

A Proposal for Improved & Effective Layout of Maintenance Department

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Abstract- The maintenance of an industry, building, vehicle, workshop, or machine is the process of keeping it in good condition by regularly checking it and repairing it when necessary. The goal of the maintenance department is to provide a safe and comfortable environment that is effective for working personnel & for the organisation in the best condition possible in the most cost effective way. The mission of the maintenance crew is to provide fast, efficient service to all. And it is only possible when the layout of maintenance department is efficient. The current paper deals with the proposal of making an improved & effective layout of maintenance department to optimize the cost of maintenance and also to provide safe working environment for personnel.

Keywords- Maintenance Department, Maintenance personnel, Repair time, Logistic time, Down time, Continuous improvement.

I. INTRODUCTION

The Maintenance Department effectively and efficiently manage and maintain the facilities and equipment to assure the support of the districts goals for improving the safety & working environment of the organisation by reducing the Repair time of the Critical system or Components which effects on the Productivity of the unit [1].

Maintenance Department offers a technical design and maintenance service throughout the Organisation. Preservation of Organisation assets is of paramount importance and careful, skilled inspections are frequently carried out. Corrective maintenance work takes place to ensure the expected performance [2] and life of equipment, vehicle, plant or building is achieved. The Department is divided into sections that specialise in a variety of engineering disciplines such as electrical, electronic, refrigeration, heating and mechanical engineering. It provides an engineering design and maintenance service to cover scientific and ancillary equipment, and building services, including heating, ventilation and air conditioning.

II. OBJECTIVE

The maintenance department are generally well equipped to deal with the maintenance tasks assigned to them but many times due to improper layout of maintenance department causes a lot of problems like increased down time which will cause loss in production, which is highly undesirable for any organisation.

Need is to design an Improved & Effective Maintenance Department layout for the organisation to reduce the logistic time & breakdown caused due to critical components failure. And also assembling and disassembling of machinery can be done quickly at the working place itself. This will provide maintenance facilities for a substantial fleet of Quick Repair of critical components and other machinery. The Department provides a general stores facility and a cleaning and security service.

III. PROPOSAL FOR IMPROVED & EFFECTIVE LAYOUT OF MAINTENANCE DEPARTMENT.

The need is to develop an Improved & Effective Maintenance Department so that the Down time [3] should be reduced and the maintenance can be done effectively at minimum cost. The proposed layout and its important element are explained below:

A) *Requirements of Improved Maintenance Department:* It is very important to know what the requirements of an improved maintenance department are; it is briefly explained in the Table 1.

1	Staff	
	Head of workshop (supervisor)	A specialized technician, preferably in Mechanical /Electronics (a mechanical / electrical background With some knowledge in the same field Would be suitable); will be in charge and will supervise the Maintenance and repair of Units Machinery.
	Multi-skilled (general) technician	Will be responsible for the Maintenance of plant and mechanical/ electrical Equipment as well as routine Maintenance and repairs to standard equipment and other Equipment used for production.
	Craftsmen	Will be responsible for the (plumber, boiler man, mason) maintenance of Boiler, Machines, Buildings etc.
2	Facilities	
	Electronics workshop	Fitted with work-benches, storage cabinets for tool kits and equipment etc.
	Mechanical workshop	Fitted with drill, grinder, welding module, work-bench, carpenter's bench, bench lathe, portable grinder, compressed air etc.
	Storeroom	Fitted with storage shelves for spare parts, components, supplies and equipment awaiting repair or delivery
	Changing room	Fitted with lockers, benches.
	Vehicle	A trolley, fitted with mobile tool kit, mobile cabinet for spares and supplies.
3	Equipments	
	Electronics test instruments	Multimeters, soldering irons (heavy and light-duty) ,simple Oscilloscope.
	Mechanical equipments	Vices, grinder and drill on stand, hand drills, welding set and air compressor.
	Basic tools	General sets of screwdrivers, pliers, cutters, round-nose pliers for both heavy-duty and electronics work; selection of hammers, steel and rubber; sets of metric and imperial spanners, including pocket size; adjustable spanners and wrenches; taps and dies, metric and imperial, steel saws, small hacksaws, files (large and pocket-size); sets of Allen keys, metric imperial, Automobile tools, Pipe working, Hammer, Chisels, Punches, Mallets, Pullers, Special tools.
	Spare parts	Set of preferred values for resistors, capacitors, transistors, very common integrated circuits, general-purpose O-rings, washers, screws, bolts, nuts, keys etc. Consumable items for electrical & Mechanical equipment

Table 1

B) Other Important Tools & Equipments Check List: Various types of tools and equipments are required for an efficient maintenance department some of the important tools & equipments are listed below.

- **Bench lathe:** - This is a small lathe usually mounted on a bench. It has practically all parts of an engine lathe or speed lathe and it performs almost all the operations, its only difference being in size. This is used for small and precision work [4].
- **Tool room lathe:-** A tool room lathe having features similar to an engine lathe is much accurately built and has a wide range of spindle speeds ranging from very low to quite high speed up to 2500 r.p.m. this lathe is mainly used for precision work on tools, dies, gauges and in machining work where accuracy is needed [5].
- **Portable drilling machine:** - this type of drilling machine can be operated with ease of anywhere in the workshop and is used for drilling holes in work piece in any position which cannot be drilled in a standard drilling machine. The machine is operated at higher speed as smaller size drills (12mm to 18mm) are only used [6]. This machine is driven by individual motor or pneumatic power.
- **Flexible shaft double grinder:** - This has a two grinding wheel on the end of a long flexible shaft driven by a motor on a relatively stationary stand. It can be easily moved about and may be used to best advantage in removing small amount of stock from widely separated areas.
- **Portable grinder:** - the usual form of portable grinder or electric hand drill with a grinding wheel mounted on the spindle [7]. This is used for roughing, snagging and small works for burring and dies work.
- **Vertical milling machine:** - the position of vertical milling machine spindle is vertical to the work table. It has all movements of the table for proper setting and feeding of work. The spindle can also be adjusted up or down relative to the work. It is used for machining grooves, slots and flat surfaces.
- **Bench vice:** - It is also known as a metalworking bench vise is used in metalworking applications. The jaws are made of soft or hard metal. The vise is bolted onto the top surface of the bench with the face of the fixed jaws just forward of the front edge of the bench. The bench height should be such that the top of the vise jaws is at or just below the elbow height of the user when standing upright. The vise may include other features such as a small anvil on the back of its body.
- **Shaping Machines:** - It is used to machine flat surfaces in horizontal, vertical and angular planes the cutting tool is mounted on the shaper head to the ram [8].
- **Tool & Cutter Grinders:** - it is used for grinding tools by hand; a pedestal type grinder is used. for the sharpening of miscellaneous cutters, universal type of grinder is used [9].
- **Surface Grinders:** - The grinding of flat or plain surfaces is known as surface grinding. Angular or formed surfaces can also ground by using special fixtures and form dressing devices.
- **Hacksaws:** - It is used for heavy duty and designed to automatically load, position, clamp, and cut-off sections and then stop.
- **Bandsaws:** - It issued for severing work pieces and doing rough counter sawing. It is a machine of contouring ability and thus intricate curved shapes can be cut by combination of hand and power feed.
- **Hydraulic Presses:** - In hydraulic press the force experienced by the tool is applied through a diaphragm to an enclosed volume of oil, which gets pressurized on application of force.
- **Shielded metal Arc welding kit:** - Shielded metal arc welding is also known as manual metal arc (MMA) welding; it is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined

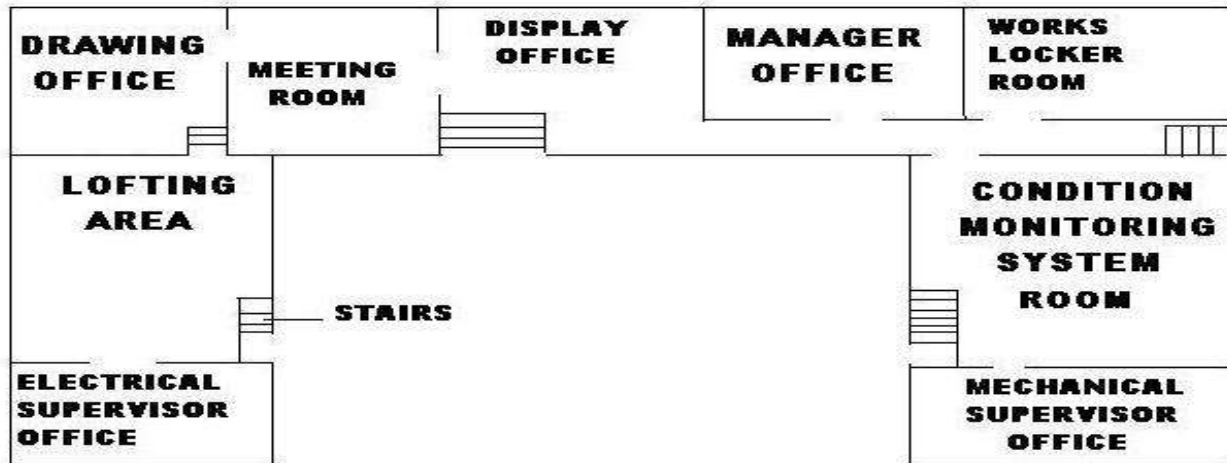
[10]. Shielded metal arc welding equipment typically consists of a constant current welding power supply and an electrode, with an electrode holder, a ground clamp, and welding cables.

- **Oxy-fuel welding kit:** - In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a shared pool of molten metal. The molten pool is generally supplied with additional metal called filler. Filler material depends upon the metals to be welded. The apparatus used in gas welding consists basically of an oxygen source and a fuel gas source (usually acetylene), two pressure regulators and two flexible hoses (one of each for each cylinder), and a torch [11]. This sort of torch can also be used for soldering and brazing. The cylinders are often carried in a special wheeled trolley. The torches includes welding torch, Cutting torch, Rosebud torch, Injector torch. And all the safety equipments related to welding.
- **Cleaning kit:** The cleaning is essential part of repair of an equipment or component or machinery. It includes surface cleaning, corrosion removal, contamination, oil and dust removal from the surface of equipment. The cleaning kit consists of wire brushes, pressure cleaning equipments, liquid chemicals to remove oil, dust, corrosion from the surface to be cleaned.
- **Monitoring Devices:** Condition monitoring is the process of monitoring a parameter of condition in machinery, such that a significant change is indicative of a developing failure. It is a major component of predictive maintenance. Some measure monitoring devices are:-
- **Infrared thermometer:** - The most basic design consists of a lens to focus the infrared (IR) energy on to a detector, which converts the energy to an electrical signal that can be displayed in units of temperature after being compensated for ambient temperature variation. This creates images based on differences in surface temperature by detecting infrared radiation (heat) that emanates from objects and their surrounding environment [12]. This configuration facilitates temperature measurement from a distance without contact with the object to be measured. It is used where the object to be measured is moving, where the object is surrounded by an EM field, as in induction heating, where the object is contained in a vacuum or other controlled atmosphere or in applications where a fast response is required.
- **Laser Doppler Vibrometer:** - A laser Doppler Vibrometer (LDV) is a scientific instrument that is used to make non-contact vibration measurements of a surface. The laser beam from the LDV is directed at the surface of interest, and the vibration amplitude and frequency are extracted from the Doppler shift of the laser beam frequency due to the motion of the surface. The output of an LDV is generally a continuous analog voltage that is directly proportional to the target velocity component along the direction of the laser beam [13].
- **Other Portable monitoring Devices:** - These are the devices [14] which are used for offline monitoring. These are portable and easy to use for monitoring vibrations, Heat sensitivity, Temperature, pressure, Alignment etc of different mobile machineries like pumps, motors, sub devices of compressors and other critical equipments.
- **Online Condition Monitoring System:** - Online Condition monitoring system is the process of monitoring a parameter of condition in machinery, such that a significant change is indicative of a developing failure. It is a major component of predictive maintenance. The use of conditional monitoring allows maintenance to be scheduled, or other actions to be taken to avoid the consequences of failure, before the failure occurs. Nevertheless, a deviation from a reference value (e.g. temperature or vibration behaviour) must occur to identify impending damages [15].

C) *Layout of Proposed Maintenance Department:* Various types of industries use different types of maintenance department layout [16], our objective is to propose a layout of an effective maintenance

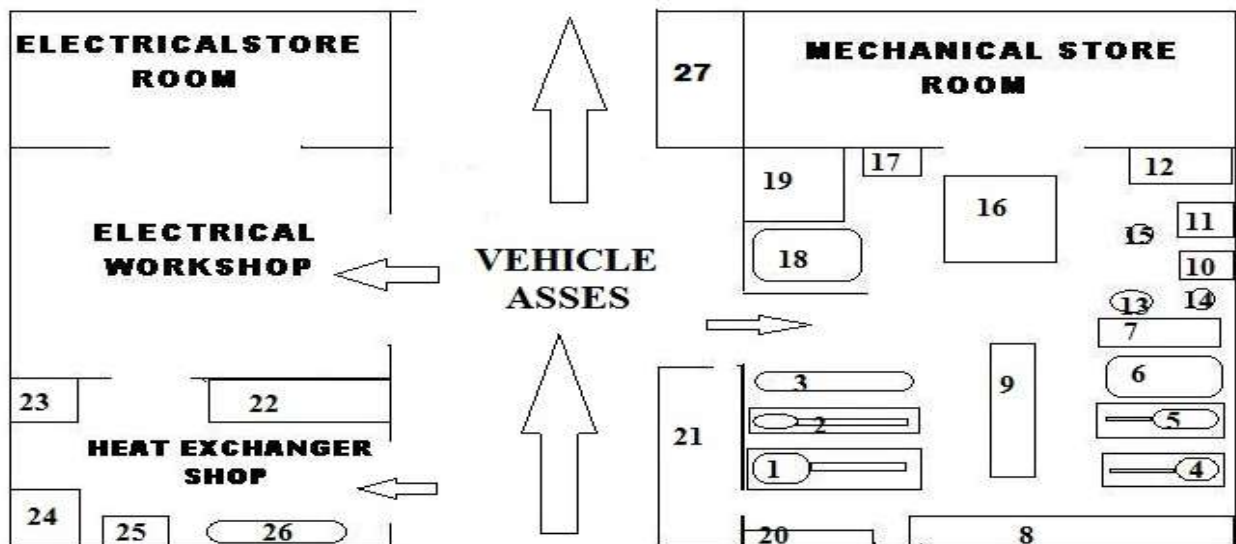
department which will reduce the down time, logistic time and enhance productivity of the workshop. Following figures shows the proposed layout of maintenance department.

Figure 1 shows the proposed maintenance department layout of first floor. In this layout there is a good connectivity between the important maintenance personnel's which will surely reduce the communication gap and help quick response to every problem.



MAINTENANCE DEPARTMENT LAYOUT OF FIRST FLOOR

Figure 1



MAINTENANCE DEPARTMENT LAYOUT GROUND FLOOR

Figure 2

Figure 2 shows the proposed maintenance department layout ground floor. This layout shows optimal locations various machineries and other important things require for an efficient maintenance department.

Workshop Machines Name [17, 18]

1. Vertical Milling Machine
2. Drilling Machine
3. Shaper Machine
4. Tool Room Lathe
5. Automatic Bench Lathe
6. Machine Lathe
7. Planner
8. Working Table
9. Bench Vice
10. Universal Grinder
11. Hydraulic Press
12. Compressor
13. Scrap Pin
14. Hacksaw Machine
15. Bandsaw Machine
16. Assembly Table
17. Surface Grinder
18. Gas Welding Kit
19. Arc Welding Kit
20. Restroom
21. Workshop Superintendent Room
22. Heat Exchanger Cleaning Kit
23. Air Compressor
24. Portable Grinder and Surface Grinder
25. Gas Welding Kit
26. Working Table
27. Monitoring Devices Room

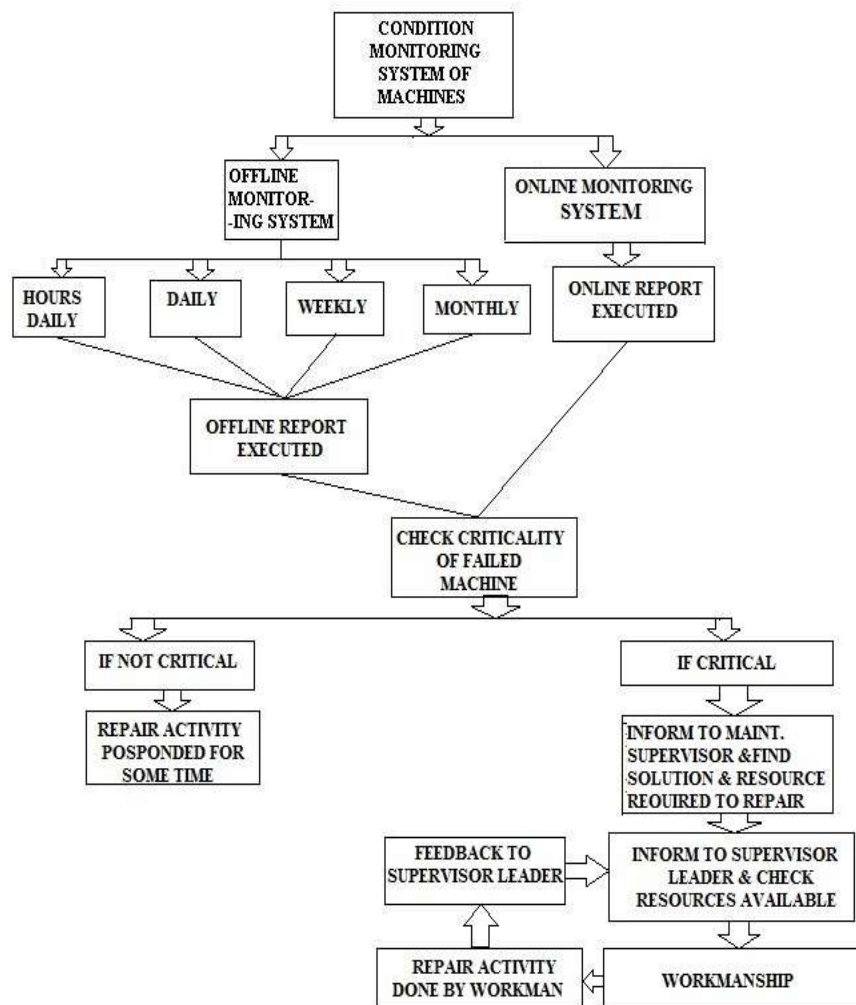
D) *Proposed Maintenance Process Flow Chart*: There are various types of maintenance process flow charts available but objective is to propose a maintenance flow chart which is sufficient to reduce the communication time and there by logistic time due to effective layout of maintenance department. If all the various sub departments of maintenance are connected together then the maintenance personnel can communicate with each other easily, which will also reduce the active repair time and administrative time. All maintenance personnel in the plant report through a maintenance manager. If the organization is large, there should be levels of supervisors reporting to the maintenance manager, so the supervisors of different departments report to supervisor leader thereafter workmanship for repair activity.

Identification of Critical Components (The Criticality Index):-It is important to understand about the critical components whose failure can highly affect the production of the unit. The criticality index puts all machines into one of three categories [19]:

- **Critical machinery** - Machines that are vital to the plant or process and without which the plant or process cannot function. Machines in this category include the steam or gas turbines in a power plant, crude oil export pumps on an oil rig or the cracker in an oil refinery. With critical machinery being at

the heart of the process it is seen to require full on-line condition monitoring to continually record as much data from the machine as possible regardless of cost and is often specified by the plant insurance.

- **Essential Machinery** - Units that are a key part of the process, but if there is a failure, the process still continues. Redundant units (if available) fall into this realm. Testing and control of these units is also essential to maintain alternative plans should Critical Machinery fail.
- **General purpose or balance of plant machines** - These are the machines that make up the remainder of the plant and normally monitored using a handheld data collector as mentioned previously to periodically create a picture of the health of the machine.



MAINTENANCE PROCESS FLOW CHART

Figure 3

CONCLUSION

The Maintenance Department monitors usage and efficiency of all the machineries and although there will always be room for improvement; levels of use are now unlikely to fall significantly without major capital investment. More and more time, effort and resources are being spent to cope with the 'what if' scenario, all of which add to the ever increasing workload of the Maintenance Department. This proposed layout of

improved and effective maintenance department will surely prove profitable for the organization in terms of reducing down time logistic time etc and also provide safer working environment.

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