In today’s competitive market, every mineral processing facility is striving to operate their plant assets at a maximum capacity or efficiency level all the time. In reality, decreased production rates, delays to production utilization and unplanned shutdowns are regular occurrences. With minimal maintenance resources, setting priorities for maintenance and preventive measures is a challenge, and as a result, plant assets often do not perform to their capability. Downtime Reporter addresses this problem by integrating with existing plant control systems to capture and analyze critical information on the entire production cycle, enabling operations and maintenance staff to target the processing and equipment issues that have the greatest impact on productivity.

Downtime Reporter is Powered by Matrikon, which represents vendor neutrality. This product works with third-party control systems and applications.

**Introduction**

Maximizing product throughput at the optimum quality is the key to profitability. The value of maintenance lies in sustaining peak performance while reducing equipment downtime in order to keep both throughput and quality at their highest possible levels. Unfortunately, although the concept of maintenance value is well understood, it is not always well-measured. In many plants, in fact, the data necessary for measuring equipment availability, production rates and product quality is thought to be inaccessible or too expensive to obtain. But given the bottom-line value that a targeted maintenance strategy based on accurate production data can deliver, the truth is that failing to monitor these key values is the more expensive option.

The following article outlines how a Real-Time Performance Management solution can help automate downtime and production reporting, leading to a more effective and profitable maintenance strategy. The solution will be defined along with the benefits of the system. An industrial case on the application of the technology on a coal processing plant will be presented to highlight the benefits and the key factors for a successful implementation.

**Real-time Performance Management**

Real-Time Performance Management (RTPM) solutions are designed to help personnel cope with rapidly changing market, supplier, raw materials and production conditions, increasing both operational agility on the plant floor and business agility in the marketplace. Typically, these solutions use a combination of advanced monitoring technology to keep a close eye on the performance of specific equipment, plant units and even entire plants in real-time, as well as visualization software to make this information available to operations, maintenance, and plant managers and other executives. By defining key performance indicators, gathering real-time performance data, putting that data into a meaningful context and then distributing it to key decision makers at all levels of the organization, these solutions give users actionable and timely information that increases responsiveness and, ultimately, profitability.

![Figure 1 - Understanding the factors of production efficiency](image-url)
Key Elements to a Successful Real-time Performance Management Solution

Establishing an effective Real-Time Performance Management solution often requires the integration of several technologies, the need to address a wide user base and the system to help facilitate the associated work processes. There are several key factors, including connectivity, knowledge capture, visualization, etc., that have been identified as critical elements for the overall success and long-term sustainability of these applications. Some of these key success factors will be discussed below, along with their application within Honeywell's Real-Time Performance Management solution for downtime and production reporting.

Connectivity

The key to Real-Time Performance Management solutions is providing reliable connections to the various information layers in the business, including the plant floor control systems (DCS, PLC and HM or SCADA), the real-time data historians, the laboratory information management systems (LIMS), external parties (such as transport companies for rail and trucking, as well as quality analysis companies), the ERP system (including Computerized maintenance management systems and planning and scheduling systems) and the business intelligence layer, such as sales and marketing systems.

If the wrong technology is used to establish connectivity, or if the technology is poorly implemented, critical data may be lost or corrupted, rendering the overall solution useless to the business. The point of a RTPM solution is to provide accurate and timely information to decision-makers. If the data is incomplete or inaccurate, the RTPM solution will not deliver its expected value. Establishing reliable connectivity to plant floor control systems has traditionally been the biggest challenge, since every control system vendor has often had its own proprietary data interface.

Fortunately, there is a solution. The advent of open connectivity standards, such as OPC are designed to bridge the gap between Microsoft® Windows®-based applications and process control hardware can greatly assist with the connectivity requirements and provide a long-term sustainable connectivity platform. OPC enables a consistent method for accessing data from plant floor devices, regardless of the type or source of data. In addition to OPC, the key connectivity technologies will include native drivers for real-time information, ODBC, email and XML for relational information. When evaluating any real-time performance management solution, make sure that it supports all of these connectivity options and consider the long-term support requirements of the connectivity layer.

Knowledge Capture and Information Analysis

By automatically monitoring production and equipment downtime information, maintenance personnel can focus their time and energy on the specific assets that are responsible for the most costly disruptions to production. These reports should prioritize problems to maximize the value of operational and maintenance efforts without forcing personnel to rely on the time-consuming and potentially inaccurate methods of manual data collection and report generation. Moreover, automatic production and equipment downtime monitoring solutions help operators understand the equipment they’re running and encourage them to take ownership over that equipment and its performance.

As an example, consider the application of Honeywell’s Real-Time Performance Management solution to automatically capture downtime and display this information through the main plant control system screens (or HMI). By choosing the ‘Downtime Summary’ display option, the operator can see a complete list of downtimes and then enter the equipment affected and the root causes of the problems. It is these latter details that are critical for useful downtime analysis. Note that although the specific details tracked in each case will vary from business to business, the detail categories are relatively universal, and include areas such as electrical problems, mechanical problems and operational issues.

One of the critical elements is the mechanism by which information is captured within the system. This task should be as integrated and automated as possible, minimizing the need for manual entry and ensuring the right information is being captured. This is essential in the users having faith in the data and being able to reconcile to a single version of the truth. Operators should attribute an appropriate root cause to every occurrence of downtime in the facility—the more complete the data, the more effective the maintenance efforts will be. Secondary effects may be described and tracked, but if you are attempting to target and reduce particular downtimes, operators should record and manage all potential causes. A sample downtime reporting screen is shown in Figure 2.

Figure 2 - Downtime Reporter capture screen
In general, when evaluating a downtime reporting solution, you should be looking for the following key features:

- the ability to both automatically capture and manually enter downtime
- functionality to adjust the stop time for a downtime
- a user interface with multiple filter categories, including items such as downtime category, problem, cause, date ranges, shifts, equipment, plant areas and crews
- support for downtime splitting
- pick lists of the most recent and most frequent downtimes
- ability to take alarms for the problem and cause
- integration tools for interfacing with an ERP or CMMS (for example, the use of the plant equipment hierarchy, crew details, and generating work requests/orders)
- support for multiple levels of root cause codes; for example: category, problem, cause and remedy
- support for user-defined names for all fields
- support for standard equipment and KPI classes; e.g.: conveyor and tones
- standard reports, such as Top 10 (or Top N, where N is user-defined) downtimes, system configuration and equipment reports

Moving from Information to Decision Making
Once operators have begun monitoring and recording downtimes and their causes, this information can be trended against downtime types and equipment, allowing operators and maintenance staff to identify and target those downtimes that are having the greatest impact on production.

It is absolutely critical to allocate sufficient maintenance resources to tackle the most serious problems. The number of downtimes to be resolved is determined by the available maintenance resources. Matching maintenance resources against possible maintenance efforts is essential for determining how many downtimes can be resolved in a given time frame, thereby allowing you to set downtime reduction goals and project timelines in order to keep work on track and ensure a solid return on your investment. Moreover, establishing strategy goals and project timelines also allows you to implement a recurring cycle of maintenance improvement. At any given time, most organizations have a set number of top downtimes that they are trying to eliminate. These top downtimes are identified by performing regular downtime analyses so that suitable strategies can be planned, implemented and monitored.
As an example, consider the application of Real-Time Performance Management applied in a major coal processing plant. Figure 3 shows the mechanical delays for a large coal processing plant during the year prior to implementing a downtime monitoring solution as well as the results one year later, after implementing a system that allowed the producer to gain a better understanding of the issues and develop a focused maintenance strategy. In moving to a continuous improvement model, it is recommended that the monitoring be integrated into the daily work processes by focusing on metrics such as the top 10 downtimes shown in figure 4.

![Figure 4 - Ongoing monitoring via the Top 10 Downtime Report](image)

The integration of production and quality data with downtime information is extremely beneficial for a business since it allows users to precisely determine how downtime has impacted these key business drivers. This information can then be used to determine (and justify) what changes, if any, are required to the production process in order to improve overall plant performance, including equipment changes and replacements, changes to operating practices, and changes to staffing. A sample report for production and quality reporting is shown in figure 5.

![Figure 5 - Product and quality reporting for stockpiles](image)

**Continued Focus through KPI tracking**

In traditional operations, the shift leader or line manager is often the person who receives daily operating data from the operators or the plant control system, including downtime, production and quality, and processes it to create reports that outline how the plant performed for the shift or day. Traditionally, this has been an extremely time consuming task that can take one or more hours per day to perform; sometimes the report needs to pass through the hands of several personnel before being finalized. With a good downtime monitoring and production reporting system in place, this process can be automated so that the appropriate reports are generated on demand, or even at preset times, without the need for time consuming and potentially error-prone manual data entry.

A key performance indicator report is shown in figure 6.

**Understanding the Cost to Business**

There is no value added by an operational and maintenance strategy that leads to high equipment availability but unacceptably low product quality. Nor is it useful to expend resources to increase equipment availability if that equipment does not have a serious impact on production levels. As a result, a good downtime monitoring solution must be able to capture and integrate production and quality data in order to make downtime information meaningful and useful to the organization.

As an example, consider Real-Time Performance Management application, where production and quality data is automatically captured from the plant control system or from other sources, such as lab information management systems or external quality analysis companies, and presented in a consistent format that is readily accessible to all users throughout the business.
Maximize Production Efficiency through Downtime and Production Reporting Solution

Figure 6 - Key performance indicator report

Moving a downtime monitoring and production reporting system to a long-term sustainment mode is an important step. The proper definition of the key KPI in the integration into daily decision making is essential. Also, these KPIs must be tracked over time to ensure that the benefits achieved are sustained and any deviations from operational goals are quickly identified.

Figure 7 provides a sample report for the operational plan versus actual applied to the cumulative plant feed.

Industrial Case Study: Improving Operating Efficiency and Asset Efficiency at a Coal Producing Plant with a Downtime and Production Reporting Solution

One of the most diversified mining companies with operations in iron ore, industrial minerals, aluminum, copper, and coal in over 40 companies. A coal processing plant in Australia, engaged in a program to improve efficiency by reducing operating and maintenance costs and increasing equipment effectiveness while maintaining production throughput – goals that are seemingly contradictory. In 2002, the operations decided to discontinue operations at one plant and increase production at another to maintain or increase the total production. An effective strategy to better understand downtime and production issues, and improve operating efficiency was deemed essential if their and goals were to be achieved.

The plants remaining in operation had their own legacy system for delay and production reporting. The legacy system in place from the normal problems of:

- no longer supported by vendor
- no longer met the needs of the Operations group
- complex system requiring extensive manual interaction
- poor data quality translating into unreliable information and low user confidence in the information presented.

The path forward to solving these challenges and meeting the goal of improving production efficiency was to implement a downtime and production reporting solution, Honeywell Downtime Reporter.

The application involved three key elements:

- **Downtime (delay) reporting**: the capture, analysis and display of downtime events to support maintenance decisions, reduce planned maintenance shutdowns and unplanned breakdowns and identify problem equipment.
- **Production reporting**: the capture and analysis of production information to enable accurate business decisions and accounting services.
- **Train loading optimization**: a main constraint is the capacity of the rail and port infrastructure to deliver processed coal to the market. The goal of the system is to debottleneck delays at the train loading point by improving load efficiency.

Figure 7 - Cumulative Plant Feed, Plan vs. Actual

Downtime Reporting
The first module in the application, “Downtime Reporting” is a module to capture the relevant downtime information when any part of the process breaks or production is interrupted. This information is summarized in a downtime summary report (see Figure 8) and provides the basis for analysis by maintenance planning and production control in order to better classify and understand the causes of system downtime.

Having accurate, reliable information about downtime empowers the processing plant to put together relevant action plans to address downtime causes. The Top 10 Downtimes (see Figure 4) are identified, discussed at a weekly meeting and included in the overall maintenance strategy. This continuous improvement cycle (identify downtimes, plan resolution, resolve, monitor and identity next Top 10) serves to focus the maintenance planning on the areas that will have the greatest impact resulting in improved equipment effectiveness.

Specifically, the coal processing plant felt that the “Downtime Reporting” module was an improvement over the legacy system by:

- improving the way operators could book delays and record events into the system
- reconciling production and equipment utilization from many modules into a single system that could view the plant as a whole and eliminate duplicate accounting systems
- providing constant focus on the Top 10 report during production meetings, to ensure that they were addressing the key issues and seeing the reduction in downtime through their initiatives

Production Reporting

The second module implemented was Real-Time Performance Management production reporting module designed to provide management with a web portal to easily access production data for the improved planning, review and analysis of production activities. Simple access of the information through a web-based system enables anyone in the business to access the information directly. Thus, the general manager looks at variance against the production plan, while the mine manager looks at product tonnes and the production planner looks at the plant performance and yields of various coal types. This is a significant improvement over the old system, where anyone who required information needed to call operations to request it. The result is empowered personnel who have rapidly accessed, up to date information and take appropriate action in their area of responsibility. A sample “Cumulative Output Variance Report” is shown in Figure 9.

Specifically, the coal processing plant felt that the “Downtime Reporting” module was an improvement over the legacy system by:

- ability to properly capture and store production related information on any particular day, providing comparative information for benchmarking the operation
- improved business workflow
Train Loading Optimization
The third module of Real-Time Performance Management, Train Loading Optimization, was implemented to help address the ongoing constraint on production of the capacity of the rail car system. Train daily loading information was captured in the system and shared with the third party rail system to help drive improvements in efficiency at the load point. This availability of information was key to improving efficiency and helping improve capacity utilization with a third party partner. A sample train manifest report is shown in Figure 11. Future plans include automated train loading, where the rail system will provide the processing plant with train details (size, wagon type, etc.) and the solution will calculate the maximum load for each wagon.

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Overall Honeywell's downtime and production reporting solution, has delivered significant operational benefits and improved production efficiencies. People at all levels are more empowered with direct access to timely and accurate information, resulting in better decision making. A legacy system that often required days to simply validate the data has been replaced with a consolidated understanding of the state of the production assets, which was implemented over a 12 month calendar period.

Figure 11 - Cumulative Output Variance Report Overall
Internal project post audits have demonstrated benefits of:

- earlier indication of root causes to problems within the operations resulting in improved plant design and maintenance practices
- the ability to accurately quantify the impact of downtime on the operation and justify capital expenditure
- reduction in consumable consumption resulting in considerable financial savings and optimization of rail loading operations to meet contractual obligations and reduce railing costs

The company is now adopting the solution in at least two of their copper and uranium operations.

**Conclusions**

Real-Time Performance Management solutions are the key to operational agility on the plant floor and business agility in rapidly changing markets. By defining a series of key performance indicators, gathering downtime and production performance data, putting that data into a meaningful context by integrating it with production and quality data, and then distributing it to key decision makers, downtime and production reporting can quickly create meaningful information that drives efficient, high-value operational and maintenance strategies.