



MAINTMASTER®

MAINTENANCE MANUAL

MAINTENANCE ACCORDING TO **EUROPEAN NORM**

Maintenance is often considered the same as fixing or repairing something that has broken, which is an old and outdated definition of maintenance. The pyramid on the next page shows that corrective maintenance represents only a small part of the tasks a maintenance organization has to do. A great deal of the work is about identifying future maintenance actions, and making sure that planning and preparation are such that the actions are carried out as cost-effectively as possible.

The principal goal of a maintenance organization is always to improve operational reliability, which means ensuring an installation continues to operate as planned during operations. To achieve this, a maintenance organization must have a clear vision and strategy with established procedures and goals. A good example of a maintenance strategy would be seeking to achieve more effective production through preventive and condition-based maintenance. It's important that everyday work include focusing long-term on factors such as root cause analyses in corrective maintenance to raise the degree of planning over time, thereby ensuring cost effective maintenance.

It's a good idea to use the manual as a practical guide and support in everyday maintenance, and as part of the introduction material for new staff. Contact us if you are looking to develop your personalized maintenance manual for your own specific company.

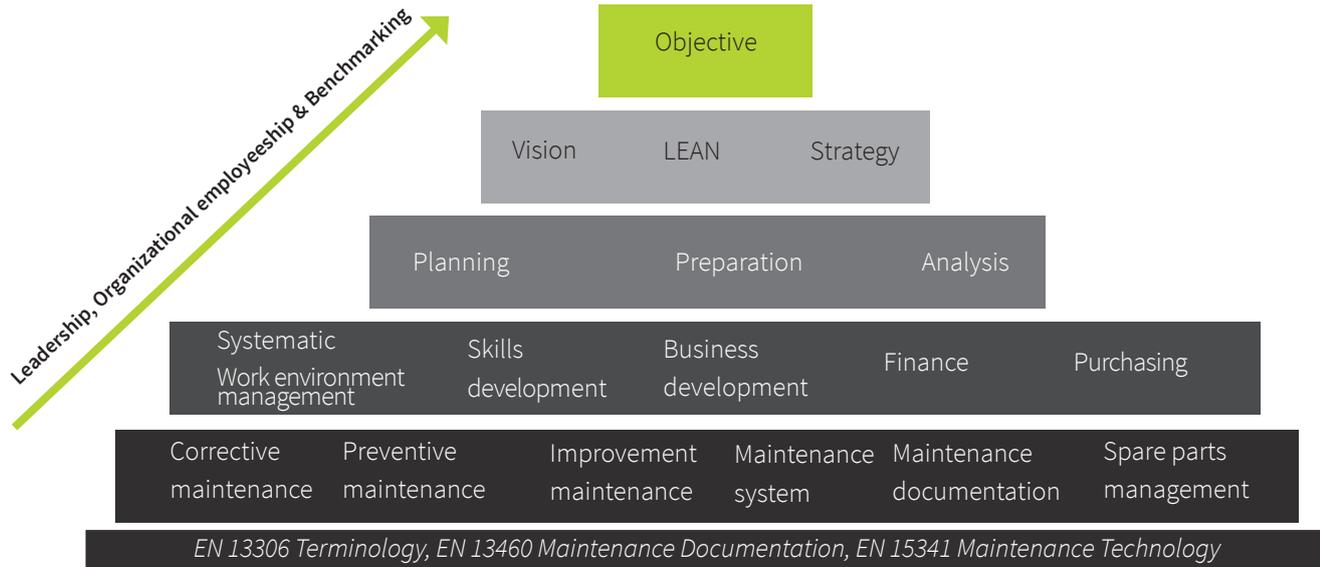
It's very important that all maintenance staff understand the importance of well-executed preventive maintenance, as well as the consequences of unscheduled production shutdowns. They should also be able to assess how improvement maintenance, or developed preventive maintenance, can improve the operational reliability of an installation.



Mikael Andersson
MaintMaster Systems AB

MAINTENANCE PYRAMID

The pyramid below shows some of the main processes involved in maintenance and the standards that form the basis for maintenance. All processes must work for cost-effective, well-functioning maintenance to be achieved.



VISION, STRATEGY & POLICY

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MAINTENANCE VISION, STRATEGY AND POLICY

A document aimed at ensuring improvement of availability of your machines, i.e. they work as planned during scheduled operations. The vision is a long-term objective that the organization must actively work towards to achieve. Strategy is a plan for how the organization is to achieve this vision, while the policy is a statement of intent and a guideline to regulate decisions and achieve the desired objectives.

EXAMPLE: MAINTENANCE VISION

- *Proper maintenance ensures reliability and good availability throughout the plant traceability through reporting in the maintenance system provides certainty about weaknesses and shortcomings.*
- *Through the insight of all employees of the importance of maintenance for availability we will achieve cost-effective maintenance for all production equipment*
- *This is enabled by all the employees' commitment and respect for procedures and instructions.*

EXAMPLE: MAINTENANCE STRATEGY

- *Create a high level of availability through consistent operational safety work with a financial balance to achieve the production goals.*
- *European maintenance standard (EN 13306) and its terminology form the basis of our daily work.*
- *Preventive maintenance is planned and based on condition-based maintenance. This is to minimize any unscheduled maintenance operations.*
- *Establish close cooperation between maintenance and operating staff.*
- *We use the LEAN concept and work on continuous improvements and systematic problem solving to remedy root causes.*

EXAMPLE: MAINTENANCE POLICY

- *Maintenance is characterized by efficiency, quality, flexibility and safety.*
- *Leadership must be visible and supportive.*
- *We are all teachers, mentors and coaches. Rapid feedback is essential.*
- *A maintenance technician must know and understand the maintenance terminology used in the European Standard (EN 13306), and also be able to use it in practice.*

MAINTENANCE STANDARD

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MAINTENANCE STANDARD

There are many definitions and interpretations of the concept of maintenance. Interpretations often vary with factors such as the industry and level within an organization. For a maintenance technician performing a practical maintenance task, the term maintenance might mean replacing a coupling between a motor and pump. For someone in management, the term maintenance might instead mean a tool designed to increase competitiveness, productivity and profitability.

The following maintenance-related standards specify general terminology and definitions for the technology, administration and management areas within maintenance.

EN- 13306 Maintenance Terminology

- Makes sure everyone does the same thing and means the same thing
- Reliable documentation and data for analysis
- Concepts that also work internationally

EN- 13460 Documents for Maintenance

- Support when making new purchases
- Reliable documentation for preventive maintenance

EN- 15341 Maintenance Key Performance Indicators

- Key performance indicators that are based on terminology standards
- Internationally understood

WHAT IS MAINTENANCE?

“Maintenance is a combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function”

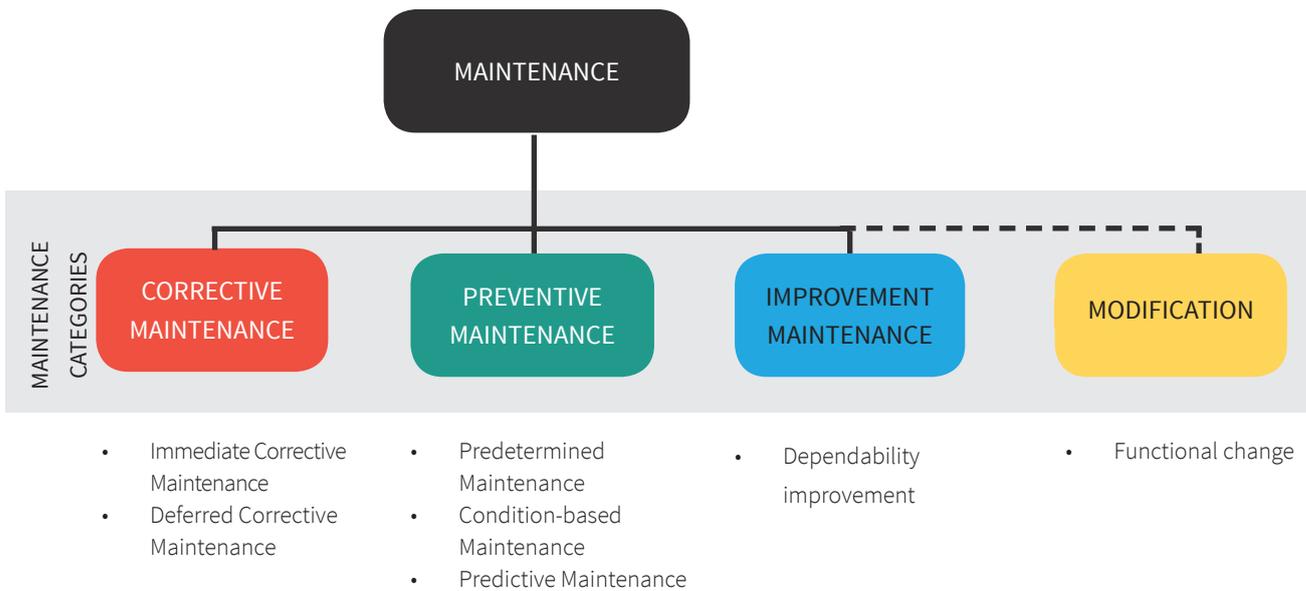
A maintenance technician must know and understand maintenance terminology and standards and also be able to use them in practice.

Conducting proper analyses requires everyone to talk and report in the same way so that they understand the different ideas the maintenance terminology conveys. This makes it possible to measure, make accurate, fact-based analyses which in turn form the basis for the maintenance organization's decision documentation.

According to standard EN 13306:2017

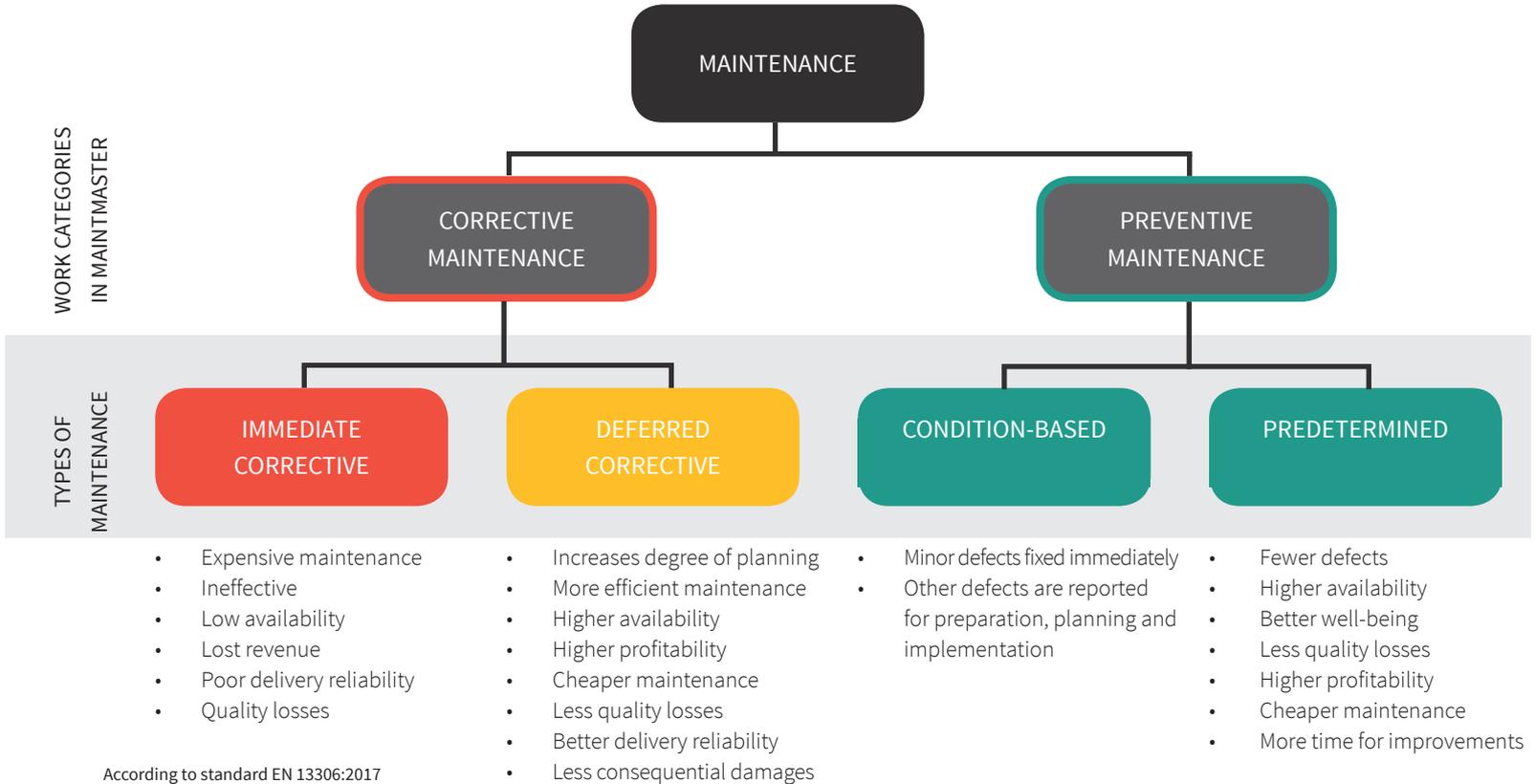
MAINTENANCE CATEGORIES

Maintenance is divided into the four sub-categories illustrated and can be implemented as work categories in MaintMaster. All existing maintenance activities and modification work can be registered within these categories.

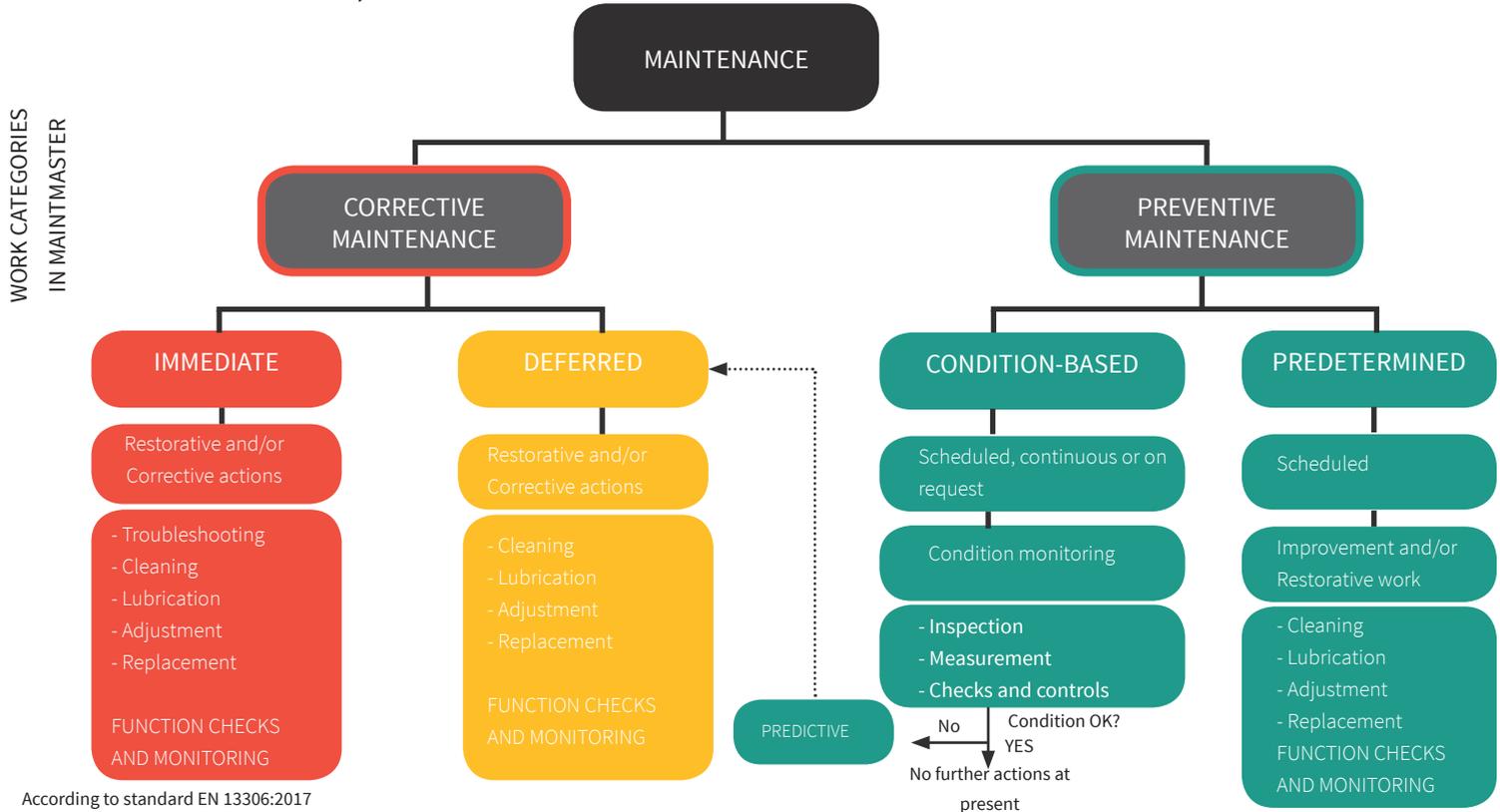


According to standard EN 13306:2017

TYPES OF MAINTENANCE



OVERVIEW OF EUROPEAN TERMINOLOGY STANDARD FOR MAINTENANCE, EN 13306



According to standard EN 13306:2017

PREVENTIVE MAINTENANCE

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An effective preventive maintenance ensures improved availability, which leads to increased profitability, and in the long term also brings down maintenance costs.

We use the condition-based maintenance concept, which is based on optimizing the technical availability by predicting the critical points in our equipment and thereby preventing problems before they occur.

Maintenance activities that are “unnecessary” are eliminated by systematically ensuring that work performed guarantees improved availability at lower cost.

We also make sure that maintenance is a coherent unit, which involves secure access to spare parts and a functioning network of maintenance service providers.

PREVENTIVE MAINTENANCE ACCORDING TO STANDARDS

Maintenance carried out intended to assess and/or to mitigate degradation and reduce the probability of failure of an object.

Preventive maintenance can consist of **CONDITION-BASED**, **PREDETERMINED**, and **PREDICTIVE** maintenance.

CONDITION-BASED MAINTENANCE

- Preventive maintenance which include assessment of physical conditions, analysis and the possible maintenance actions
- Control and monitoring of performance and characteristics can be scheduled, on request or continuous. Subjective or objective assessment.

PREDETERMINED MAINTENANCE

- Preventive maintenance carried out in accordance with established intervals of time or number of units of use, but without previous condition investigation
- This could be, cleaning, lubrication and replacement of components or spare parts.

PREDICTIVE MAINTENANCE

- Condition-based maintenance carried out following a forecast derived from repeated analysis or known characteristics and evaluation of the significant parameters of the degradation of the item

CONDITION-BASED MAINTENANCE

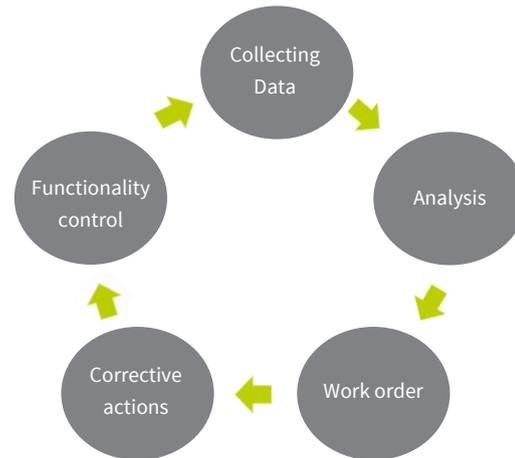
This is a method designed to acquire information about the condition of individual machines in order to identify the appropriate maintenance action at an optimal time. Accordingly, condition-based maintenance requires the means to retrieve information about the condition of a machine. This usually involves various types of measurement techniques such as vibration measurement, thermography, ultrasonic measurement and oil analysis. The condition-based maintenance process consists of five process steps; data collection, analysis, work order, corrective measure and function control.

ADVANTAGES

- Appropriate maintenance actions at the right time
- Scheduled maintenance actions instead of emergency actions
- Minor machinery defects are detected in good time and corrected
- Fewer emergency breakdowns due to worn parts
- High rate of skills development for maintenance staff
- Knowledge of in-house machinery builds up within the organization

DISADVANTAGES

- May entail high initial investment costs
- Risk of machinery being renovated too early
- Can be difficult to gain support for CBM throughout the organization



PREDETERMINED MAINTENANCE

Refers to preventive measures performed according to calendar schedule or operating time, e.g. the replacement of oil, belts, clutch discs and other wear parts. The term also includes scheduled overhauls where machinery and components are taken apart for inspection.

ADVANTAGES

- Reduced risk of emergency breakdowns
- Improved availability
- Increases degree of planning for the maintenance operation
- Development of staff competence
- Reduced maintenance costs

DISADVANTAGES

- Costs for unnecessary spare parts and working hours
- Risk of machinery being “maintained” to excess
- Unnecessary downtime costs
- Often static maintenance planning with limited feedback of experience to the maintenance plan

PREDICTIVE MAINTENANCE

According to the standard, predictive maintenance involves identifying a fault during its development period. It is a form of condition-based maintenance. With today's technology, there is usually some kind of smart monitoring system that analyzes and processes the measurement data. This makes it easier to e.g. determine when it's time to replace a bearing or the oil in a unit.

The predictive maintenance principle can naturally also be used with recurring condition monitoring, such as visual inspections or collecting measurement data for subsequent analysis and a decision on scheduled, predictive maintenance.

The purpose of predictive maintenance is simply to forecast the best time to e.g., replace a unit in order to exploit its full service life.

CORRECTIVE MAINTENANCE

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CORRECTIVE MAINTENANCE **ACCORDING TO STANDARD**

Maintenance carried out after a fault recognition and intended to restore an object into a state in which it can perform a required function.

Corrective maintenance can consist of both deferred and immediate corrective maintenance.

DEFERRED CORRECTIVE MAINTENANCE

- Corrective maintenance is not carried out immediately after detection of a malfunction, but is delayed in accordance with given maintenance directives.
The work can be planned.

IMMEDIATE CORRECTIVE MAINTENANCE

- Maintenance performed immediately after detection of a malfunction to avoid unacceptable consequences.

CORRECTIVE MAINTENANCE

ADVANTAGES

- Suitable for machinery that is easy to replace or has low purchasing costs.
- Suitable for some machinery in redundant systems where no costly side effects can be expected following a breakdown.
- Needs little or no investment in competence or technology.

DISADVANTAGES

- Means urgent unforeseen machine failures.
- Difficult and sometimes impossible to schedule maintenance operations.
- Capital destruction - minor machine problems remain undiscovered and develops into costly breakdowns.
- Little or no development of staff competence
- Risk of personal injury in breakdowns.
- Increased environmental impact.
- Higher energy consumption.

IMPROVEMENT MAINTENANCE

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IMPROVEMENT MAINTENANCE ACCORDING TO STANDARD

Combination of all technical, administrative and managerial actions, intended to ameliorate the intrinsic reliability and/or maintainability and/or safety of an object, without changing the original function.

For maintenance, this means all measures aimed at prolonging service life and eliminating future defects.

The purpose of an improvement could be to:

- Eliminate defects
- Extend MTM
- Improve safety
- Improve MTTR
- Improve maintainability

Improvement maintenance excludes measures aimed at improving the machinery in terms of speed and quality. The same applies to the adaption of equipment for a new product or new packaging.

These measures are called Modifications.

MODIFICATION

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MODIFICATION

According to the European Standard, modification is defined as: “The combination of all technical, administrative actions, intended to change one or more functions of an object.”

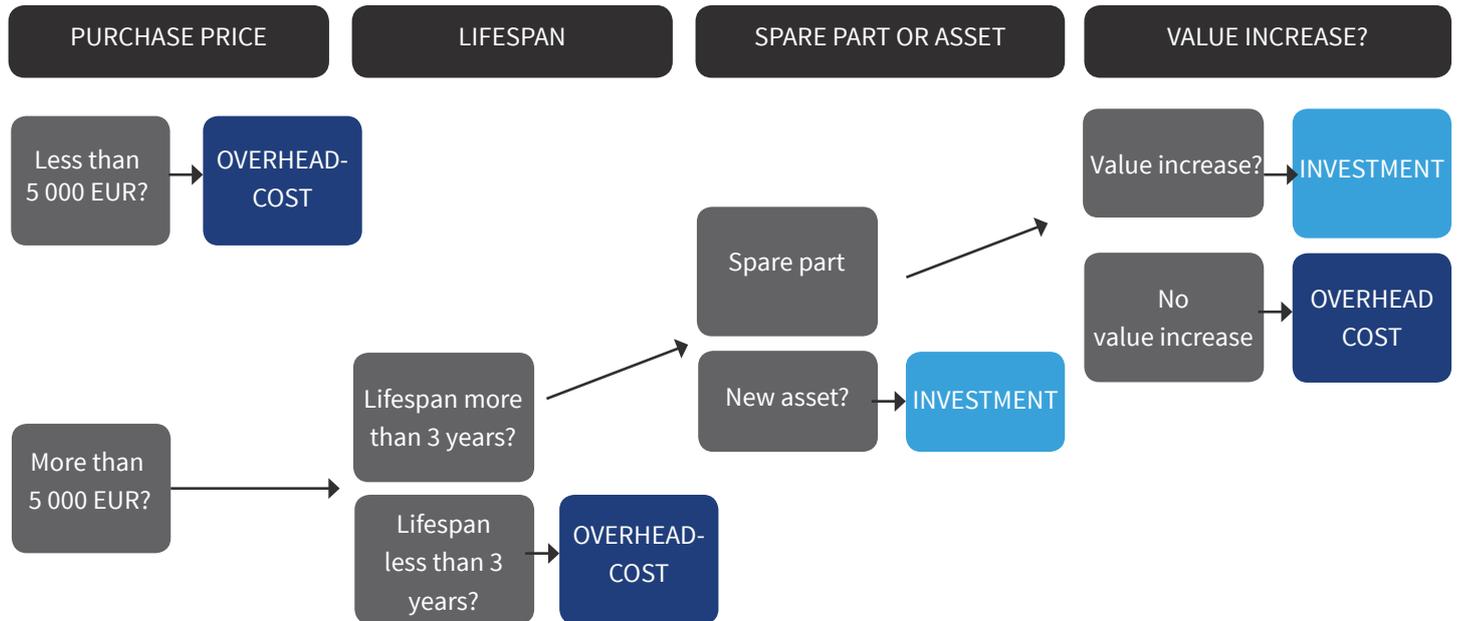
For maintenance, this means all measures designed to improve product quality or speed. This also applies when a piece of equipment is modified to suit a new product or packaging. Such measures should be separated in terms of cost from the maintenance budget and they are usually expensed as investments.

The standard states that:

- Modification is not a maintenance measure but refers to the modification of a unit's required function into a new one.
- Modification does not mean replacement with an equivalent unit
- Modifying a unit can be a task for the maintenance organization

DECISION SUPPORT DATA: OVERHEAD COSTS OR INVESTMENT

Sometimes it can be difficult to determine if a scheduled activity should be expensed as an investment (modification) or as an overhead cost. The chart below is intended to serve as an aid in the face of similar issues.

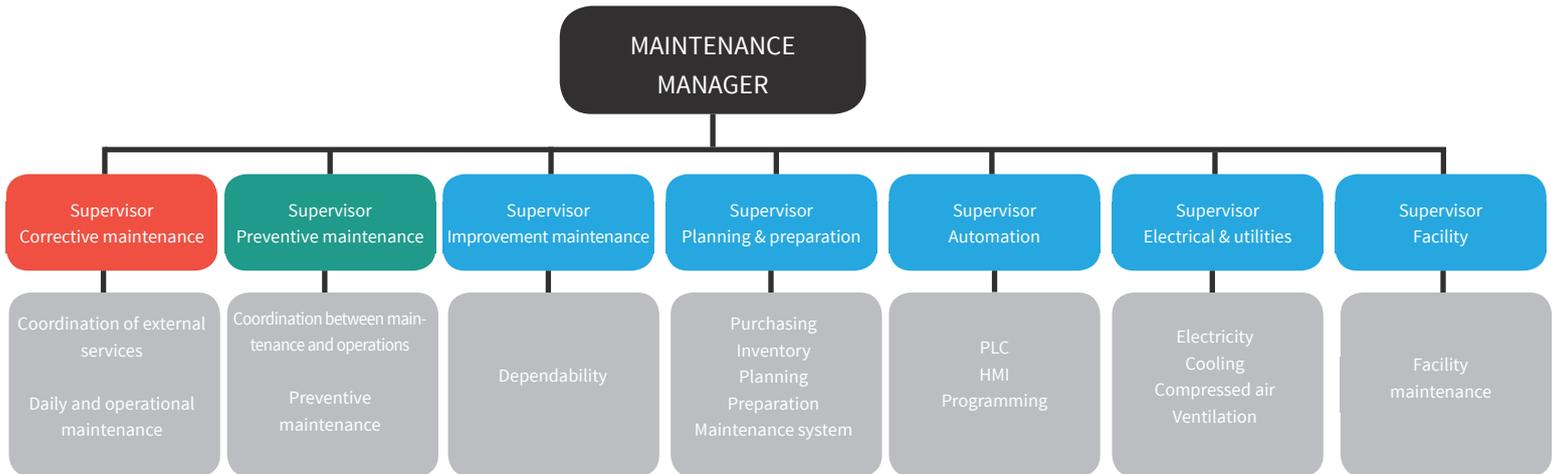


ORGANIZATION

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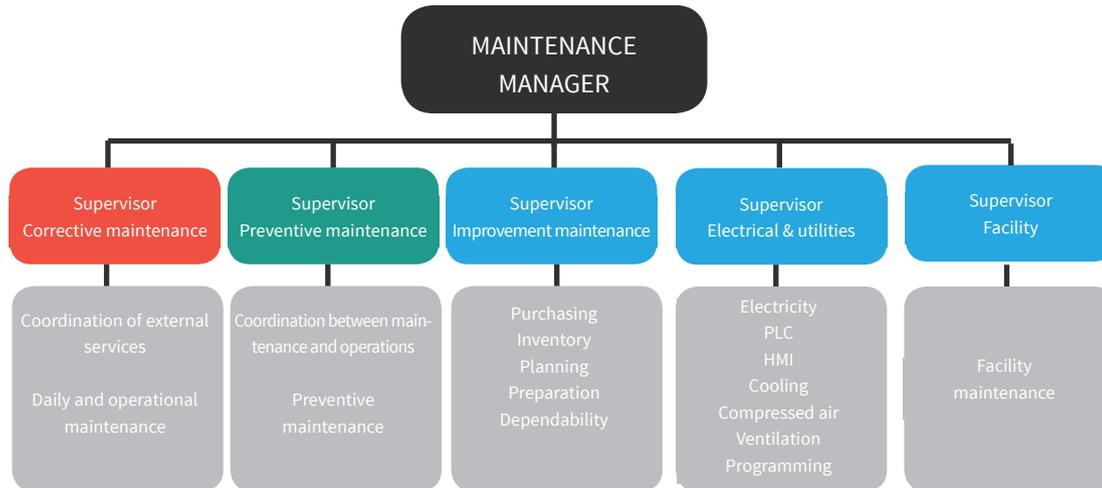
MAINTENANCE ORGANIZATION, BASED ON EN 13306

- For major organizations.



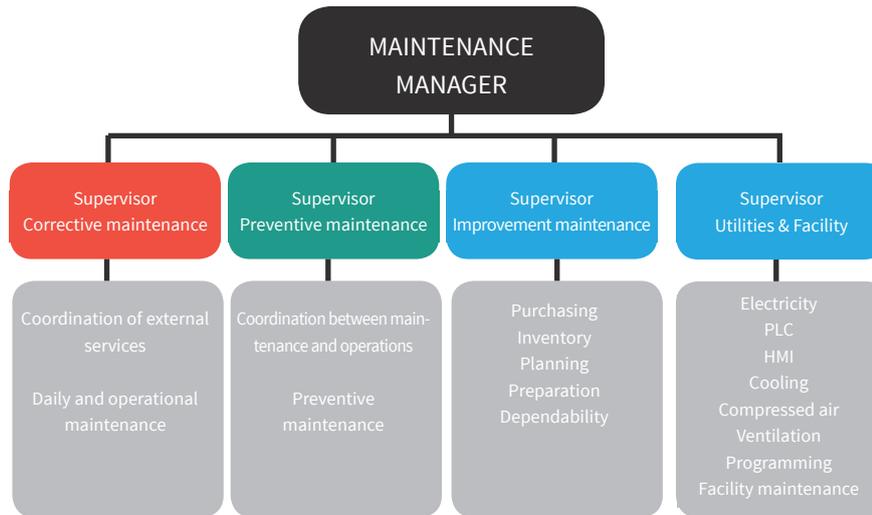
MAINTENANCE ORGANIZATION, BASED ON EN 13306

- For medium-sized organizations.



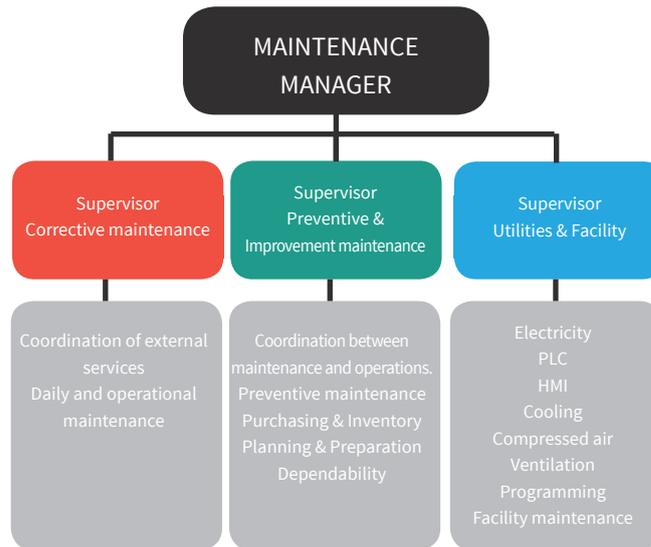
MAINTENANCE ORGANIZATION, BASED ON EN 13306

- For the slightly smaller organization.



MAINTENANCE ORGANIZATION, BASED ON EN 13306

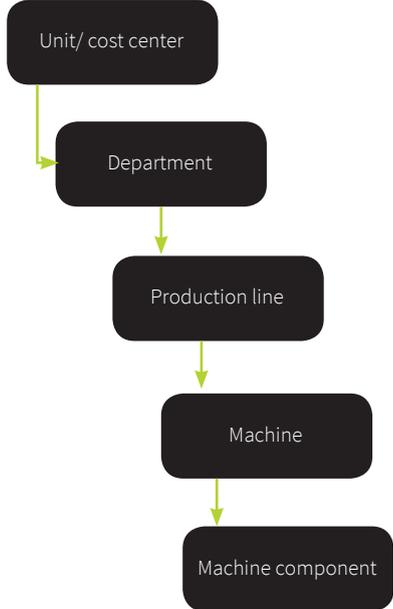
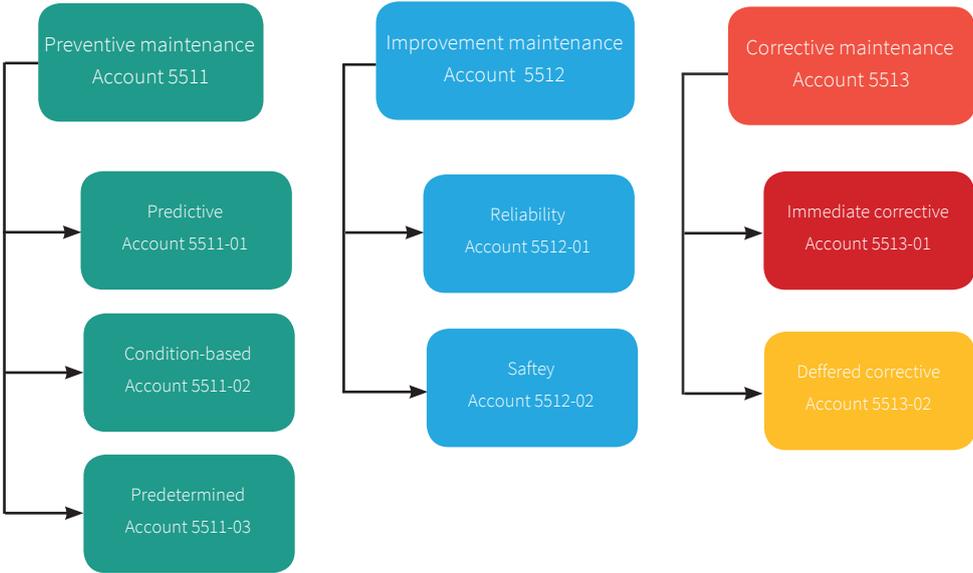
- For the small organization.



FINANCE

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ACCOUNT SETUP FOR MAINTENANCE COSTS BASED ON EN 13 306 & AN ACCOUNT PLAN EXAMPLE



GOALS & KEY PERFORMANCE INDICATORS

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GOALS & KEY PERFORMANCE INDICATORS

The goal of maintenance should always be to improve operational reliability and personal safety, which in turn produces positive effects in terms of availability. Operational reliability depends on the combined characteristics of reliability, maintainability and maintenance supportability. These can be measured using the following numerical values:

EXAMPLES OF NUMERICAL VALUES

- The relationship between scheduled and unscheduled maintenance
- Maintenance costs divided by production volume or number of units produced
- MOTBF: Mean Operating Time Between Failures
- MTTR: Mean Time To Restoration
- MMDT: Mean Maintenance Down Time
- MWT: Mean Waiting Time

HIGH OPERATIONAL RELIABILITY EQUALS:

- Lower maintenance costs
- Higher profitability
- More stable production
- Fewer quality losses
- Lower energy costs
- Improved working environment
- More time for improvements

GOALS & KEY PERFORMANCE INDICATORS – DEPENDABILITY

According to the European Standard, dependability is defined as:

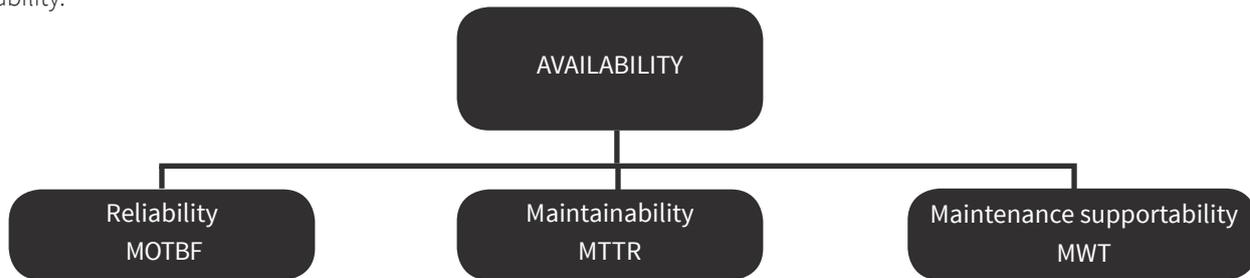
Dependability includes availability, safety, durability, economics and their influencing factors (reliability, maintainability, supportability, conditions of use and operators influence).

AVAILABILITY

According to the European Standard, availability is defined as:

The ability of a unit to perform the required function under specified conditions at a given time or within a set time interval, provided that the required support functions are available.

Note: Availability depends on the combined characteristics of reliability, maintainability and maintenance supportability.



According to standard EN 13306:2017

GOALS & KEY PERFORMANCE INDICATORS – RELIABILITY

A measure of the reliability is Mean Operating Time Between Failures (MOTBF). That is the period between the last corrective action for an error until the next error occurs. Through machine condition monitoring, the time between failures may be extended which leads to a higher reliability.

Reliability is the ability to perform required functionality under given conditions.



According to standard EN 13306:2017

GOALS & KEY PERFORMANCE INDICATORS – MAINTAINABILITY

Mean time to restoration (MTTR) measures the system's maintainability. MTTR is the average time needed to repair a malfunction. Mean time to restoration is easiest to influence when constructing the machine. By improving accessibility and supporting functions you can raise the level of maintainability.

Maintainability is a measure of how easy it is to detect, locate and correct faults in a device or a system.

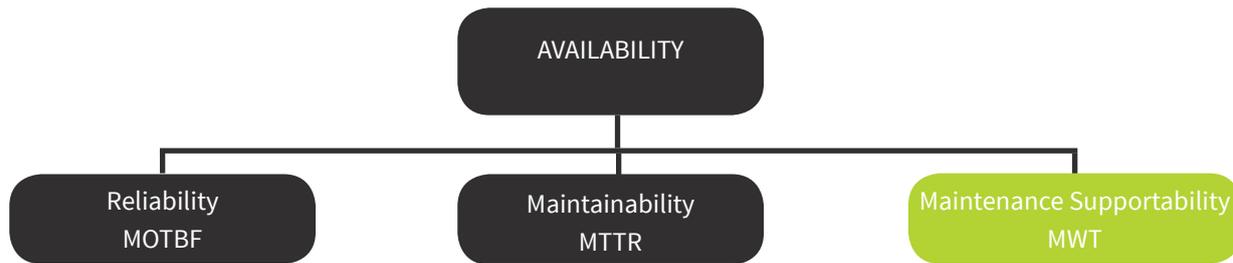


According to standard EN 13306:2017

GOALS & KEY PERFORMANCE INDICATORS – MAINTENANCE SUPPORTABILITY

Maintenance supportability can be described as the average waiting time for a maintenance action. Factors that lead to improved supportability include scheduling maintenance activities and ensuring accessibility, technical documentation of high quality.

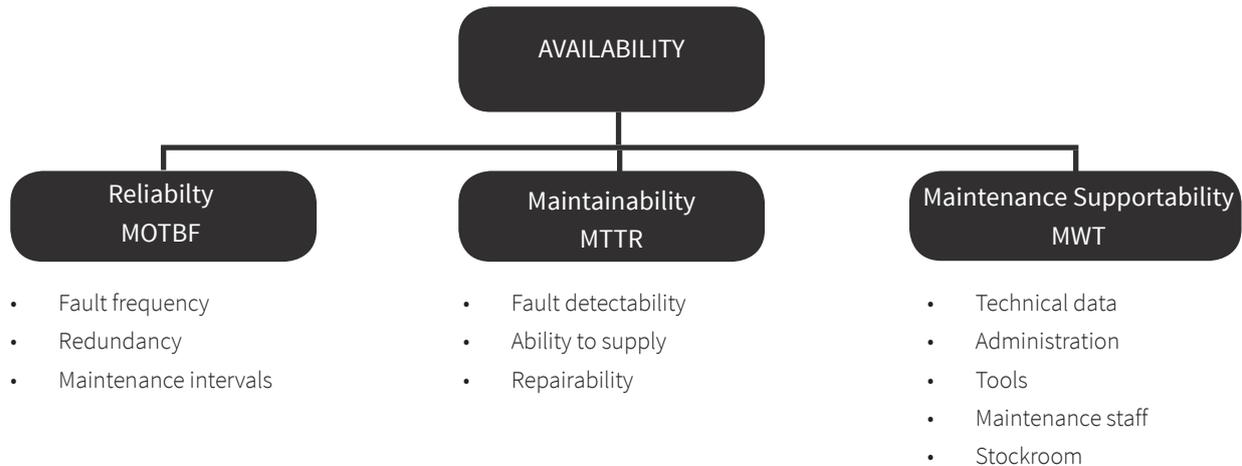
Supportability describes the maintenance organization's ability to provide the resources required for maintenance



According to standard EN 13306:2017

GOALS & KEY PERFORMANCE INDICATORS – DEPENDABILITY

Reliability and maintainability takes into account the technical system's ability to meet availability while the maintenance supportability describes the maintenance organization's ability to effectively correct faults. These three factors, in turn, are determined by a number of subfactors and maintenance activities.

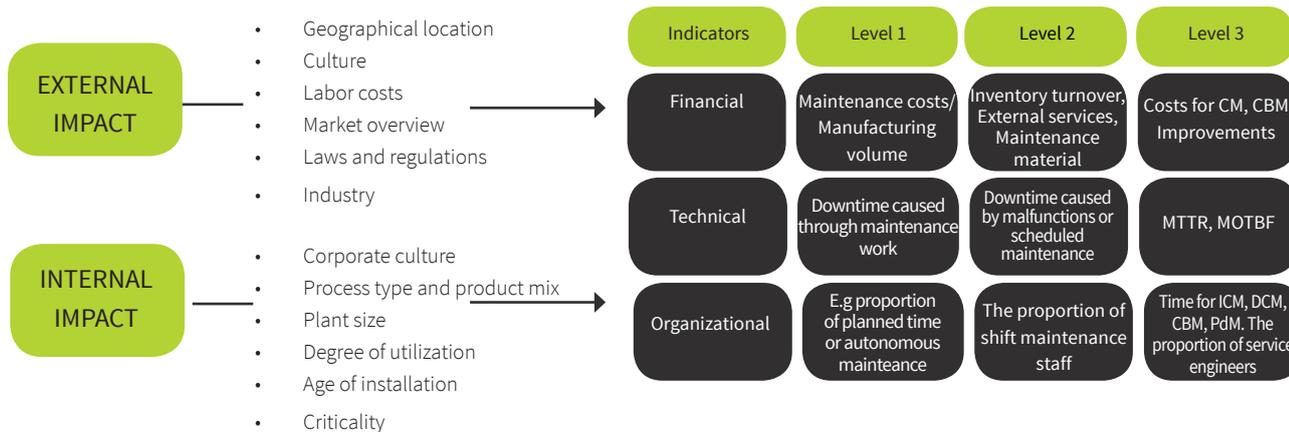


According to standard EN 13306:2017

KEY PERFORMANCE INDICATORS

European Standard-EN 15341:2007 Maintenance Technology - Key Performance Indicators

To manage maintenance operations effectively, it's important to measure what we do, how often and how well we do it. To do this, we must identify a number of numerical values; these are often referred to as key performance indicators (KPIs). The chart below presents a few examples from the standard containing 71 available KPIs defined in three different categories; financial, technical and organizational. Select an overall key performance indicator from each category that adds value to the maintenance activity over time and to which all staff can relate.



According to standard EN 15341:2007

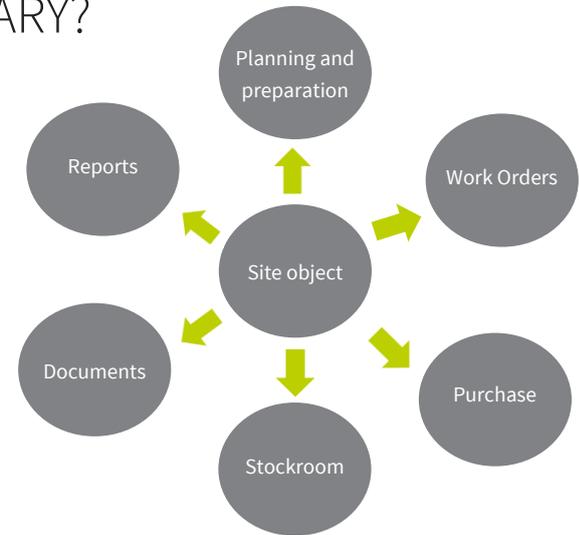
IMPLEMENTATION IN MAINTMASTER

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WHY IS A MAINTENANCE SYSTEM NECESSARY?

Maintenance management and planning requires a systematic approach. Information that can be gathered by a maintenance system provides invaluable support in the planning and execution of all types of maintenance activities as well as helping to ensure operational reliability. Regardless of strategy, there is always a need for some kind of preventive maintenance, and for this to work, documentation, planning and monitoring are necessary to ensure a return on investments. A maintenance system is also the hub for all of the information a maintenance engineer or planner needs. What has been done so far; what spare parts are suitable; have we performed inspections as per procedures; what deviations have we identified?

It's very easy in MaintMaster to customize work categories and codes according to standard EN 13306. This enables proper analysis and provides useful decision-support data.



MAINTENANCE ACCORDING TO EUROPEAN STANDARD

Conducting proper analyses requires everyone to talk and report in the same way and that they understand the different ideas the maintenance terminology conveys. Accordingly, the categories have been adapted to comply with European standard EN 13306 Maintenance Terminology, which clearly states what the various maintenance terms mean. The following pages present various terms in the standard with explanatory text describing what they mean.

EXAMPLE OF WORK CATEGORIES, COMPLETION GROUPS AND COMPLETION CODES

JOB CATEGORY	CORRECTIVE MAINTENANCE	PREVENTIVE MAINTENANCE	IMPROVEMENT MAINTENANCE	MODIFICATION
COMPLETION CODE GROUP	<ul style="list-style-type: none"> - IMMEDIATE CORRECTIVE MAINTENANCE - DEFERRED CORRECTIVE MAINTENANCE 	<ul style="list-style-type: none"> - PM PERFORMED ACCORDING TO ROUTINE 	<ul style="list-style-type: none"> - AVAILABLE IMPROVEMENT 	<ul style="list-style-type: none"> - FUNCTION CHANGE
COMPLETION CODE	<ul style="list-style-type: none"> - INSUFFICIENT MAINTENANCE - HANDLING - WEAR OUT FAILURE - AGEING FAILURE - FAILURE MECHANISM - SECONDARY FAILURE - PRODUCTION SUPPORT - NO FAULT DETECTED 	<ul style="list-style-type: none"> - STATUS OK - DEVIATION IDENTIFIED - STATUS OK (CHANGE PROCEDURE) 	<ul style="list-style-type: none"> - RELIABILITY - MAINTAINABILITY - MAINTENANCE SUPPORTABILITY 	<ul style="list-style-type: none"> - SPEED - QUALITY - ENVIRONMENT - PERSONAL SAFETY - ADAPTION, NEW/MODIFIED PRODUCT
PROPERTIES IN JOB CARD (VALUE LIST)		<ul style="list-style-type: none"> PM TYPE - PREDETERMINED MAINTENANCE - CONDITION BASED MAINTENANCE - PREDICTIVE MAINTENANCE - OPERATOR MAINTENANCE 	<ul style="list-style-type: none"> TYPE OF IMPROVEMENT - ROOT CAUSE ANALYSIS - RELIABILITY - MAINTAINABILITY - MAINTENANCE SUPPORTABILITY 	<ul style="list-style-type: none"> SPECIFY MODIFICATION PURPOSE - QUALITY IMPROVEMENT - CYCLE TIME IMPROVEMENT - PRODUCT CUSTOMIZATION - PERSONAL SAFETY IMPROVEMENT - ENVIRONMENTAL IMPROVEMENT

WORK ORDER FLOW - EXAMPLE

FAULT REPORTS

For fault reports, call maintenance immediately, who will respond as per applicable procedures. The reporting person then creates a fault report in the maintenance system. The order is then sent to the relevant area manager for further processing. Recipients of fault reports must always ask the reporting person if a fault report has been registered in the maintenance system. In cases where the reporting person cannot confirm or is unsure, the responsible technician or supervisor must assist in processing the fault report. This may be done retroactively once the fault concerned is remedied, but in principle the work should only be performed in exceptional cases if an order has not been created in the CMMS (maintenance system).

RECIPIENT OF THE FAULT REPORT

The supervisor for the line, area or equipment concerned is responsible for ensuring that planning, execution and completion of the work is accomplished.

COMPLETION OF WORK ORDER

Once the maintenance actions are complete, the work must be reported immediately stating the time taken and a simple analysis of the action taken to remedy the problem. In the event of emergency measures under the work category immediate corrective maintenance, also indicate the length of the downtime the fault in question has caused, before the job is completed in the maintenance system.

ORDERING OF NON-EMERGENCY MEASURE

The job category Improvement is used in the same way as above, with the difference that it's only used for ordering non-emergency jobs, such as suggestions for improvements and other work orders..

COMPLETION CODE GROUPS FOR CORRECTIVE MAINTENANCE

Completion code group: **Immediate Corrective Maintenance**

Maintenance performed immediately after a defect has been detected in order to avoid unacceptable consequences.

- *The machine is down, fix now! Downtime must always be specified following termination with this completion code group.*

Completion code group: **Deferred Corrective Maintenance**

Corrective maintenance which is not immediately carried out after a fault detection but is delayed in accordance with given rules.

- *The machinery works, but not very well. The job can be scheduled for later.*

Endeavor to move actions from Immediate to Deferred. Initially, this is the quickest way of achieving higher operational reliability and more efficient maintenance.

COMPLETION CODES & COMPLETION CODE GROUPS IMMEDIATE AND DEFERRED CORRECTIVE MAINTENANCE

The completion code is used in this example to show the cause of a fault

Insufficient maintenance

- Fault caused by improper or unsuccessful maintenance

Incorrect operation

- Failure caused by improper handling of equipment or machine

Wear-out-failure

- Failure whose probability of occurrence increases with the operating time or the number of operations of the item or applied stressed

Ageing failure

- Failure whose probability of occurrence increases with the passage of time. This time is independent of the operating time of the item

Failure mechanism

- Physical, chemical or other processes which lead or have led to failure

Secondary failure

- Failure of an item caused either directly or indirectly by a failure or a fault of another item

Production support

- Used for reporting of non-maintenance-related actions, such as assistance in machine adjustments or parameter settings

No fault detected

- Can be used when you have not found any root cause. For example, in event of slippage contact or when the machine starts normally after resetting it

COMPLETION CODE GROUP AND COMPLETION CODES FOR PREVENTIVE MAINTENANCE

Completion code group: **Preventive Maintenance according to procedure**

All existing maintenance activities for preventive maintenance are terminated with a single completion code group; Preventive maintenance according to procedure.

The completion code is used here to monitor how well preventive maintenance is working.

Status OK

- The equipment is in good condition and approved for continued use.

Deviation identified

- Equipment or component does not correspond to the standard or does not maintain satisfactory performance. Follow up with actions by creating a follow-up job.

Status OK (change procedure)

- The equipment is in good condition and approved for continued use, but the procedure or intervals need to be adjusted in the original job/template.

CHARACTERISTICS FOR PREVENTIVE MAINTENANCE

Start with creating a new property to your job category Preventive Maintenance. It should contain a value list using the different types of Preventive maintenance below. Now it's really easy to create a recurrent preventive job of any type.

Create a property in MaintMaster with the name, Type of PM-measure. Add the following captions as values to your list.

Predetermined maintenance

- Preventive maintenance performed at specified intervals or following a specific application, but without prior condition monitoring

Condition-based maintenance

- Preventive maintenance consisting of the control and monitoring of the condition of a unit in terms of its performance and characteristics.

Predictive Maintenance

- Maintenance measure following condition-based maintenance, when predicting a unit's impaired function is based on the analysis and evaluation of key characteristics

Autonomous maintenance

- Maintenance that is performed by the user or operator of the machine

COMPLETION CODE GROUP AND PROPERTY FOR IMPROVEMENT MAINTENANCE

Completion code group: **Improvement**

Create a property containing a value list representing the three captions below. This is to define the type of Improvement performed.

Reliability

- Ability of a unit to perform the required function under given conditions within a specified time frame.

Maintainability

- The ability of a unit, when used under given conditions, to be maintained or restored such that it is able to perform the required function once the maintenance has been performed under given conditions and under established procedures and resources.

Maintenance Supportability

- The ability of the maintenance organization to provide the appropriate maintenance resources to the required location, to perform the required maintenance on a unit at the specified time or within a specified time frame.

COMPLETION CODE GROUP AND PROPERTY FOR MODIFICATION

Completion code group: **Modification**

Create a property containing a value list representing the five captions below. This is to define the type of Modification performed.

Quality

- For reporting an action where the purpose is or was to improve the quality output from a machine or equipment.

Speed

- For reporting on an action where the purpose is or was to improve the speed or cycle time of a machine or equipment.

Product modification

- Used to report an adaption or adjustment of an equipment aimed at producing a new product or packaging.

Personal safety

- Used to report cases where the purpose is to improve personal safety. Including activities for ergonomic improvements.

Environment

- For reporting environmental improvement issues.

PLANNING AND PREPARATION

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HEALTH AND SAFETY MANAGEMENT

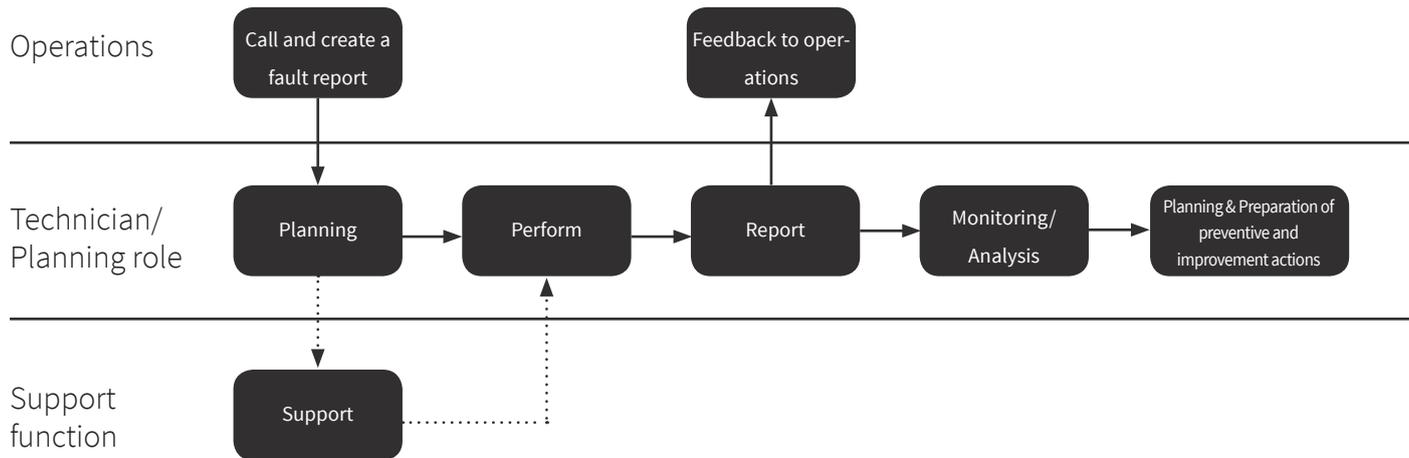
PREPARATION OF MAINTENANCE ACTIVITIES

In order to ensure good-quality, efficient and safe preventive maintenance without unnecessary waiting time, it is very important that such activities are prepared in respect of spare parts, time expenditure and any other resources.

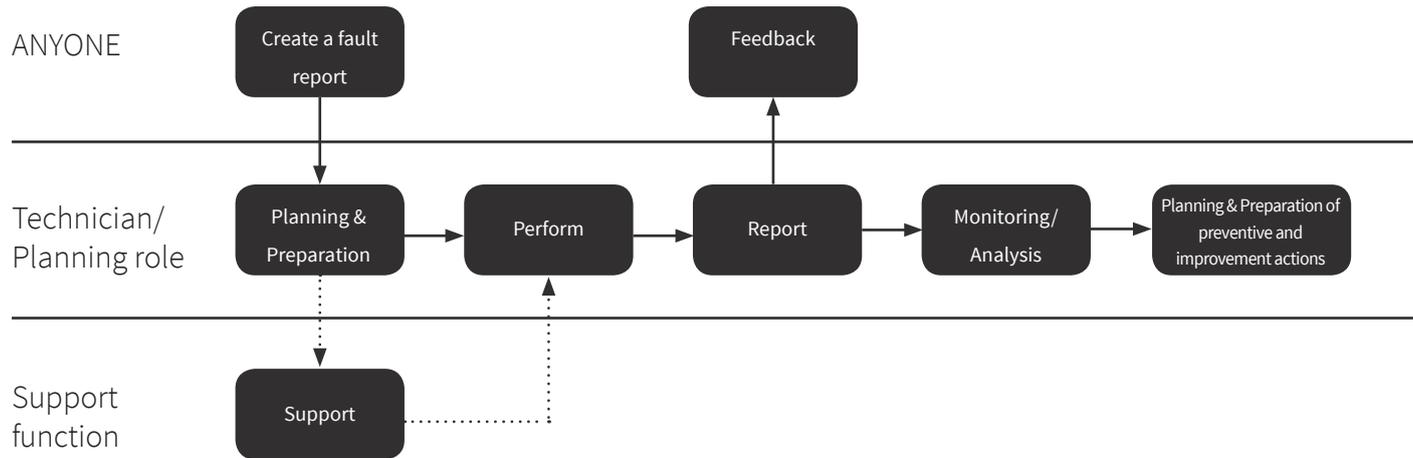
Some of the elements of the preparation work include

- Entering machines and updating the machine directory including picture navigation in the maintenance system.
- Decisions and registration of spare parts to be held in stock and linking them to objects in the maintenance system.
- Entering spare parts requirements and time expenditure for recurring maintenance activities, including autonomous maintenance in to the maintenance system.
- Developing preventive maintenance instructions.
- The labeling of equipment in the form of inventory numbers and lubrication points, etc.
- Registration of changes to machinery and equipment, and updating the related maintenance documentation.

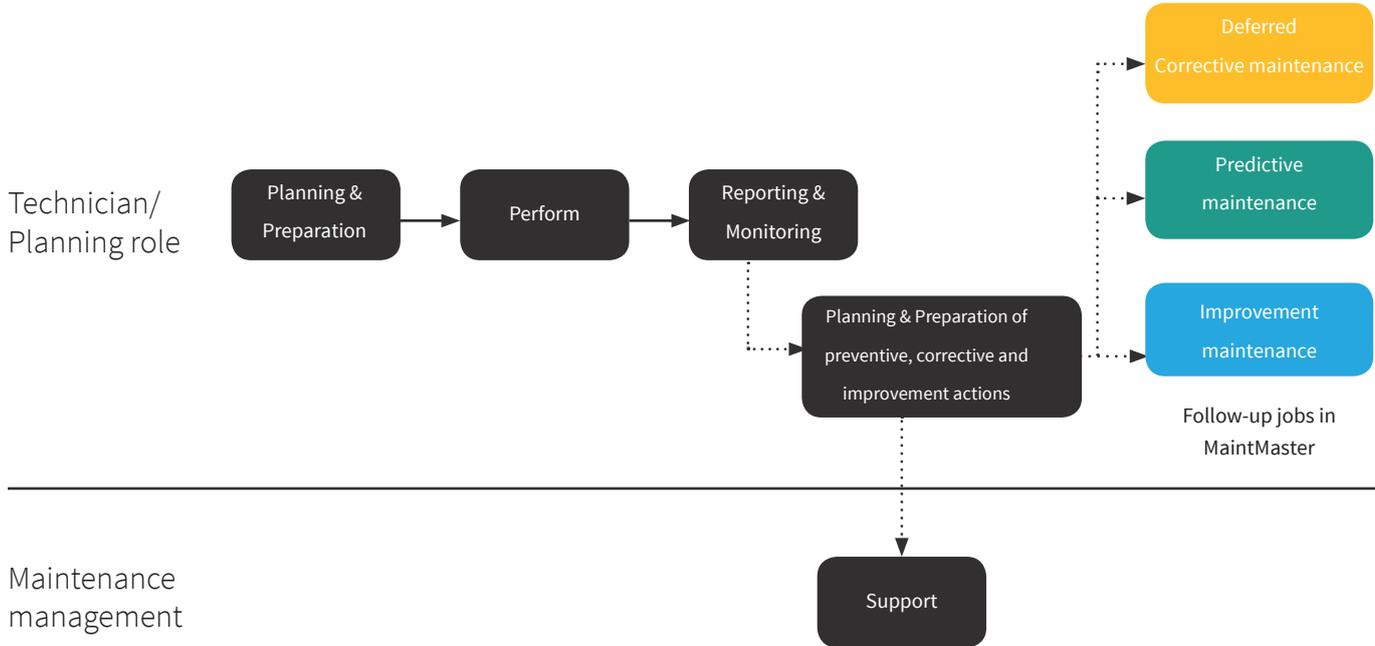
IMMEDIATE CORRECTIVE MAINTENANCE



DEFERRED CORRECTIVE MAINTENANCE



PREVENTIVE MAINTENANCE

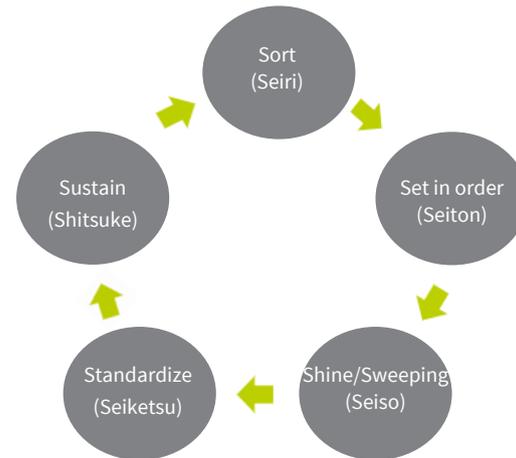


LEAN

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LEAN – 5S

5S is a method to create and maintain an effective, safe and orderly workplace. It is just as easy to implement 5S in an office as in production and it is based on everyone’s participation. 5S comes from five Japanese words which have been translated into English, see explanation below. A workplace that has good order simplifies and reduces the risk of injury significantly. It also provides increased opportunities for better maintenance, and reduces waste as well as changeover times and rejects. But above all, it gives a pleasant workplace and a more stable process.



LEAN – AUTONOMOUS MAINTENANCE

Autonomous maintenance aims to improve the operational reliability of production equipment by establishing a close level of cooperation between maintenance technicians and operators. Operators have unique insights and knowledge of daily operations that are extremely valuable for maintenance. At the same time, maintenance has a unique understanding of maintenance and functionality. By exchanging and transferring knowledge closer to equipment, undesirable variations can be detected in time and actioned before any faults can develop. Maintenance technicians have a really important role as mentors, teachers and coaches in this work.

Involving operators in the implementation of certain maintenance tasks provides greater opportunities for daily checks and weekly maintenance. Examples of maintenance actions that can be performed by operators include controls, lubrication, some replacements and basic repair work.

Autonomous maintenance will also free up time for maintenance staff to do more specialized and improvement maintenance to enhance operational reliability.

Production is responsible for the performance of planned autonomous maintenance according to standard procedures and intervals, the reporting is done according to instructions in the maintenance system. In cases where a deviation is detected during an inspection, it is handled as a follow up job in the maintenance system.

LEAN - SPECIALIST MAINTENANCE

Effective maintenance is aimed at value-creating work from preventive, planned and improvement perspectives. Work requiring immediate corrective action is regarded as a quality deficiency, and actions are taken to reduce the risk of a recurrence recurring. An important aspect for ensuring that specialist maintenance functions well, involves coordinating the work with work performed by operations personnel.

Specialist maintenance is goal-oriented maintenance that continually improves dependability based on the needs of production, by measuring and managing operations in relation to the results. This is created by standardizing how improvement work, goal-oriented management and performance measurement are conducted, as well as incorporating continuous optimization of the existing maintenance plans.

Below are examples that can be included as part of specialist maintenance

- Goal-oriented management and monitoring using key performance indicators
- Budget work
- Standardized working method
- Corrective and preventive maintenance
- Planning and preparation of maintenance actions
- Maintenance strategy
- Analysis (6-sigma, FMEA, SPL, Root cause analysis)
- Skills development
- Vibration and oil analyses
- Thermography
- Spare parts management
- Documentation
- LCC (Life Cycle Cost)

SPARE PARTS MANAGEMENT

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SPARE PARTS MANAGEMENT

Spare parts management is about, how spare parts handling must be systematized and structured to enable efficient inventory management that leads to improved availability and reduces the amount of capital expenditure.

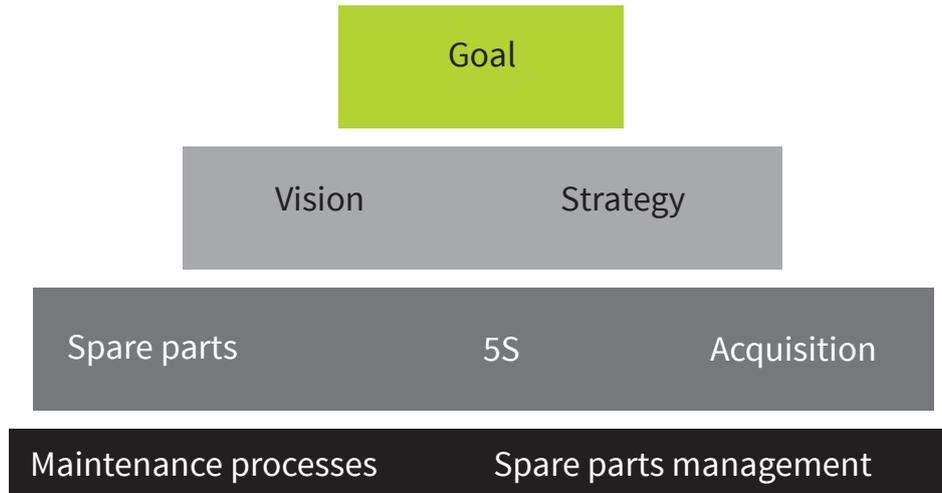
Maintenance often results in some form of material consumption. A breakdown often entails major problems that can be further aggravated if no spare parts are available.

Without spare parts, there is a risk of downtime, which may lower the quality of goods produced, cause environmentally hazardous emissions and create a hazard to staff. This usually leads to the accumulation of an excessive amount of spare parts, which often leads to large amounts of capital expenditure. It could also be that it is difficult to plan spare parts consumption as it is subject to varying demand. Therefore it is important to have a good spare parts inventory system in place. This reduces the production downtime and simplifies equipment maintenance. The goal of spare parts management is to ensure the lowest overall cost possible.

The total cost includes inventory, administration and various forms of shortage costs.

SPARE PARTS MANAGEMENT

The pyramid shows the various aspects of spare parts management.



EXAMPLE SPARE PARTS MANAGEMENT – VISION

- *The selected methods, systems and all employees must work together to achieve a cost-effective spare parts inventory.*
- *We have clear, tangible KPIs that reflect how well we are implementing working methods and cost savings in the stockroom.*
- *Spare parts management is a strong contributory factor to improved availability in production.*
- *We work in a structured way to ensure good order in all of our stockrooms, where the labeling of items is also clear and functional.*

EXAMPLE SPARE PARTS MANAGEMENT – STRATEGY

- *Our spare parts strategy is based on guaranteed access to the right spare parts at the right time, not all spare parts always.*
- *Items are recorded and linked to objects in the maintenance system by the technicians. The withdrawal of consumables and insurance spares are each recorded with a direct link to the job in the maintenance system.*
- *In order to optimize storage we work with requirements assessment and classification of items to determine whether spare parts should be stored or acquired when the need arises.*

OBJECTIVES & KEY PERFORMANCE INDICATORS FOR SPARE PARTS MANAGEMENT

The objective of spare parts management is to ensure the lowest overall cost of spare parts possible without compromising availability.

A high level of availability requires spare parts to be available or for the delivery time to be as short as possible. In cases where faults still arise, it's necessary to identify and correct them as soon as possible. The overall cost includes costs for warehousing, administration and various types of shortages.

Some examples of KPIs used to measure spare parts management include:

- Stock value and quantity
- Number of emergency orders
- Value of scrapped material
- Overall cost (warehousing costs + shortage costs)
- Downtime (due to lack of spare parts)
- Warehousing costs
- Turnover rate (excluding insurance spare parts)

SPARE PARTS MANAGEMENT

Assessing the need for spare parts

Maintenance activities often entail the need for replacement part availability in the warehouse. Accordingly, it's advisable to stock selected spare parts to avoid unnecessary production downtime caused by long lead times. Articles are registered and linked to objects to shorten lead times when ordering. For recurring maintenance activities, such as predetermined maintenance, spare parts should be ordered for the scheduled activity instead of keeping them in stock. Costs for stock held should be weighed against costs incurred by their lack, but there are several other factors that must be considered in an accurate needs assessment.

Examples of data for needs assessments:

- Consumption statistics
- Supplier collaboration
- Commitment from maintenance technicians and management
- Classification of spare parts

ASSESSING THE NEED FOR SPARE PARTS

Classification of spare parts

To facilitate efforts to optimize inventory, items are divided into the following categories:

Consumable materials

- Items that cannot be regarded as spare parts and can have a high rate of consumption or low value.

Consumable spare parts

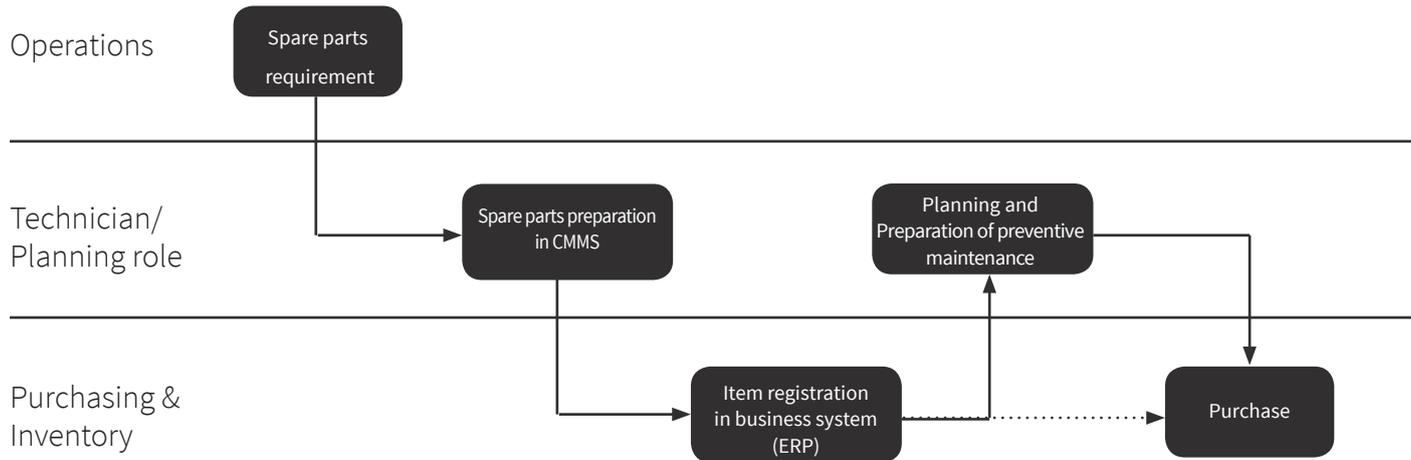
- Standard items such as sensors, cylinders and valves that can be used on multiple types of equipment; they are often of low value and have short lead times.

Insurance spare parts

- Spare parts stocked to avoid long and costly shutdowns. These can be expensive and often have long lead times

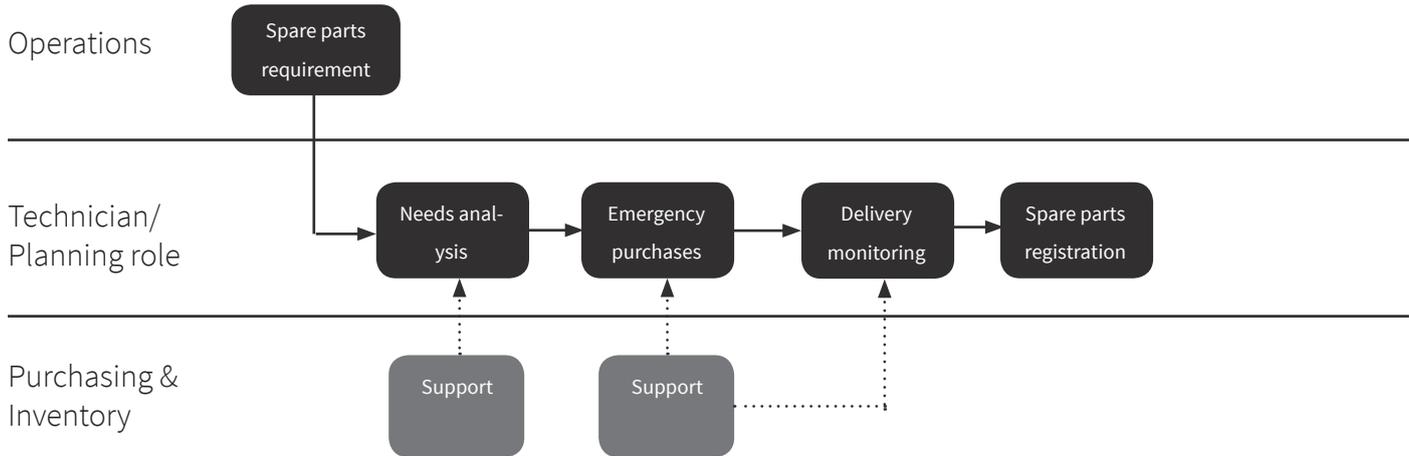
SPARE PARTS PREPARATION AND REGISTRATION

The process chart below shows the responsibilities and procedures for the registration and purchase of spare parts under normal conditions. The technician responsible for preparation is also responsible for ensuring the preparation of spare parts for the line or equipment within the designated area of responsibility Support for this work may be requested from maintenance management.



EMERGENCY SPARE PARTS NEEDS (items not stocked)

The process chart below shows the allocation of responsibilities and procedures for the registration and purchase of spare parts in an emergency situation. Responsibility for an emergency purchase lies with maintenance management or the department manager, while fact compilation and ordering is delegated to maintenance technicians who can request support from maintenance management.



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SYSTEMATIC HEALTH AND SAFETY MANAGEMENT

Safe maintenance

Maintenance seeks to reduce disruptions and stoppages in production, and under your National Work Environment Act, work must be planned and arranged such that it can be conducted in a healthy, safe environment. Any extraordinary work such as repairs due to a machine breakdown, must also be planned and prepared such that it does not pose a risk to maintenance technicians or people in the vicinity. Machinery, equipment and other technical devices must be constructed, located and used such that adequate safety is provided to prevent ill health and accidents.

Responsibility for coordination

Sub-contractor activities always need someone within your organization ordering/approving the job. It must be clearly determined who's responsibility for coordination in work carried out by subcontractors. The individual responsible for coordination must schedule the work and make sure responsibility for protective devices, cordons and other protective measures such as hot works is clearly defined between the responsible and the sub-contractor. Communication and joint planning are necessary to reduce any risks that may arise over the course of maintenance in progress. The dedicated responsible is also responsible for ensuring the subcontractor is acquainted with, and complies with applicable rules and regulations.

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MaintMaster and the maintenance standard
a perfect match!

