

## Preventative maintenance for maximum up-time

Keeping a close eye on wear and tear is an indispensable part of the mining process, coupled with rapid action when infrastructure and equipment need attention. For this, planning and reporting systems have a striking effect.



*Ongoing preparation of road in production area.*

There is widespread appreciation among modern mining companies for the role of preventive maintenance in the mining process. This has become especially apparent in recent years with the constantly increasing level of technology associated with mining equipment, coupled with a growing scarcity of skilled labour.

Preventive maintenance as a means of avoiding disturbance to operations and costly downtime is beyond dispute. The high availability of equipment that this provides is crucial for production reliability, which enables mining companies to follow their plans and meet their targets.

As in many other industries, maintenance is equally important when it comes to facilities and infrastructure. Roads, workshops, shafts, hoists, ramps and all other components of a mine need continuous attention in order to safeguard not only productivity but a reliable working environment.

Although it is true to say that a great deal of progress has been made in this area around the world, there is still a lot of room for improvement.



*A dry, well-lit and well-equipped central workshop in an underground mine.*

## **Quality in all areas**

To achieve maximum efficiency in service and maintenance, it should not be regarded as an isolated function but rather as an integral part of a process in which all components interact.

The ability to monitor equipment performance and automatically compile statistics on wear and tear has enabled companies to optimize their service arrangements. This information reveals where the biggest problem areas lie and enables preventive actions to be taken in good time. Simultaneously, the training of maintenance technicians has improved as more and more suppliers develop professional on-site training programs for their customers.

An interesting case in point is the approach that has been adopted at the Boliden mining company in Sweden, which, with the help of the supplier, Atlas Copco, has targeted the elimination of bottlenecks primarily by building up storage capacity in the process system and achieving good quality in all areas of mining.

With the development of more advanced underground equipment offering longer service intervals, the nature of maintenance work has shifted from repairs to component replacement. Instead, the removed components are transferred to the surface for repair. In addition, more mining companies are also providing areas where equipment suppliers can establish their own workshops to provide expert maintenance service, and this is a trend that is expected to continue.



*Service and maintenance on a Boomer T1 D.*

## Maintenance planning

To make the most of preventive maintenance and avoid disruption to operations, mining companies must implement a planning system with data mapping. This, in turn, requires strategy and organization. The objective is to make maintenance and service as calculable as possible so precise outage time of all equipment can be factored into the production cycle. A maintenance organization should always be established in accordance with the production strategy. It should measure performance and keep records, considering everything from emergency repairs to scheduled maintenance hours with specified procedures.

Whatever the underground project may be, benefits will be obtained from employing such a system, including the following:

- Ratio of production vs. maintenance
- Mechanical availability data
- Service tracking of components
- Cost and trend reports

Calculating the availability of equipment is an efficient way of achieving full capacity production in a mine. To optimize the preventive maintenance cycle, a number of definitions and distinctions are normally adhered to and include the following:

- Maintenance shutdown: planned on a yearly basis.
- Machine interruptions: downtime due to technical malfunction of equipment.
- External interruptions: downtime due to factors unrelated to machinery including rock fall or changed market conditions.
- Availability: calculated by dividing machine uptime with planned operational time.
- Utilization: percentage of calendar time when machinery is used for production.

To illustrate with an example: of a 24-hour calendar time with 1 h of planned downtime, 1 h of preventive maintenance, 0.5 h machine interruptions and 2 h external interruptions, the calculation will show the following:

- Availability =  $(24 - 1 - 1 - 0.5) / (24 - 1) = 93.47\%$
- Utilization =  $(24 - 1 - 0.5 - 2) / (24) = 85.42\%$

As shown in Figure 1, preventive maintenance is essential to secure maximum machine uptime and is particularly important for mines working with automated processes.

- Is there a clear division of responsibilities?
- Are procedures and instructions established?
- How is monitoring and reporting performed?
- Is there an organized system for making improvements?

## Location of Workshops

In general, service and maintenance facilities should be located as close as possible to the orebody. A rule of thumb is the further the distance, the greater the cost and vice versa, but in many cases, the most practical solution is to locate main workshops at strategic locations that are at a safe distance from the mining areas and smaller workshops for minor maintenance work near the mining areas.

However, it must be remembered that these smaller workshops may have to be relocated as the mining operation advances. It is also quite often the case that main workshops are set up in close proximity to central installations such as hoisting systems, water and pumping systems.

To achieve maximum uptime, it is advisable to look at the whole mining process, preferably using a maintenance planning system. Statistical data should be used to follow up, eliminate bottlenecks and establish the most favorable conditions, such as good road foundations and a well drained, dry environment that protects cables and other sensitive equipment components.

In addition to machine maintenance, road maintenance and grading of ramps should be an ongoing process and major repairs should be carried out before wear and tear gets out of control. For example, dirt roads need to be regularly maintained to allow not only the speedy and safe transport of excavated rock and ore from mining areas but also to reduce wear and tear factors on equipment such as vehicle tires.

In this way, the requirements on service and maintenance further down the line will be that much less and, therefore, less costly.

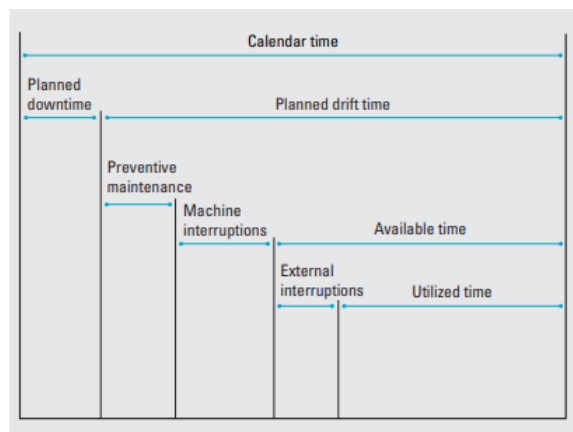


Figure above describes the relation between calendar time, planned drift time available time and utilized time.