Information Technology Support Service

Level II

Learning Guide 36

Unit of Competence:	**Implement Maintenance Procedure**
Module Title:	**Implementing Maintenance Procedure**
LG Code:	**ICT ITS2 LO4-LG-36**
TTLM Code:	**ICT ITS2 MO2 TTLM 1019v**

LO4: Apply maintenance procedures

Instruction Sheet	Learning Guide # 36

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Identifying Equipment and software to be maintained and implemented
- Identifying Vendor documentation, peer organizations or research information
- Obtaining user Requirements
- Documenting maintenance procedure

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Identify Equipment and software to be maintained and implemented processes to ensure future acquisitions of equipment and software.
- Identify Vendor documentation, peer organizations or research information detailing best practices in equipment and software maintenance to improve system performance and reliability.
- Obtain Requirements from user in the area of equipment maintenance and reliability.
- Document Procedures for maintenance based upon best practices.

Learning Activities

1. 1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 , Sheet 4, sheet 5” **in page -1-7,9-12, 14-15,17,20-23**.
4. Accomplish the “Self-check 1, Self-check 2, and Self-check- 3, Self-check-4 and Self-check-5 **in page 8,13, 16,18 and 24** respectively

Information sheet-1	Creating Preventive Maintenance schedule

1.1. Basics of Preventive Maintenance and Troubleshooting

Preventive maintenance is a regular and systematic **inspection**, **cleaning**, and **replacement** of worn parts, materials, and systems.

Purpose of preventive maintenance

Reduce the likelihood of hardware or software problems by systematically and periodically checking hardware and software to ensure proper operation.

Reduce computer down time and repair costs

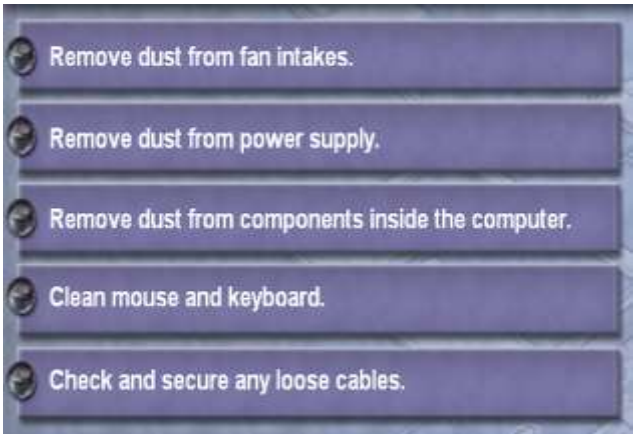
Troubleshooting is a systematic approach to locating the cause of a fault in a computer system.

- Troubleshooting is a learned skill.
- Not all troubleshooting processes are the same, and technicians tend to refine their own troubleshooting skills based on knowledge and personal experience.

- **Hardware Maintenance**

Make sure that the hardware is operating properly.

- Check the condition of parts.
- Repair or replace worn parts.
- Keep components clean.
- Create a hardware maintenance program.

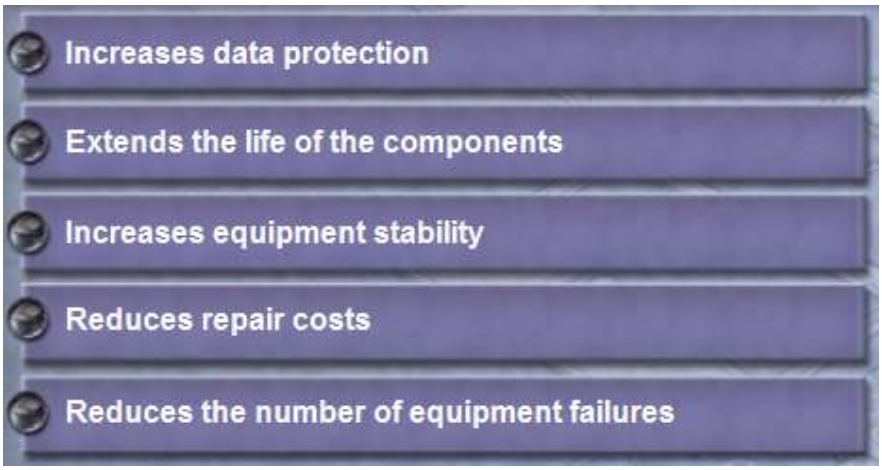


- **Software Maintenance**

- Review updates
- Follow policies of your organization
- Create a schedule

Preventive Maintenance Benefits

- Reduce computer down time.
- Reduce repair costs.
- Reduce loss of worker productivity.



The Troubleshooting Process

- Follow an organized and logical procedure.
- Address possible issues one at a time.
- Troubleshooting is a skill that is refined over time.
- The first and last steps involve effectively communicating with the customer.

Data Protection

Check with customer

- Date of the last backup
- Contents of the backup
- Data integrity of the backup
- Availability of media for data restore

If no backup can be created, ask customer to sign a release form

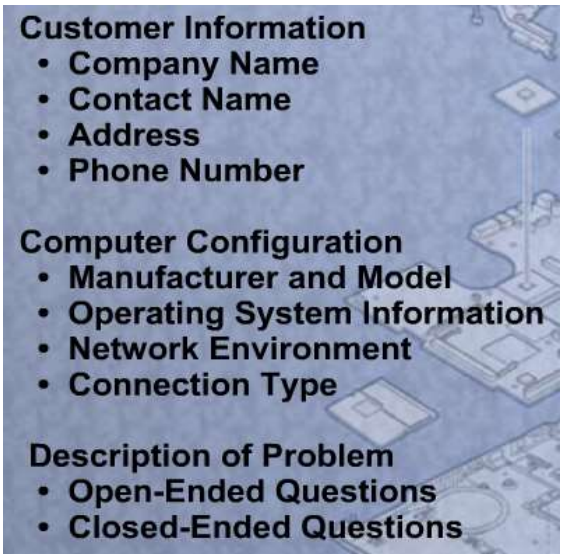
Gather Data from the Customer

- Communicate respectfully with the customer
- Start with open-ended questions

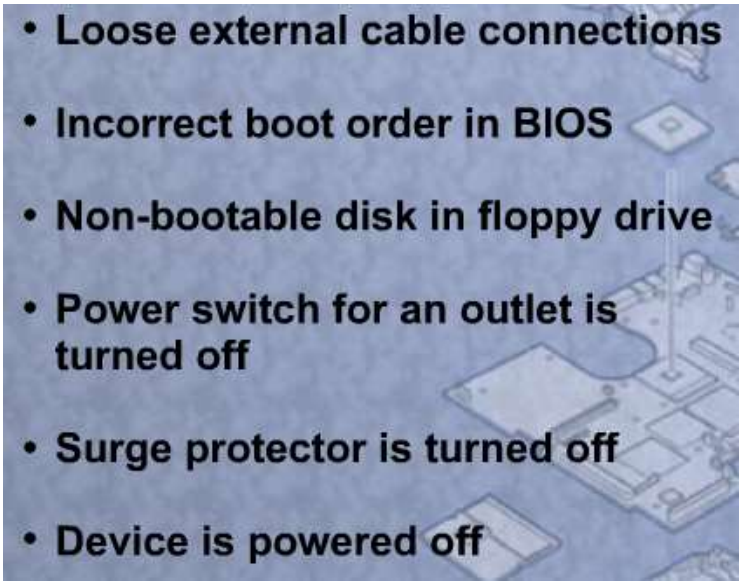
“What types of problems are you having with your computer or network?”

- Then, ask closed-ended (yes/no) questions

“Have you changed your password recently?”



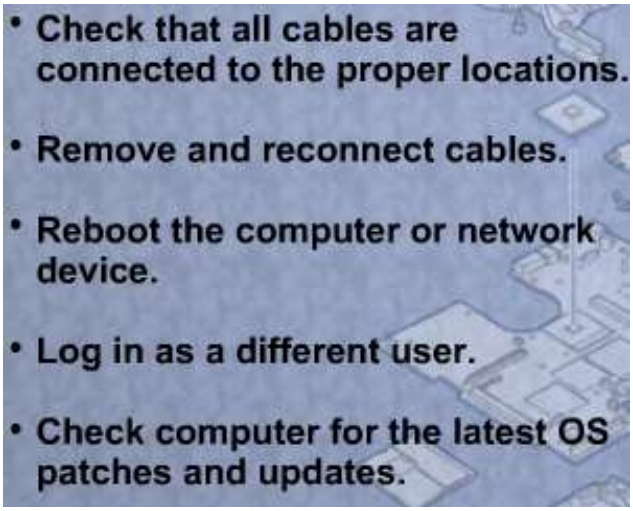
Verify Obvious Issues



- Problem may be simpler than the customer thinks.
- Checking for obvious issues can save time.
- If this step turns up nothing, continue to the next step of the troubleshooting process.

Try Quick Solutions

- May provide additional information, even if they do not solve the problem.
- Document each solution you try.
- May need to gather more information from the customer.
- If you find the problem at this stage, document it and proceed to the end of the troubleshooting process.



Gather Data from the Computer

- When system, user, or software errors occur on a computer, the **Event Viewer** is updated with information about the errors:
  - What problem occurred
  - The date and time of the problem
  - The severity of the problem
  - The source of the problem
  - Event ID number
  - Which user was logged in when the problem occurred
- Although this utility lists details about the error, you may still need to research the solution.

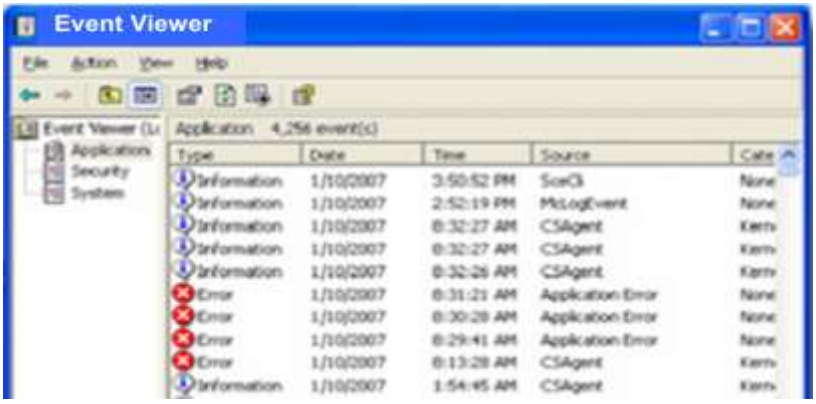


Fig 1.1. Event viewer window

Gather Data from the Computer

Device Manager

- A flag of ! indicates the device is acting incorrectly.
- A flag of X indicates the device is disabled.

Figure 1.2. Device manager window

Gather Data from the Computer

- When troubleshooting, power on the computer and listen to the **beep code sequence**. Document the beep code sequence and research the code to determine the specific hardware failure.
- If the computer boots and stops after the POST, investigate the **BIOS settings** to determine where to find the problem. Refer to the motherboard manual to make sure that the BIOS settings are accurate.
- Conduct research to find software to use to diagnose and solve problems. Often, manufacturers of system hardware provide **diagnostic tools** of their own.

Evaluate the Problem, Implement the Solution

- Research possible solutions:
- Prioritize solutions to try.
- Try easiest solutions first.
- After an unsuccessful try, undo any changes you have made.

Unnecessary changes could complicate finding the solution

Close with the Customer

- Discuss the solution with the customer
- Have the customer confirm that the problem has been solved
- Document the process

Problem description

- Solution
- Components used
- Amount of time spent in solving the problem

Summary

- Regular preventive maintenance reduces hardware and software problems.
- Before beginning any repair, back up the data on a computer.
- The troubleshooting process is a guideline to help you solve computer problems in an efficient manner.
- Document everything that you try, even if it fails. The documentation that you create will become a useful resource for you and other technicians.

Fig 1.3. ICT equipments

Ref. Cisco | Networking Academy® Mind Wide Open™

Self-Check 1	**Written Test**

Name:_____ Date:_____

Instruction: Answer all the questions listed below, if you have some clarifications- feel free to ask your teacher.

Please ask your trainer the answer key for this Self-Check.

I. Choose the correct answers from the given alternatives

1. Event Viewer is holds:

A. What problem occurred C. The severity of the problem

B. The date and time of the problem D. All

2. The Troubleshooting Process

A. Follow an organized and logical procedure.

B. Address possible issues one at a time.

C. Troubleshooting is a skill that is refined over time.

D. All

3. Which one is not Preventive Maintenance Benefits

A. Increase equipment stability

B. Decreases life time of the components

C. Increase Data protection

D. All

4. Preventive maintenance is a regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems.

A. True B. False

5. In a Device Manager A flag of "!" indicates the device is

A. Working Correctly

B. Installed and functional

C. Acting incorrectly

D. All

Note: **Satisfactory rating - 3 points, Unsatisfactory - below 3 points**

You can ask you teacher for the answer key

Information sheet-2	Identifying and applying maintenance procedures

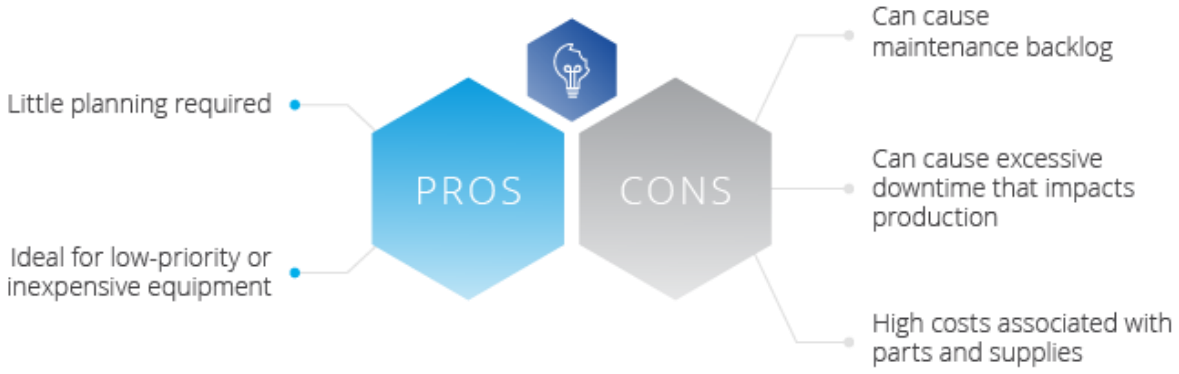
2.1. **Types of maintenance**

- **Reactive maintenance (breakdown maintenance)**

Also known as breakdown or run-to-failure, reactive maintenance is pretty simple: fix things when they break. Since repairs are not planned, it's a good method to employ for equipment that is not essential for operations or has a low cost (think anything that's rarely used or duplicates the function of other equipment).

For example, think of a $1000 belt feeder, whose lifetime value can be extended by 10% by servicing it every 3 months. How hard are you willing to work to save $100? For a non-critical piece of machinery, the answer should be "not hard"."

While it requires minimal planning, the drawbacks of reactive maintenance can be substantial if it's not carried out correctly. If the approach is used for all equipment, there can be huge delays in production when a critical piece of equipment fails. Further, if you don't have the right parts and supplies on hand, the costs for rushed shipping can become significant. In short, reactive maintenance often means more downtime and higher maintenance costs when it's not used strategically.



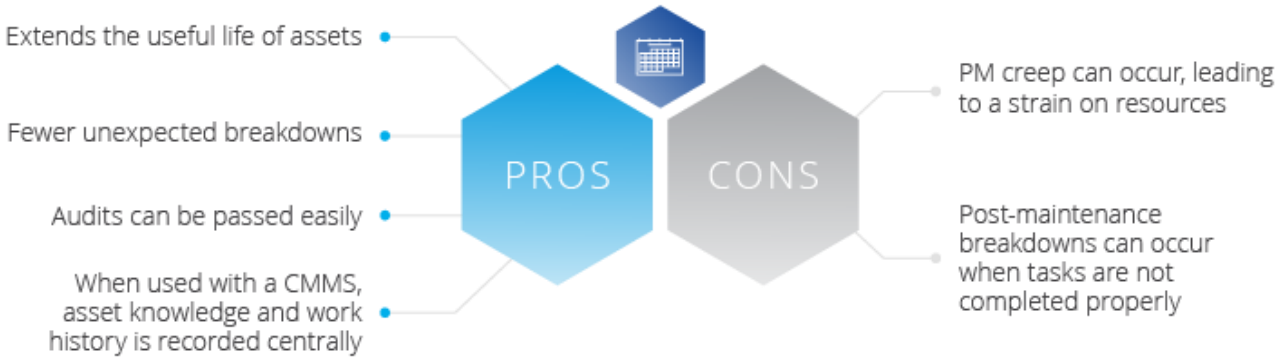
- **Preventive maintenance (scheduled)**

Also known as proactive maintenance, this method involves periodically taking assets offline and inspecting or repairing them at predetermined intervals (usually time or event-based triggers). The goal of this approach is to extend the useful life of an asset and prevent breakdowns from occurring.

Many organizations employing preventive maintenance use CMMS software to trigger work orders when a PM is due. This allows a facility to automate much of its scheduling efforts, which is a key ingredient of this preventive approach. Because planning is done in advance, it's much easier to have the right parts and resources on hand to complete each task.

With all maintenance types, there are potential drawbacks to relying solely on preventive maintenance. If the PM schedule isn't regularly monitored, audited, and improved, "PM creep" can occur. This is when technicians get bogged down by unnecessary tasks and cost the organization time and money.

Similarly, performing too many PMs can open the door for post-PM breakdowns. There are a number of ways to prevent this, but the risk gets higher as PMs get more frequent. The bottom line is, if a preventive maintenance program is used, it should go hand in hand with PM optimization.



- **Predictive maintenance (PdM)**

Predictive maintenance (PdM) aims to predict failures before they happen so maintenance can occur at just the right time. PdM uses data from machine sensors and smart technology to alert the maintenance team when a piece of equipment is at risk of failing. For example, a sensor may use vibration analysis to alert the maintenance team that a piece of equipment is at risk of failing, at which point it will be taken offline, inspected, and repaired accordingly.

It is possible to carry out PdM via visual inspections of equipment, but the easiest way to establish a predictive maintenance strategy is by using a CMMS to track meter readings. The advantage of PdM (over PM) is the potential for cost savings from reduced man-hours spent on maintenance, and more insight as to the performance and potential issues arising with the machine. Additionally, a reliance on

data and sensor information means maintenance is determined by the actual condition of equipment, rather than a best-guess schedule or gut feel.

Of course, relying so heavily on data means that there is a higher up-front cost to ensuring this maintenance approach can thrive. Another thing to keep in mind with predictive maintenance is that you have to walk before you can run. For an organization coming from a pen-and-paper or Excel-based maintenance program, you have to first build on the processes and insights that preventive maintenance provides in order to build an effective predictive maintenance plan.

- **Reliability-centered maintenance (RCM)**

Reliability-centered maintenance (RCM) addresses the fact that failure is not always linear. RCM is a highly-involved process that seeks to analyze all the possible failure modes for each piece of equipment and customize a maintenance plan for each individual machine. The ultimate goal of RCM is to increase equipment availability or reliability.

RCM is considered complex because each individual asset must be analyzed and prioritized based on criticality. The most critical assets are those that are likely to fail often or will result in large consequences in the event of failure. Because each piece of equipment is analyzed on its own, it's possible that the end result of embarking on an RCM effort is having as many different maintenance plans as you do pieces of equipment.

RCM is very sophisticated, to the extent where it is not a realistic or necessary technique for every organization. It's requires a very mature maintenance team that has mastered prevention, basic inspections, predictive maintenance, and has access to lots of existing data on their assets.

Maintenance management strategies comparison chart

Need a quick comparison of these four strategies? Check out the chart below for a quick rundown of each approach.

Maintenance strategy comparison chart				
Strategy	Summary	Cost to Implement	Pros	Cons
Reactive	Fix it when it breaks	Low	Ideal for low-priority equipment	Can lead to runaway repair costs
Preventive	Maintenance on a predetermined schedule	Average	Best strategy to implement without expertise	Without optimization, “PM creep” can occur
Predictive	Condition-based monitoring triggering work orders	High	Timely and informed monitoring. More insight into causes of breakdowns	Can be expensive to set up
RCM	Investigation of failure modes to determine best maintenance strategy	Highest	If executed properly, provides the most efficient maintenance schedule	Requires time, skill and financial resources to be effective

Table. 2.1 Maintenance Comparison Chart

Ref. *Maintenance strategies: 4 approaches to asset management*

Self-Check 2	**Written Test**

Name:_____ Date:_____

Instruction: Answer all the questions listed below, if you have some clarifications- feel free to ask your teacher.

Please ask your trainer the answer key for this Self-Check.

I. Write True if the statement is True and Write False if the statement is incorrect

1. Predictive maintenance aims to predict failures before they happen so maintenance can occur at just the right time.
2. RCM is very sophisticated, to the extent where it is not a realistic or necessary technique for every organization
3. Predictive Can be expensive to set up
4. Reactive maintenance often means more downtime and higher maintenance costs when it's not used strategically.

Note: **Satisfactory rating - 3 points, Unsatisfactory - below 3 points**

You can ask you teacher for the answer key

Information sheet-3	Documenting recommended procedures and submitting for Approval

1.1. Understanding Document Approvals

Document approvals are formalized processes that you use to track the development of a whole document. Using document approvals, you can route documents for approval, monitor the approval process from person to person, log who approved or denied the document, and review suggestions that they made about the document. The process facilitates a more detailed control of a document and helps ensure that the contract is within standards of individuals and groups in an organization.

Supplier Contract Management provides a sample approval process definition as a starting template process for the document and the clause approval workflow processing. Application administrators can define approval framework configurations to support an organization's internal processes.

Document approvals use approval framework. For document approvals, the approval process ID that you use must be named Document. The approval framework supports multiple approvers who can be notified at the same time, creating parallel approval paths. Approvers can approve or deny transactions and assign ad hoc reviewers or approvers for the transaction. When the approval process is complete, the system updates the document as approved or rejected. Supplier Contract Management also incorporates an optional clause-level approval stage so that the system can automatically include appropriate individuals in an approval process based on the presence or modification of specific contract clauses.

During the approval process, approvers can add other approvers or reviewers to the current or a later stage of the approval process. For example, if an author wants input from an inventory analyst, she can add the analyst as an approver. This is called ad hoc approval. It applies only to the approval instance in which the addition occurs and does not affect the overall approval flow. Only the approver who adds an ad hoc approval can delete it.

An author can also be a document approver. Document writters approving their own documents are called self-approval. A check box setting on the Approval Process Definition page enables self-approval. If self-approval is enabled, the author's approval is assumed and the process continues; however, you can establish criteria that help control the author's approval authority. For example, you can place a limit on the monetary amount for which the author writes a document so that if the transaction is over that amount, the author cannot be an approver.

An administrator can manage approvals by reassigning those that do not have alternates defined for their approval. You can enter criteria to limit the number of approvals that the system displays.

The approval processing of documents can also include enabling internal users to digitally sign documents at the same time they approve the document if the installation and document type settings dictates signatures are to be captured for this document during approvals. You can configure the system to capture internal signatures before, during, or after approvals.

.**Preview Approval**

Select to view a list of approvers based on the approval process definition.

Submit for Approval

Select to immediately start the approval process. After starting the approval process, the system displays another Document Approval Status page with the new approval status. Using the page you can:

- Review approvers and reviewers.
- Review approval process stages and paths.
- Make comments about the document before continuing the approval process.
- Add approvers and reviewers.
- Start new approval paths.
- Cancel the approval process.

Ref.

Schuh, G., Lorenz, B., ‘TPM – eine Basis für die wertorientierte Instandhaltung‘, Betriebliche Instandhaltung, Springer Verlag, Berlin Heidelberg, 2009.

Self-Check 3	Written Test

Name:_____ Date:_____

Instruction: Answer all the questions listed below, if you have some clarifications- feel free to ask your teacher.

Please ask your trainer the answer key for this Self-Check.

I. Write True if the statement is True and Write False if the statement is incorrect

1. Document approvals are formalized processes that you use to track the development of a whole document
2. Document writers approving their own documents are called self-approval
3. During the Document approval process, approvers can't invite other approvers or reviewers
4. Document approvals use approval framework

Note: **Satisfactory rating - 3 points, Unsatisfactory - below 3 points**

You can ask you teacher for the answer key

Information sheet-4	Giving Orientation to staffs to implementing maintenance procedures

Why is Orientation Important?

Orientation is important because it lays a foundation for the users in the department. First impressions are important since they establish the basis for everything that follows. Without orientation, users sometimes feel uncomfortable in his/her activities and take longer to reach his/her full potential.

Orientation is important because it:

- Provides the users with concise and accurate information to make him/her more comfortable in the job;
- Encourages users confidence and helps the new user adapt faster to the job;
- Contributes to a more effective, productive workforce;
- Improves users retention; and
- Promotes communication between the technical person and the users.

Ref.

1. European Agency for Safety and Health at Work (2011), Risk assessment. Retrieved 24 February 2011, from:
2. Schuh, G., Lorenz, B., ‘TPM – eine Basis für die wertorientierte Instandhaltung‘, Betriebliche Instandhaltung, Springer Verlag, Berlin Heidelberg, 2009.

Self-Check 4	Written Test

Name:_____ Date:_____

Instruction: Answer all the questions listed below, if you have some clarifications- feel free to ask your teacher.

Please ask your trainer the answer key for this Self-Check.

I. Write True if the statement is True and Write False if the statement is incorrect

1. Orientation is important because it contributes to a more effective, productive workforce.
2. Without orientation, users sometimes feel uncomfortable in his/her activities and take longer to reach his/her full potential.
3. Orientation is given only in maintenance procedure implementing

Note: **Satisfactory rating - 2 points, Unsatisfactory - below 2 points**

You can ask you teacher for the answer key

Information sheet-5	Observing OHS throughout the process

5.1. **Overview of OHS**

For smooth, safe and successful maintenance work a prior risk assessment has to be carried out. A risk assessment is a careful examination of what could cause harm to people, allowing one to judge whether there are enough precautions in place or more if more are needed to prevent harm. It involves identifying the hazards present in any undertaking (whether arising from work activities or from other factors, e.g. the layout of the premises) and then evaluating the extent of the risks involved, taking into account existing precautions Potential hazards could be: dangerous substances, confined spaces, working at height, awkward positions, plant under pressure, moving parts of machinery, unexpected start-ups, chemical substances or dust in the air, stress, communication problems, etc. Outsourcing and subcontracting should be afforded special consideration and the risk assessment should include both perspectives as well as any problems with work arrangements and communication.

The results of a suitable and sufficient risk assessment should enable to choose which good practice measures are most appropriate in preventing risks in general and also in preventing risks to any individuals identified as being particularly at risk. The implementation may mean making changes to the organization and working procedures, working environment, equipment and products used. Changes could also be necessary in training management and staff as well as improving communications.

Employees and their representatives should be involved in the carefully planned adoption of any policies and measures, as a key component of success. This should include coordination and communication between the contractor and service company personnel. The general principle, also laid down by the respective EU directives, is that risks should be prevented at source and that work organization, tasks, equipment and tools should be adapted to workers in order to eliminate and reduce risks. Measures should follow the prevention hierarchy:

- Elimination of risks
- Substitution e.g. of dangerous substances
- Collective control measures like exhaust systems
- Individual control like personal protective equipment

This means for example that personal protective equipment has only to be seen as last resort. There have to be periodic reviews to check that measures, policies and procedures remain appropriate and are working and revised if necessary[2].

Special issues, qualification

Based on the conducted risk assessment the following issues need special attention:

- A qualification level has to be determined for the specific repair and maintenance tasks. It may be necessary to put a permission system in place, only giving specifically trained people access to sensitive and dangerous areas. The issuing of permits for work and lock-off systems has also to be considered. A permit to work should detail the work to be done and the precautions to be taken.
- Enough time and appropriate resources have to be allocated. Stress and unsuitable tools may lead to errors, unsafe situations and prolonged down times.
- Coordinating panels involving the service company have to be set up while the means and paths of communication between all stakeholders need to be established carefully. Comprehensive instructions should be provided. For complicated tasks written work orders should be issued and discussed with the workers.

Ensuring instructions, qualification and further education of the workers performing maintenance tasks is another important planning issue. With buildings and machines becoming more and more sophisticated, and maintenance also being seen as a means to improve technology, maintenance staffs need to keep up with this development. Employees should be given the opportunity to not only develop their knowledge but to also bring in their experience. This is all the more important as maintenance tasks can always bring about situations of unplanned and unforeseeable danger and workers need to make use of all their knowledge and skills to manage these situations safely. It also plays an important role in changing risky behaviour on behalf of the workers. However, in this aspect it is also of utmost importance that all superiors set a good example and always follow the determined rules themselves.

It might also be necessary to seek advice from outside experts, if the company does not have sufficiently qualified personnel.

Maintenance workers and their representatives should already in the planning stage look to it, that the outsourcing issue is considered sufficiently:

- Outside workers are usually less familiar with the company-specific layout and construction of machinery and plants; special instructions are needed.
- Communication between own and outside workers may be problematic with regards to time, language and organisation; special monitoring as to understanding of measures is necessary.
- Coordination of production and maintenance work becomes more difficult; contact persons, deputies have to be identified and time schedules set up to ensure they are on site during the maintenance work.

Providing a safe work area

Only authorized personnel should be allowed to do repair or maintenance work. This becomes all the more important when the machines and structures are more sophisticated. Only then can it be guaranteed that the right steps are followed and the correct equipment is used.

The work area needs to be secured by preventing unauthorized access, for example, by using barriers and signs and safe routes, which have to be established for workers to enter and exit the work area.

Structures and machines have to be cut off from any energy sources, such as power supplies and pressure hoses using special locks, whereby only the maintenance workers and their supervisors have the keys necessary for doing this. Warning signs should be attached to machinery, with the date and time of lock-off, as well as the name of the person authorized to remove the lock. In this way, the safety of the worker performing the maintenance on the machine will not be jeopardized by another worker inadvertently starting it up .

Any residual energy should be safely discharged (e.g. an exhaust system for decompression of gases and liquids may be necessary) and it should be considered that some machine parts may need additional time to move into their home position. This has to be indicated in the machine's manual. The essential health and safety requirements of machines and plants have to be met with regards to maintenance. They have been established by the Council Directive 2006/42/EC on machinery [15].

Sometimes, it can be necessary to conduct the repair or maintenance work at running machines. In this case special measures have to be taken:

- The normal safeguards should be in place and should be used.
- If that is not possible, special protection devices have to be used (special tools, mobile switches), the speed of the machine has to be reduced, and special covers for dangerous areas have to be provided.

- If this should, in some very special cases, not be possible, special measures have to be taken based on a detailed risk assessment. Supervision must be provided throughout the process.

Allocating appropriate equipment

According to statistical data, the next largest cause of accidents during maintenance – after 'getting injured at running machines' – is, 'falling from heights'. This clearly shows that in addition to improving the design of structures, machines and plants in order to provide easier access for maintenance and repair, it is very important that maintenance workers have safe access to and safe work platforms at their place of work. Ranked in hierarchical order, the following measures are recommended:

- Stationary steps (fitted with slip resistant material) and work platforms with guards (secured against unauthorized access)
- Scaffolds (providing proper stability and structural safety)
- Mobile elevating work platforms
- Properly installable special work platforms for specific fork lifts
- Safety ladders (if possible, fitted with special working platforms)
- Personal protection equipment against falling.

Maintenance work often requires contact with a variety of substances, many of them hazardous:

- Cleaning and lubricating agents should be selected carefully e.g. using selection tools such as GISBAU CatSub or Clean tool, in order to use substances with the least impact on human health.
- During the work time, gases, smokes and vapors may occur, e.g. by releasing pressure, cleaning surfaces or welding and soldering. When appropriate, quantitative measurements should be taken. Workers or supervisors can also be equipped with test tubes. Appropriate exhaust systems have to be put in place and comfortable personal protection equipment has to be provided.
- If liquids flowing from machines or plants cannot be avoided during maintenance work, workers have to have proper instructions and equipment to handle these (exhaust, skin protection, etc.).
- Work often produces or raises dust. The risk assessment will indicate as to whether there is any asbestos risk present (brake linings, sealing, insulations). In this case, very special measures have to taken.

- Flammable substances as well as welding and soldering will also involve the danger of fires and explosions. (dust too, when getting airborne, can lead to explosions). This requires special equipment (e.g. non-sparking tools) and related instructions.

References

3. VMBG – Vereinigung der Metallberufsgenossenschaften, ‘Instandhaltung – schnell aber sicher‘, Mitteilungsblatt Gesund+Sicher, Juni 2001.
4. EU-OSHA – European Agency for Safety and Health at Work (2011), Risk assessment. Retrieved 24 February 2011, from:
5. Schuh, G., Lorenz, B., ‘TPM – eine Basis für die wertorientierte Instandhaltung‘, Betriebliche Instandhaltung, Springer Verlag, Berlin Heidelberg, 2009.

Self-Check 4	**Written Test**

Name:_____ Date:_____

Instruction: Answer all the questions listed below, if you have some clarifications- feel free to ask your teacher.

Please ask your trainer the answer key for this Self-Check.

I. Write True if the statement is True and Write False if the statement is incorrect

1. A risk assessment is a careful examination of what could cause harm to people, and equipments
2. Any person can repair or maintain equipments in the organization.
3. The work area needs to be secured by preventing unauthorized access
4. Warning signs should be attached to machinery, with the date and time of lock-off, as well as the name of the person authorized to remove the lock.

Note: **Satisfactory rating - 2 points, Unsatisfactory - below 2 points**

You can ask you teacher for the answer key