borings, sprues, and flashes is characterised as scrap.

They may have a commercially valuable enduse within the plant. As a result, should be disposed of on a regular basis.

Reasons for generation and accumulation of obsolete, Surplus and scrap items

The following factors contribute to the production and accumulation of outdated, excess, and scrap items:

1. Modifications in Product Design: This may render certain elements obsolete in terms of the final product. As a result, the whole stock of such excess products has become outdated.

2. Rationalization: Raw resources are sometimes renationalized to reduce diversity and simplify procurement. Some goods become superfluous or outdated as a result of the reduction process.

3. Cannibalization: When a machine fails, it is occasionally repaired by utilising components from another identical equipment that is not working for different reasons. This 'cannibalization' technique is typical in many projectbased companies. If left unchecked, this leads to outmoded and scrap things.

4. Poor Planning and Forecasting: The marketing department may have predicted an overly optimistic sales prediction. All material planning must be based on sales estimates, which may result in excess products. Incorrect indentation by user departments also contributes to buildup.

5. Poor Purchasing Practises: Buying in bulk to take advantage of discounts and transportation economy without considering aspects such as shelf life, storage space needs, and technology upgrades leads to the accumulation of surplus and outdated goods.

6. Additional Causes: Many products are kept as claimable spares for long years without being used. Faulty storage practises, along with insufficient preservation, result in deterioration.

Obsolete, excess, and junk products are also the result of bad materials management, incorrect coding, and inefficient production procedures. Improper machine tool maintenance can lead to excessive tool wear and increased process waste.In turn, the materials manager can halt additional orders for such items and attempt to negotiate with suppliers to return the stock. For particular goods, he can include a buyback provision in which the supplier returns things that are not eaten within a certain time frame. For new things that may be necessary, he can endeavour to create sources and arrange orders so that modifications can be implemented as soon as possible. All of this emphasises the importance of good collaboration in order to prevent stockpiling outdated and excess commodities. Such buildup is minimised by selective management based on ABC analysis, accurate forecasting methodologies, and effective preservation.In the instance of perishable storage, the Central Warehousing Company created a programme to broaden its reach to include some specialised lines of storage.

The corporation's plans include establishing a chain of cold storage plants for potatoes and fruit, as well as storage facilities for certified seeds.Several firms have implemented formal documentation when making design or product modifications. It's known as 'Effective Point Advice.' This is commonly referred to as EPA. The proposed modifications are documented and communicated to interested departments, as are the specifics of new materials and products necessary, the details of materials and goods that will be invalid/obsolete when the change happens, and the approximate date when the change is expected to be implemented.As a result, EPA assists in reducing stockpiles of 'invalid' products, cancelling orders for such things, putting orders for buying and/or producing replacement items, and other associated tasks. EPA systems aid in improved coordination for the lucrative implementation of changes with the least amount of side effects, such as the buildup of outdated products.Scrap reclamation has not piqued the interest of upper management in Indian industry. Optimum scrap usage would allow for the conservation of rare natural resources such as iron ore. This is because scrap is a key component in the production of steel and castings.

In certain circumstances, scrap can be salvaged for use inside the company. Sheets and plates are commonly used to make press components. Offcuts created during this process can be profitably used to manufacture smaller press components such as washers. Rationalizing the supply size, as well as adjustments in process such as reversing the dies, may result in scrap reduction. A fullfledged scrap salvage department exists in large corporations. These departments sort scrap into categories such as turnings, borings, plate cuts, billet endpieces, punching, and so on. To avoid the mixing of different sorts of scrap, the scrap is colour coded. It is also beneficial to endusers in each category and the supply of scrap at the right moment for manufacture. Informing the production department about the volume of scrap created at the appropriate time often allows for the prevention of excessive scrap by timely modifications in production processes, tools, and materials.

Disposal of Scrap

When scrap is disposed of creatively, it may yield substantial returns to the company. A compact disposal organisation reporting to a materials manager, a continual market survey on the pricing of various kinds of scrap created in the plant, and frequent contact with companies that generate comparable waste and endusers are all required for efficient disposal.When scrap cannot be used inside the company, disposal action is taken. In practise, it has been shown that it is more economical to sell trash directly to end users than than through intermediaries, who typically establish their own cartel,

resulting in lower returns. Prior to disposal, it is critical that the scrap be separated according to metal, size, and so on.

When the return is blended, it is even lower than the lowest ingredient in the combination. This is because the buyer of scrap will have to pay for segregation. A casual examination of scrap pricing reveals that sheet and plate cuts will pay less per tonne than turnings and borings. However, when it comes to expensive scrap metals like copper, aluminium, and tungsten, it is critical that they are separated since the returns are significant and the price levels vary. Scrap is created in a segregated state as a result of the operation, thus sorting should be straightforward.Scrap is regularly disposed of through auction and tender techniques. Parties in both the cases are normally required to inspect the scrap in the scrap yard and deposit earnest money. Frequently, the corporation insists on a base price based on the type of scrap. In this regard, the disposal division collaborates closely with the finance department. In many circumstances, the disposal division may attempt to establish longterm relationships with endusers such as steel factories.

Numerous businesses have been irritated by trashed components coming on the market and competing with their parts as original equipment. This is the cost that organisations incur for not disassembling and disfiguring scrap before disposing of it. Vehicle replacement components and bearings, in particular, are vulnerable to such hazards. Some groups even go so far as to ask vehicle owners to dismantle filters and plugs before scrapping them. This is a critical consideration.Given the scarcity of raw materials and the scarcity of credit, it is critical to maximise material utilisation while minimising monies locked up in outmoded surplus and trash products. This is only achievable if high management commits and supports it. Employees are, by definition, the greatest individuals to recommend improvements in materials, procedures, and new end users for trash. They are the ones who can reduce scrap buildup via cooperation.As a result, senior management should devise formal compensation mechanisms to encourage employee engagement in this topic. A few organisations have suggestion box strategies that pay off handsomely for the company. Workers are also rewarded and recognised during the process[10]–[12].

III. CONCLUSION

In conclusion, the use of Six Sigma in maintenance analysis provides operational management with useful tools and approaches to improve maintenance procedures, maximise equipment dependability, and raise operational effectiveness as a whole. Using the DMAIC Define, Measure, Analyse, Improve, Control technique, organisations may systematically and datadrivenly discover, analyse, and manage maintenancerelated problems.An essential part of Six Sigma maintenance analysis is data analysis. Organisations may learnmore about maintenance performance, spot trends, and make datadriven choices by gathering and analysing pertinent data. In order to adopt efficient remedial and preventative actions, organisations must first identify the root causes of maintenance problems.

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