Short Interval Control with groundHog
The Authors

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Introduction

The mining industry is still adjusting to a slowdown in demand growth over the past few years. A fall in commodity prices and mining profitability has meant that mining companies are increasingly under pressure to optimize operations and cut production costs. The industry is now looking beyond traditional cost-cutting approaches and shifting strategy to include new technologies to raise productivity. Most companies have shelved expansion plans and are now focused on producing more efficiently.

Digital innovation in the mining industry has the potential to transform key operational aspects of mining to deliver significant bottom line value. Harnessing technology is central to dealing with productivity shortfalls and driving higher operating efficiencies. While miners have no control over the vagaries of the world economy, they can control how they operate.

In this ebook, we look at the concept of SIC and how a modern implementation of SIC can improve the effectiveness and efficiency of production.

“Digital innovation in the mining industry has the potential to transform key operational aspects of mining to deliver significant bottom line value.”
Challenges in Underground Mining Ops

Production in underground mines involves managing a complex chain of operations. These include development, drilling, blasting, mucking, filling and ore transport, along with support activities such as maintenance and logistics that are required to carry out the operations. Each shift requires the assignment of people and equipment to different tasks, and the coordination of multiple tasks to improve equipment utilization and achieve sustainable production targets.

“Since tasks are reported verbally or on paper at the end of the shift, the accuracy and validity of the data is often questionable.”

Plans vs. Actuals Feedback Loop

Mining Operations Management System
Real-time Process Monitoring and Control

Minning Planning & Scheduling

Support & Maintenance Processes

Mining Execution Business Processes
Drilling, Loader, Transportation, Crushing and Conveying

Plans

Actuals
The delay of a single task could lead to a domino effect, subsequently impacting the start time of the next task, and thereby the overall completion time of the production process. Typically, interruptions or delays are handled by individual workers, and occasionally, with the help of supervisors on shift. The usage of call-in reporting via radios has improved the response time to problems that occur during a shift, but is proving insufficient to calculate accurate production figures.

Since tasks are reported verbally or on paper at the end of the shift, the accuracy and validity of the data is often questionable. Additionally, the opportunity to address delays during the shift itself is lost since the results of the shift are known only after the shift has ended.
Mike works for a mine looking to get as much production out of its mine as safely possible. As a result, he is under pressure to hit production goals. Mike knows that waiting for shift-related data until the end of shift is not the best way to hit his goals, but he can’t do much about it with the technology currently at his mine.

SIC enables miners like Mike to get shift-related data much quicker, and enable his mine to safely increase production by 15% or more. Let’s see how.
Scenario 1

*No visibility, no ability to adjust plans during shift*

In this case, Mike knows his plan for the shift ahead of time - and that’s it. During the shift, he has zero idea how things are going and where his team is relative to their daily goal. His team could be performing at pretty much any level on the graph shown below - he won’t know or be able to fix it until after the shift is over.

Mike is pretty much in the dark during the shift and it frustrates him to no end. He wishes there was a better way to run his mine.
Scenario 2

Limited visibility, limited ability to adjust plans.

Here, Mike knows his plan for the shift, and he also gets one or two opportunities to see how things are going by reviewing data that comes in once in several hours. He and his team can then do their best to adjust their activities, but they’ll still be flying blind for the next several hours. It’s better than Case 1, but not good enough.

Mike isn’t frustrated, but he isn’t thrilled either. Limited visibility means that he and his team operate like a bunch of B-players, not the A-players that they can be.
Scenario 3

*Full visibility, full ability to adjust plans anytime.*

Mike knows his plan for the shift, he sees what’s actually happening in the shift almost in real time, and his team can quickly adjust operations to stay on track so they can meet their production goals. Management can also receive updates on what’s going on, right as things happen. This is the state of the art in modern mining..

Mike is really happy. He and his team now always have the information they need to make instant adjustments so they can meet or exceed their targets and take home their well-deserved bonuses..
**SIC: The Concept**

SIC is a framework of structured processes to better manage shift tasks by regularly reviewing performance within a shift and evaluating where production stands relative to plan. This enables supervisors to enforce mid-course corrections that can improve the overall effectiveness and efficiency of production during a shift. In other words, each shift is broken into ‘short intervals’ during which supervisors use data to identify and act on opportunities to improve existing production and asset utilization. In some cases, the improvement actions may be countermeasures to ongoing or emerging problems.

Better known as a factory-floor process, SIC has been applied successfully in the manufacturing industry for years to support front-line decision making and resource allocation to achieve maximum results for a shift.

**The underlying principle of SIC is: learning quickly from the immediate past to improve the immediate and long-term future.**
**SIC Methodology**

SIC is implemented as a series of short and focused review meetings carried out by front-line teams every two to four hours. The objective of the meeting is to rapidly identify and react to emerging problems which could adversely affect production and to use data to determine improvement opportunities for the next shift. These meetings are typically completed in five to ten minutes, during which front-line personnel complete a series of four steps:

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**Reviewing the Previous Interval**

1. Identify losses from the previous interval and brainstorm countermeasures.

2. Assess the effectiveness of actions from the previous interval and determine whether follow-up actions are required.

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**Looking Forward to the Next Interval**

3. Identify risks and emerging conditions or changes that may impact performance.

4. Decide on a specific set of actions to be implemented during the next interval.
**SIC Methodology**

Quick and focused reviews of performance data during the shift enable mid-course corrections and immediate small-scale fixes that collectively result in significant improvements in performance.
Traditional Implementation of SIC

Over the years, underground miners have applied SIC to improve asset and personnel utilization, and control production within a shift. Individual operators are assigned goals, and tasks are performed against these goals. At the end of the shift, tasks are reported via call-in or paper, and supervisors use this data to forecast employee shifts, ensure safety and control production. Process interruptions and shift delays are handled by supervisors as and when reported by mining operators, making the management of shift tasks and maintenance process reactive, rather than proactive. Also, the process of manual reporting of shift tasks can significantly understate downtime.

Despite room for improvement in the SIC process, miners have been effective in managing short interval control operations on paper. This method of SIC was working well until the mining industry experienced seismic downfall in the resources market. The profit squeeze in the industry has forced many mining companies to look for technology innovation to scale back on operating costs. Some companies have already begun to transition their operations into the digital age.
Digitization of SIC

Mining companies have shifted from the traditional methods of paper-based data collection to recording data on digital devices such as smartphones and tablets. Mobile-based data collection eliminates the possibility of manual errors that creep in with paper forms, and enables quick operational assessment from the command center.

By harnessing data that is now available digitally, management gains the intelligence to pursue new goals in a more strategic, data driven framework. Also, since mining is a highly regulated industry, accurate data is crucial to ensuring compliance with environmental impact regulations and health and safety standards.

The successful application of SIC requires that your team has the skills and the desire to make improvements to the production process. With the right set of tools, your team can be equipped to measure current happenings and identify areas to improve performance.

"Companies across the industry have benefited from shifting traditional methods of paper-based data collection, also known as the digitization of information."
What must mine supervisors and operation controllers do differently?

1. **Get crew related information on tablet or web browser (laptop/desktop) instead of reading off paper.**
   - Heading and equipment allocations.
   - Task progress by operator.
   - Equipment pre-ops, post-ups, workplace inspections.
   - Reports: tons hauled, equipment availability & utilization.

2. **Input everything on the tablet, smartphones or web browser instead of writing on paper.**
   - Review & conduct workplace inspections.
   - Edit tasks & production data if needed.

3. **Use tablet in place of radios.**
   - Communicate digitally for non-urgent matters to help keep frequencies less busy.
Digital SIC: Real-Time Data

Modem implementations of SIC use real-time production data to guide instantaneous front-line decision making. Personnel and equipment location tracking, fixed equipment monitoring and ventilation monitoring require wireless connectivity to transmit real-time data. To enable transmission in real-time, mines can be wired for wireless connectivity but it can be expensive. This challenge can be solved by setting up peer-to-peer networks. RFID tagging and ad-hoc wireless connections are cost-effective and easily accessible.

Real-time data enables miners to track the precise location and state of mining equipment at every instant and detect deviations from expected operating standards. This empowers front-line personnel to identify key drivers of process variability and drive rapid and focused operational improvements. This results in eliminated challenges of underutilized equipment and wasted capital.

A successful implementation of SIC must give front-line teams the ability to see where everything is and what is being used in real-time.

1. Location of vehicles, what something is being used for and by whom.
2. Location and state of equipment.
3. Status of environment (air quality, ventilation, rock burst hazards, etc.)
4. Location of operators / mine workers and the tasks assigned to them.
Digital SIC: Production Scheduling

A digitized SIC enables the creation of a quick feedback loop on the current state of production against expected outcomes at short intervals. This is made possible using a multitude of interconnected seamless technology pieces working together to manage and track production. While a traditional implementation of SIC has been in use for many years to control production, the primary benefit of digitizing production control is to improve the speed at which production can be tracked and consequently (automatically) matched to expectations.

Digitization of production control requires a cutting-edge scheduling and actuals tracking system that:

- Imports your mining long-range schedule and “tunable parameters” from your production.
- Identifies skill and effectiveness index according to a capability matrix, identifies and matches operator to the most effective equipment, creates shift task lists for supervisors to review and dispatch.
- Location of operators / mine workers and the tasks assigned to them.

"Mine operators and supervisors must have real-time visibility into the status of equipment, personnel and tasks during production and be able to assess where the current state of production stands relative to plan. Mobile apps allow the capturing and reporting of this info seamlessly."
Digital SIC: Sample Interfaces

Task List Interface
Digital SIC: Sample Interfaces

Underground Maps/Nav Interface
Digital SIC: Sample Interfaces

Equipment preOps/ Worksite Inspections
Digital SIC: Sample Interfaces

Cycle Count - Data Capture
Digital SIC: Sample Interfaces

Consumables Data Capture Interface
Digital SIC: Sample Interfaces

Delay Codes

Delay Reason: Waiting for Supplies
Reason Code: SUP.215
Actual Start Time / End Time: 09:20 AM / 01:50 PM
Estimated Delay Time: 1:30 hrs
Operator Comments: 10' Coated Bolts required at CA4520_YCDF_K8492. Please send them ASAP.

Submit Delay
Digital SIC: Sample Interfaces

Alerts

You have been assigned a new work package. Drill 25 Holes at HDX_4465_87BR

OK
Digital SIC: Sample Interfaces

Supervisor Interface
Digital SIC: Sample Interfaces

Administrator Interface
The mining industry is recalibrating to a set of strong headwinds. As companies work towards rebuilding profitability, productivity improvements are high on the agenda. Digital technology has the potential to transform key aspects of mining operations to deliver significant bottom line value. In this context, the concept of SIC will play a crucial role in achieving operational excellence in the mining industry.

It is important for mining companies to invest in a cutting-edge short interval control system that will drive higher process efficiencies and improve overall asset utilization.
About groundHog

groundHog

groundHog, powered by rapidBizApps, is a fleet management and production control system optimized for use in underground mines, and designed to work out of the box for all underground mine operations such as cut and fill, block caving, Alimak and pillar mining operations. Using leading technology integrations, groundHog helps accomplish better mining.

rapidBizApps

rapidBizApps creates intuitive, reliable, and scalable apps for some of the world’s largest companies. Its products and solutions are focused on solving complex, mission-critical problems and driving digital transformation across mining, oil & gas, construction, and more. Based in Silicon Valley, rapidBizApps counts global industry leaders such as Cargill, Barrick Gold, Freeport McMoran, AECOM, and Atlas Copco among its customers.

"Our cutting-edge short interval control system enables sites with equipment at 60% overall equipment effectiveness (OEE) improve to 65% OEE in under three months and to 75% OEE within two years."
References

01 Short Interval Control in Today’s Underground Mine: A Case Study
Presented at MINExpo International 2012
Authors: R. Howes, C. Forrest
[http://edstechnologies.com/Mailer/Sep15/Newsletter_September/images/ShortIntervalControl.pdf]

02 Short Interval Control (SIC)
Article by LeanProduction
[https://www.leanproduction.com/short-interval-control.html]

03 Using Short Interval Control (SIC) to enhance mining operations
Blog post by GroundHog
[https://www.rapidbizapps.com/short-interval-control-mining]