DOWNTIME ANALYSIS ARTICLE FOR SEP/OCT 2011 INTECH

Table of Contents teaser: Downtime analysis enables identification, quantification and restoration of lost production capacity by accurately collecting data which measures actual overall output against theoretical or rated capacity.

Fast Forward Bullet Points:

- Downtime analysis is often performed manually in many process plants with limited results
- Automated downtime analysis supplemented by manual identification of causes has proven to be a superior method for capturing downtime and rate loss information
- Automated downtime analysis software presents results in easily understood terms that facilitate analysis of results and subsequent corrective action

Resource Box:


2. Don't be Alarmed. Avoid unplanned downtime from alarm overload, use top techniques to improve alarm management, http://www.isa.org/InTechTemplate.cfm?Section=Archives4&template=/ContentManagement/ContentDisplay.cfm&ContentID=58395


Image 1. As with many process plants, downtime incidents at this fertilizer plant are very costly. Downtime analysis software and systems can reduce these incidents to increase uptime and throughput.

Image 2. Rate loss, depicted on this screen shot, is defined as the steady-state deviation in actual output from the rated maximum. Without downtime analysis, these losses are difficult to detect.

Image 3. Skilled operators and technicians can view and analyze downtime and rate loss incidents using textual and graphical data presented through various displays.

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Downtime Analysis

Analyzing downtime increases uptime and production by optimizing operation and prioritizing maintenance

Unplanned production stoppages and rate loss can have an enormous impact on the productivity and profitability of process plants. Rate loss is defined as the steady-state deviation in actual output from the rated maximum.

Downtime analysis (DTA) is an essential part of plant operations management as it provides a powerful tool which enables a better understanding of the underlying issues that affect plant availability and rate loss. DTA enables identification and quantification of lost production capacity by accurately collecting data and measuring actual overall output against theoretical or rated capacity.

DTA systems provide easy to understand and comprehensive Key Performance Indicators (KPIs) which show the causes, duration and timing of downtime and rate losses. Reports produced by DTA systems are used by both production management and process engineers to implement continuous process improvement programs that can reduce the level of downtime and increase production rates.

Real-time reporting and analysis of KPIs enables the true impact of production interruptions to be determined and corrected—improving return on assets and availability, while increasing utilization of critical production processes. The costs attributable to unplanned downtime can be enormous, and for high throughput operations such as refineries, the cost of downtime can run into the hundreds of thousands of dollars per hour.

DTA is typically provided via a vendor-supplied software program, but in addition can also include services in which process experts assist customers in interpreting the KPIs and then make recommendations as to best courses of action. DTA software is usually run on a PC, and typically communicates with the host automation system via an industry standard protocol such as OPC to gather the required data. This data is then analyzed and presented to plant personnel via printed reports and the automation system HMIs—or via viewing platforms such as office PCs, smart phones and other web-enabled devices.

DTA provides a complete record of lost production by utilizing automated processes to capture all production stoppages and slowdowns. With some DTA software packages, operators can manually attribute each downtime or rate loss event to a specific cause or causes, adding valuable additional information which complements the automatically gathered data. These records provide a holistic view of all relevant information, key to diagnosing underlying issues and providing effective solutions.

Typical Functionality

A DTA system needs to have functionality that is appropriate for the particular type of industry in which it is used. For example, a downtime system intended for use in the process industries should include the ability to measure rate loss. These hidden losses are often overlooked or difficult to see, but can have a substantial impact on overall plant productivity.

DTA provides KPIs for lost production over a chosen time period, and also the latest Downtime and Rate Loss events. This enables comparisons to be made between different production lines and shifts over a chosen time period.

Lost production can be measured either as Downtime (on a time basis) or as Rate Loss (measured by production quantity lost). Downtime information can be translated into Rate Loss (and vice versa) based on assigned plant and unit capacities.
DTA enables staff to add reasons for each event, adding valuable understanding to the underlying reasons for lost production. Losses can also be attributed to multiple reasons, dividing the total loss by assigned percentages.

Downtime can still appear in reports even if a reason hasn’t been entered. Downtime Losses can be automatically collected and registered on a per-plant basis, while Rate Loss can be calculated and registered on a daily basis per plant item. DTA results can be stored in the Plant Historian to ensure a common data set with other production performance information.

Typical DTA system reports include a summary report, reason classifications, downtime rankings and rate loss rankings. Users can usually view reports by day, week, month, quarter or year. Custom reports can often also be created within Microsoft Excel and/or through customer database queries. Both these and standard reports can generally be scheduled for emailing to users.

Why Analyze?

Like any hardware or software product added to the basis regulatory control system, DTA requires expense and effort in implementation. But a correctly designed, implemented and operated DTA system will provide a host of benefits as detailed in Table 1 and as described below.

1. Maximizes return on assets

Maximizing asset utilization and plant productivity are keys to the profitability of process operations. Successfully identifying production underperformance and implementing process improvements forms the underlying basis for achieving these goals.

DTA helps achieve these objectives by identifying non-productive times when the plant is not running at its rated throughput. The latter issue can be easily missed with staff unaware of the level of lost production from running the plant at less than rated capacity.

2. Identifies common equipment failures

DTA causes can be grouped together to create a hierarchy of faults with major classifications such as mechanical, electrical, raw materials, procedural, personnel and availability being expanded into more detailed causes.

As major causes of downtime are uncovered and underlying reasons addressed, the focus on particular downtime causes will change with some categories being expanded, with less significant causes being grouped together.

3. Reduces unplanned stoppages and production slowdowns

Using DTA, process engineers can gain a clear understanding of the most important causes of unplanned stoppages and production slowdowns. Often it is the short regular incidents that have the greatest cumulative effect on downtime. Large unusual events will certainly attract the attention of staff, but if these occur infrequently due to exceptional conditions, the cost of prevention may outweigh the benefit gained.

4. Compares existing and past performance

Comparisons can be made between current and past performance. Today’s process plants are rarely run steady-state as there are often continual changes in raw materials, operating conditions and end products. As a result, the impact of these changes needs to be understood and quantified. For example, a plant’s steady-state throughput may be increased, but this may come at the cost of excessive downtime.
5. Generates accurate actionable information

The automated collection of downtime information, verified and enhanced with manual input, ensures that all downtime and rate loss events are recorded without undue bias from operators or other staff. DTA provides quantifiable, accurate information that directs users to production areas and processes that need attention. Traditional manual recording techniques are highly prone to staff bias and incomplete recording of incidents.

6. Identifies areas for improvement

When DTA is implemented, the most significant causes of downtime become readily apparent. DTA systems commonly provide a list of the top downtime causes and show the time, number of occurrences and percentage of total time for each downtime cause. Using this information, underlying causes can be identified and a case developed for any necessary action, weighing the additional profit from increased production against the costs involved in rectifying the problem.

7. Prioritizes Maintenance

By identifying the causes and effects of production loss, plant management can make informed decisions on maintenance priorities and schedules. In addition, when DTA systems are installed, the level of maintenance required typically decreases due to an improved understanding of the process and to better overall operation of the plant.

8. Improves operations and shared best production practices

The findings from DTA can help plant management make informed decisions on a range of practices including spares holding, operator training (for example, enabling them to deal with incidents directly rather than calling in external help, leading to a quicker resolution of the problem), and operational procedures than can mitigate or eradicate causes of downtime. DTA findings also facilitate the sharing of best practices to reduce potential downtime.

9. Optimizes planning and scheduling

Regular unplanned stoppages and production slowdowns result in constant reshuffling of production plans and schedules. Reducing the level of these interruptions leads to more consistent production schedules and more accurate delivery forecasts.

10. Provides continuous plant availability improvement

DTA is an important tool for any continuous improvement program such as Six Sigma as it provides a clear guide to where production is being lost, and where operational changes are needed to increase availability.

DTA benefits are substantial, but implementation isn’t always straightforward.

Implementation Challenges

Although DTA is a powerful tool with a wide body of proven applications, there are challenges to implementation (Table 2):

1. Integration of existing automation systems with the DTA system

A successful DTA system relies on accurate data from the plant’s regulatory control system. To correctly register a downtime or rate loss event the DTA system needs a clear and unambiguous
signal concerning the state of the equipment. These signals are typically calculated tags derived from raw tag data provided by the control system. While it may appear easy to determine whether or not a production unit has stopped, this isn’t always the case as manual overrides can mask true conditions.

2. Management and staff buy-in

Gaining Management and Operations staff buy-in is crucial to the success of a DTA project. At the management level, a product champion is needed to be the prime decision maker and move the project forward, ensuring the necessary resources and training are provided. This person will also drive the project forward by setting and evaluating objectives and system usage.

At the operator level, developing an operator-friendly system is equally crucial. Operators are already under significant pressure, so they must see any additional tasks as assisting them rather than adding to their burden. While events are captured automatically, it is the operators who manually attribute each event to one or more causes. If operators believe the downtime system is too onerous, for example in classifying downtime causes, they will be tempted not to attribute causes or to do so in a haphazard manner. This will result in a significant number of downtime events that are misattributed.

3. Downtime classification choices

DTA is typically implemented as part of an improvement project. As a result, operations management will know approximately where the problem lies. The challenge becomes designing a useful classification list and hierarchy of downtime or rate loss causes. The temptation is to create a very detailed listing covering every possibility. Doing so will cause difficulties in attributing causes from very long drop-down lists, and won’t add useful information to results since most possible downtime events occur infrequently.

4. Quantifying the cost of downtime in lost production

In order to calculate the impact of downtime, it’s necessary to understand the cost to the business of consequent lost production. Establishing this enables accurate ROIs to be calculated for proposed action plans.

5. Follow through to make sure action items are performed

A DTA system will help uncover the underlying causes of downtime and rate loss events. It is the responsibility of plant management, and the DTA champion in particular, to ensure that this knowledge is translated into a plan of action that is carried through. Linking the DTA system to a continuous improvement program provides the motivation and accountability that an action plan requires.

A pilot project can be a good way to address challenges as it allows the DTA system to be tested before it’s rolled out across the entire plant. During the pilot project, inevitable implementation issues can be resolved, and experience can be gained in assigning the most appropriate downtime classifications. The pilot will also provide useful training and experience to the continuous improvement team prior to full-scale implementation.

From Theory to Practice

DTA was implemented for a major Middle East petrochemical producer on a world-scale facility producing a range of fertilizer products. The DTA package was developed to meet part of the requirement for a complete instrumentation and control system.
Due to the scale and complexity of the production facilities, restarting even a single production unit following a shutdown could take several shifts to complete. Bringing a plant back to full capacity would take days and possibly weeks, with significant problems associated with inevitable pipe and equipment blockages. In addition, while the plant was being restarted, it would be producing off-spec material which would either need to be disposed of or reworked, with both of these activities being costly and wasteful.

Factors that influenced the decision to include DTA in the plant’s automation system included the need to ensure product quality and consistency, a strong desire to quickly resolve the inevitable issues that attend the commissioning and start-up of a plant, and the need to ensure that power and utilities maintained 100% continuity of supply.

When downtime or rate loss incidents occur, the DTA system captures these incidents and allows plant personnel to attribute each incident to specific causes. This knowledge is helping the plant to reduce the frequency of future events and incidents—while providing invaluable insights that will allow production, maintenance and engineering teams to bring the plant to its full output potential.

DTA is an essential part of a continuous plant improvement program as it provides a powerful tool which enables a better understanding of the underlying issues that affect plant availability and rate loss. The costs of unplanned downtime can be enormous, so even small reductions in downtime can have significant benefits to plant profitability.

Implementing a DTA system requires buy-in at both management and operations level if it is to succeed, and incorporating DTA into a continuous improvement program helps ensure that actions identified by the system are implemented.

Table 1: Benefits of DTA

1. Maximizes return on assets
2. Identifies common equipment failures
3. Reduces unplanned stoppages and production slowdowns
4. Compares existing and past performance
5. Generates accurate actionable information
6. Identifies areas for improvement
7. Prioritizes maintenance
8. Improves operations and shared best production practices
9. Optimizes planning and scheduling
10. Provides continuous plant availability improvement

Table 2: Challenges of DTA Implementation

1. Integration of existing automation systems with the DTA system
2. Management and staff buy-in
3. Downtime classification choices
4. Quantifying the cost of downtime in lost production
5. Follow-through to make sure action items are performed