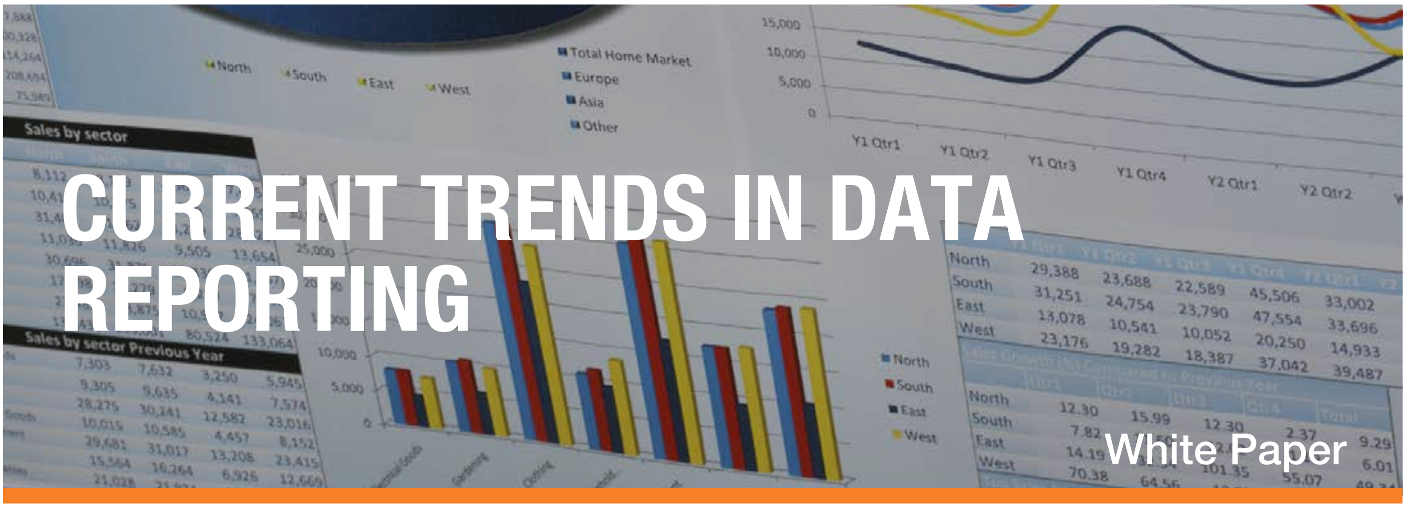


CURRENT TRENDS IN DATA REPORTING

White Paper

The value of correctly distilled information in improving safety and productivity in mines.

Current worldwide trends in mining are focused on improving operational efficiency and reducing costs. The industry is looking to technology and operational data to help keep costs down and maximise the return from existing investments. By providing visibility of relevant reporting data, operations can identify and remove inefficiencies, track productivity levels, streamline processes and optimise resources based on real time conditions.

A system that provides reliable up to date data which is captured and integrated from disparate systems is vital to ensure this is achievable.

Underground systems

The increasing use of PLC and SCADA systems in the mining industry, coupled with more sophisticated automation, is enabling a large amount of data to be collected from underground mining equipment. In addition, production personnel are capturing a significant amount of information via manual entry to record production levels, personnel tracking, equipment stoppages and movements. The value of this data is well recognised as it improves production and utilisation efficiency, highlights possible issues, reduces downtime and in some cases fulfils statutory requirements.

However there is a potential downside to the increasing volume of data now available to mine operators. Often extracting the value of the data requires personnel with a thorough knowledge of the mining process to be reviewing and analysing results from multiple sources on an ongoing basis.

Typically, what occurs is that every discrete data element is imported into a SCADA system and displayed on a screen or included in a report without any context. Generally site SCADA systems display large amounts of information making it difficult to determine a deeper understanding of the operation, other than instant notification of a significant failure.

To quantify the problem; a typical mine may have in the order of 50,000 to 100,000 recordable data points across the longwall, coal clearance and development systems. It is simply not possible to present this amount of data in meaningful way that gives insight into the operating health of the system. There is however an emergence of the need for a distilled set of information in the form of key performance indicators.

Mining Environment

Working in an environment that is characterised by a collection of OEM provided equipment is a significant challenge faced by engineers in the mining industry. These systems have a range of data interfaces from a number of vendors and integration of these has been a longstanding challenge for systems integrators.

The challenges inherent in hazardous and industrial environments are an ongoing problem for equipment and user interfaces; but there a number of devices and network options emerging to provide solutions in these areas. The level of maturity of mine infrastructure varies from site to site. This means no single reporting solution will suit every site.

Multi-platform support for browser types and device types is essential, as no one standard can claim to have dominated the market in this aspect. Web based solutions are the preferred method of deploying the user interface, but must be able to support the various browser types currently available in the marketplace.

Client requirements

Ampcontrol was recently approached by a longwall system original equipment manufacturer (OEM) to supply a reporting solution for an underground mine in central Queensland. The client's requirements were centred upon the availability and optimisation of the longwall system equipment, to ensure that these two parameters met contractual obligations.

The longwall system consisted of a shearer, armoured face conveyor (AFC), beam stage loader (BSL) and roof support system supplied by the OEM and the supporting electrical systems, including the Distribution Control Box (DCB) and substation, supplied by Ampcontrol.

The OEM had a primary need to provide a reporting system that could report on equipment availability to measure real performance of their longwall against their contractual obligations. In addition they envisaged a reporting application consolidated the information available from a variety of disparate systems adding context to the overall longwall system.

The key reporting requirements were:

1. Shearer downtime periods (classified as per the Time Usage Model *)
2. Shearer optimisation (use of automatic shearer functions)
3. Wall optimisation (metres advanced and production issues)
4. Production data (belt tonnage)

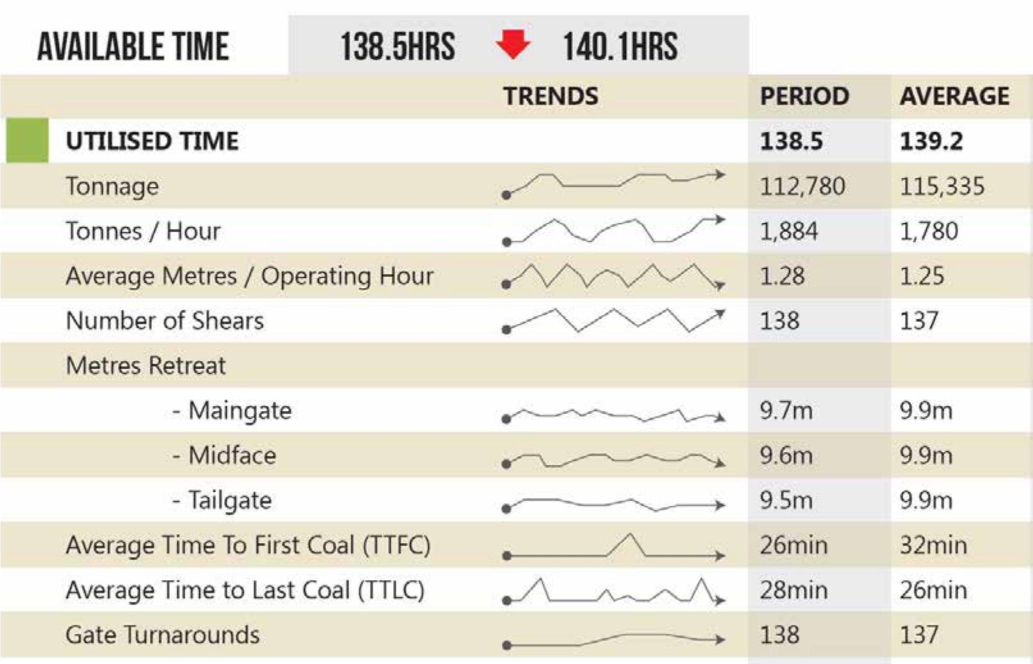
* The Time Usage Model is a definition of how a calendar time period is broken down in components and sub components of productive and unproductive time categories. This allows metrics to be evaluated for availability, utilisation and delays. The Time Usage Model is generally defined by the site to match their process.

Longwall portal system

Having worked with the many challenges in this environment for many years Ampcontrol had first-hand experience that has assisted with the development of its INTEL system (Cognyx MES). This system is a production and downtime reporting platform that was developed in house and has been deployed for a number of mining and non-mining related projects. It was decided to use this platform for its proven reliability and build extra modules to suit the specific needs of this project. The project also required some third party software components to enhance the functionality of the system.

Downtime measurement within the system was centred on the shearer operation. The interpretation of contract availability versus operational was dealt with by the classification of downtime periods to a category, problem and root cause code. These allowed clear "visual reporting" of utilisation, availability and production time in accordance with the Time Usage Model.

The Model was matched to the contractual availability, but also broken down into problem and root cause that reflected the mines operating requirements.



AVAILABLE TIME	138.5HRS ↓ 140.1HRS		
	TRENDS	PERIOD	AVERAGE
UTILISED TIME		**138.5**	**139.2**
Tonnage		112,780	115,335
Tonnes / Hour		1,884	1,780
Average Metres / Operating Hour		1.28	1.25
Number of Shears		138	137
Metres Retreat			
- Maingate		9.7m	9.9m
- Midface		9.6m	9.9m
- Tailgate		9.5m	9.9m
Average Time To First Coal (TTFC)		26min	32min
Average Time to Last Coal (TTLC)		28min	26min
Gate Turnarounds		138	137

Figure 1: Production Report –Production details and sparklines provide a quick overview

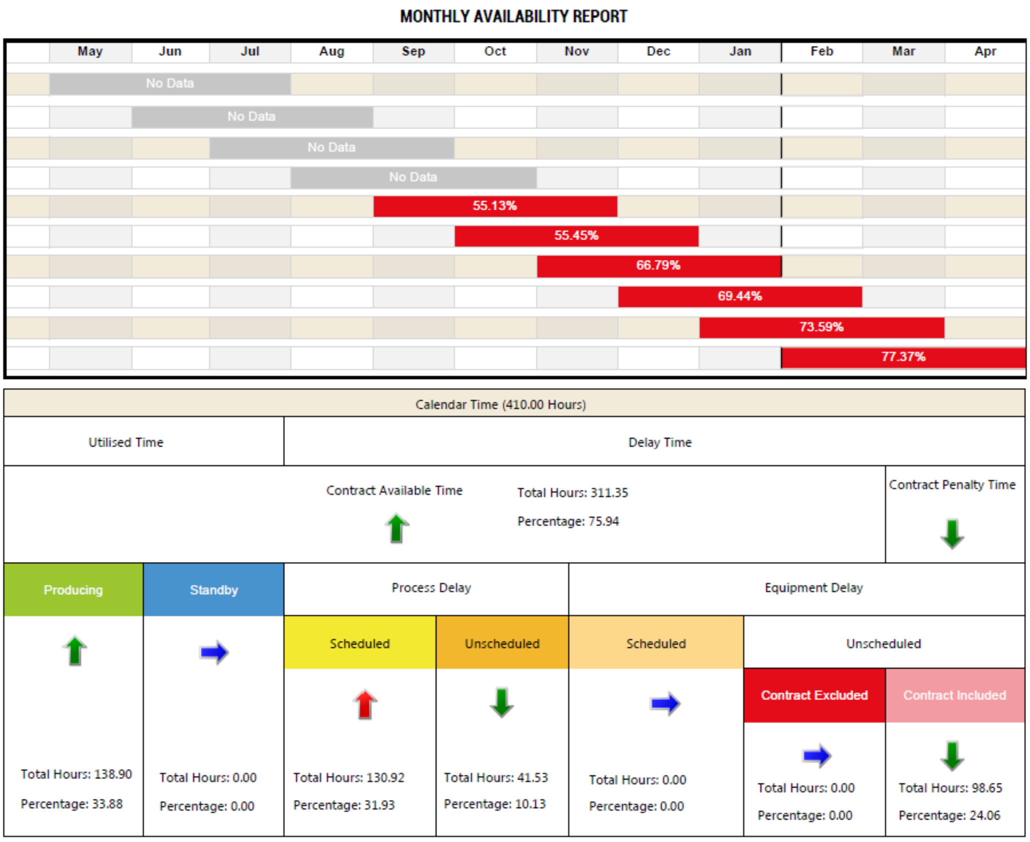
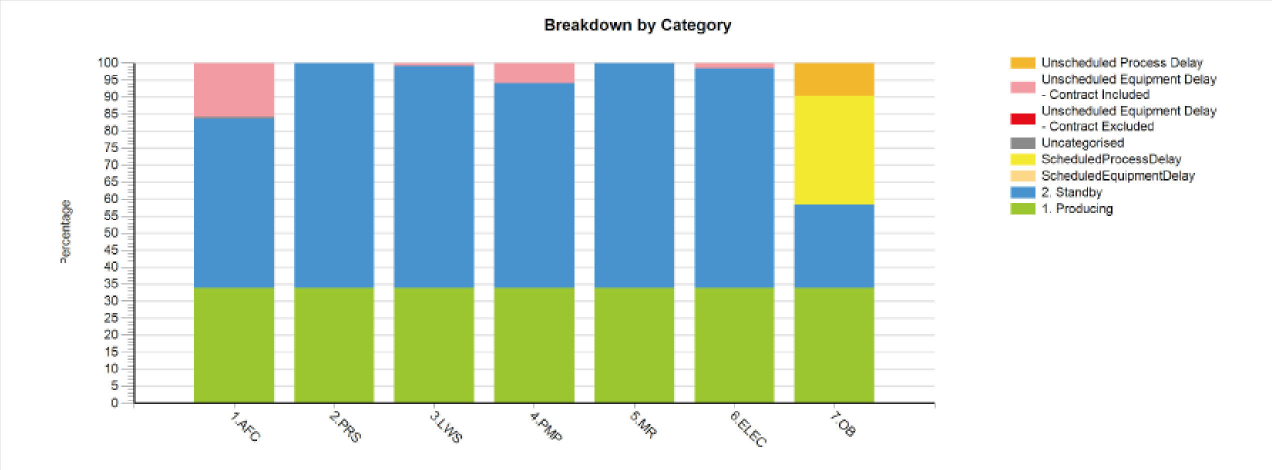


Figure 2: Availability Report – Rolling averages and time usage model view



	AFC	PRS	LWS	PMP	MR	ELEC	OB	Total Availability	Guaranteed Availability
Calendar Time	410.00	410.00	410.00	410.00	410.00	410.00	410.00		
Production Time	138.92	138.92	138.92	138.92	138.92	138.92	138.92		
Total Area Downtime	64.98	0.00	3.26	23.83	0.00	6.57	0.00		
Standby Time	206.10	271.08	267.82	247.25	271.08	264.51	271.08		
Availability	84.15	100.00	99.20	94.19	100.00	98.40	100.00	77.37	77.37

Figure 3: Availability Report – Downtime categories and areas

The downtime events are captured by a code module installed in the DCB PLC. This PLC communicates directly with the shearer, shields and all of the support systems in the longwall area. The module detects the shearer stoppage and then interprets the fault codes from the shearer and other PLCs in order to classify the stoppage. The classifications are based on a set of rules programmed into the code module. A simple user interface is provided for an operator to reclassify the stoppages after the fact.

It is also possible to schedule known stoppages, such as scheduled maintenance periods and other outages prior to the stoppage occurring. The system is then able to classify each stoppage once it is detected by matching it against the pre-scheduled stoppages in the database. Rules can be setup to override the classification determined by the PLC code module, which is not aware of the schedule.

In addition to the downtime measurement and classification, production and operational data is needed to be captured by the system for reporting.

To help assist with user buy-in, statutory data previously recorded on paper was also incorporated into this system for data entry.

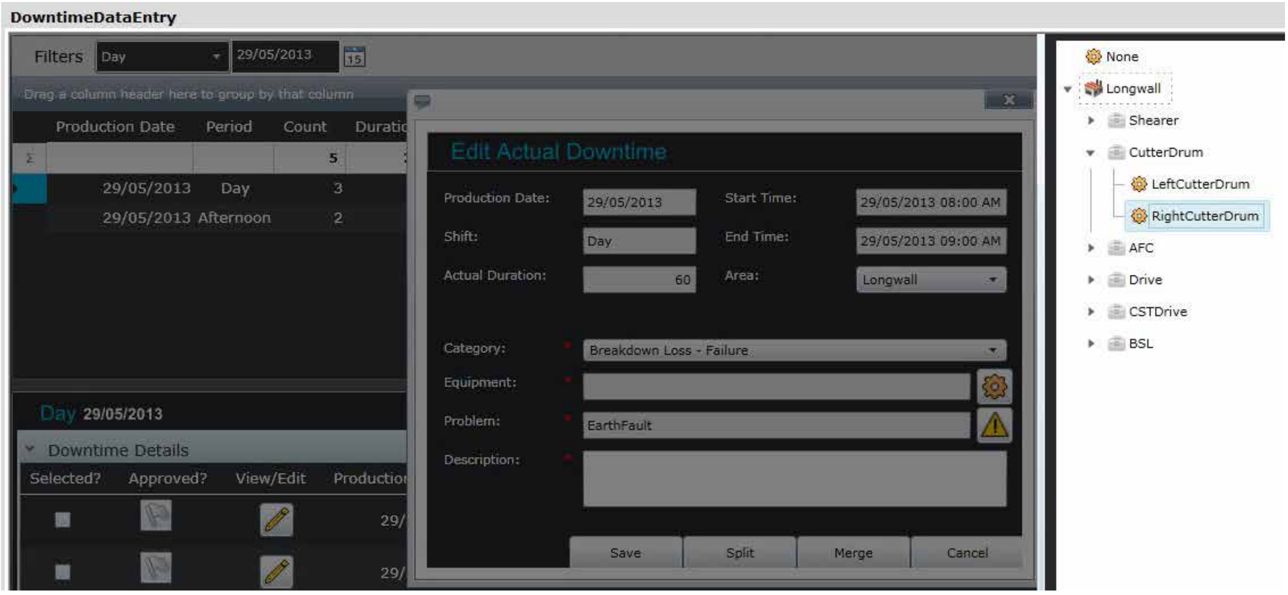


Figure 4: Downtime manual data entry page

Data integrity

With the increased reliance on reports and the scrutiny of key performance indicators against forecasts and targets, data integrity becomes an underlying prerequisite to the system. The option was provided for caching of the data within the PLC, so as to avoid data loss in the event of communications issues with the underground network. This option was not needed for this project, due to a stable communications platform, but is available for deployments in mines with less reliable networks. The OEM had the responsibility of ensuring data integrity within their system for data relating to the shearer, shield, drives and BSL.

The OEM system data was read from the supplied surface server using OPC and stored in an historian database for reporting, aggregation and analysis. The Ampcontrol analysis process reads the data from the historian and aggregates it into shift time periods based on the rules configured in the system. The aggregated data is then available for displaying on the user interface and reports.

System implementation

The system was implemented in a virtual environment running under ESX. Three virtual machines (VM) were created to house the various modules of the system. This allowed the deployment to be implemented on purpose built hardware or on the site's existing infrastructure.

The first VM is dedicated to data acquisition. It maintains the communications to the PLC system. OPC communications to the OEM data server is also setup on this VM.

The second VM runs the data historian server. Due to resources required and to allow for future expansion a dedicated VM was allocated to this function.

The third VM houses a web server, the aggregation engine, reports server and the SQL database for production and downtime data. The services on this VM process the production and downtime events, applying the configuration rules and aggregating the data for the user interface.

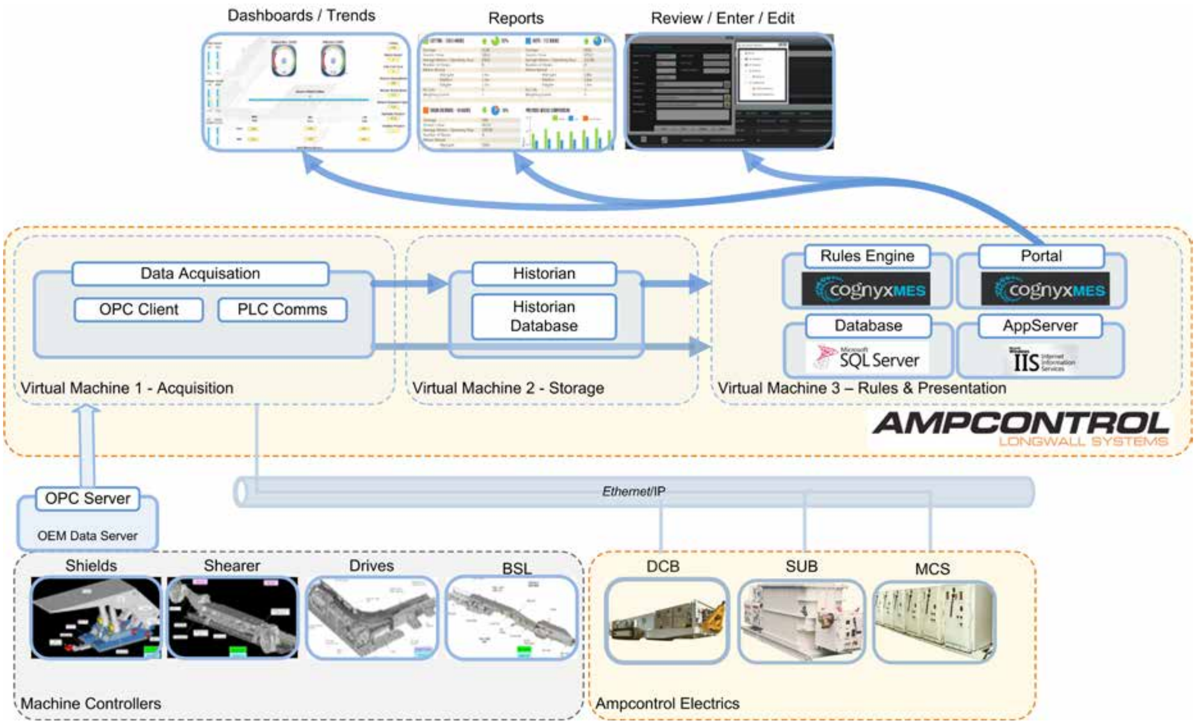


Figure 5: Longwall monitoring system architecture

Offline testing was greatly assisted by the ability to replay recorded data from a real longwall system. Simulation code was added to allow testing of the PLC code module that performed the automatic classification of the downtime periods.

The acquisition system was initially deployed so the data historian could start gathering data prior to the full deployment of the reporting components. This allowed for extended testing of the interfaces, using real mine data.

The full deployment occurred some two months later in conjunction with user training on the system. A number of enhancements have been identified and due to the flexibility of the architecture and some of these have already been accommodated.

Development is still continuing on additional data collection and compression methods, improved user interfaces and reports for release into the next project and will be available for the wide range of implementations that the system is earmarked for.