WHITE PAPER

SITE MASTER SCHEDULING:

Integrating infrastructure and production schedules

Optimizing critical path by managing shared locations and materials in underground construction projects

Neil Tyson, Deswik
BEng(Mining), MAusIMM

Deswik®

EXECUTIVE SUMMARY

Managing all underground work is a key challenge for miners delivering large scale construction or expansion projects in mines.

Planning of work is spread across many stakeholders and completed in disparate systems, making it difficult or impossible to identify and manage the project critical path.

Work is planned by mine planners, EPC contractors, in-house engineering and project controls teams. Not all planning systems used are capable of managing shared locations and materials underground. The result? Rolled-up project master schedules that appear comprehensive but fall apart at granular levels of detail once the realities of underground mining are quantified and the 'real' critical path emerges.

The resolution to this issue is straightforward, and can be achieved with existing, proven technology: integrate ALL influencing activities into a single planning environment that can manage shared locations and material constraints underground. Use this fit-for-purpose site master schedule to manage risk, identify and resolve interactions and bottlenecks, then optimize for value.

To achieve this goal, a collaborative approach is required from multiple stakeholders, supported by a willingness to challenge old ways of doing things with new applications for technology, strong leadership, and effective change management.

BACKGROUND

Mining construction, expansion and infrastructure installation, particularly for underground operations, often involves multiple schedules and scopes of work that share locations, materials and resources.

Using the traditional approach, It is difficult, if not impossible, to integrate these into a single, unified view of the project at the right resolution to be useful.

The inability to see a complete project overview can have severe safety or financial impacts. For example, when planned work occurs in locations that impact each other, there is a higher risk of hazardous interaction.

When tightly-coupled interactions between different scopes of work are not captured and managed, it can lead to frequent critical path fluctuations of weeks to months. For example, a minor design change to a crusher can in turn disrupt:

- mechanical envelope
- excavation dimensions
- excavation sequence and geotech requirements
- jumbo and ancillary resource requirements and schedule.

This cascading effect can result in the handover to infrastructure for installation occurring months late, delaying the critical path, and throwing the overall project schedule into oscillations with unplanned work to compensate.

The lack of options for granular integration to enable whole-of-project decisions limits the ability of the project director, operations and mine management to mitigate the accumulating disruptions to the overall program. This can result in loss of NPV and increased project delivery costs.

NEW APPLICATIONS FOR EXISTING TECHNOLOGY

Deswik.Sched is a credible functional replacement for P6 and MS Project for mining construction, expansion and infrastructure installation projects. It has a superior architecture that delivers an advantage for managing complex underground mining projects.

Planners can also easily calculate, forecast and report material quantities as well as equipment and labor hours, utilizing sophisticated techniques for calendars and resource levelling. Financials can also be seamlessly incorporated providing cost-based planning. Manual planning of precedences and constraints is replaced by business rules that crystalize the project logic and are transparent, repeatable and automated.

As a significant advantage, these tools are spatially aware, allowing planners to constrain resources and material quantities based on the spatial relationships between tasks and locations.

> A proven tool in the mining sector, this technology is now transitioning into civils, tunneling, and project controls applications.

Stakeholders can view and understand data in terms of multiple changeable hierarchies, not limited to just a standard work breakdown structure. This allows for the definition of fit-for-purpose information hierarchies critical to managing complicated interactions across multiple domains.

Crucially, Deswik.Sched automates the application of program logic and resource levelling, thereby requiring fewer scheduling resources. A proven tool in the mining sector, this technology is now transitioning into civils, tunneling, and project controls applications.

PROBLEMS TO SOLVE

SAFETY

As a prime focus, the solution should act to improve safety and reduce workplace risk. To keep people safe, work in all locations must be planned so that no hazards are introduced by the spatial location of the work and interactions with other concurrent tasks. Examples of hazardous interactions can include:

- Working in a heading that is being drilled into from another location;
- Downwind effects of works in the same vent network area such as dust or chemical fumes;
- Activities that restrict access or retreat from connected locations;
- Alterations to major services that affect safety equipment, i.e.: power loss to an UG rescue chamber.

VALUE

Delays in a project's critical path can result in loss of Net Present Value (NPV). Project engineers need to be able to plan and incorporate scopes of work being managed in disparate areas of the business. This work can span production, early works, development, mass excavation, infrastructure design or installation, surface works, commissioning & operational readiness, ramp up and full production.

The solution must be able to manage work that depends on predecessor delivery and configuration, which changes frequently during the project lifecycle. It also needs to manage tasks that share locations, materials or resources , working to prevent clashes and delays to the critical path.

A key challenge is managing complex projects that require many 'enabling activities' before project critical tasks can be initiated. These enabling activities may span multiple lines of accountability and may not be visible within the critical path of a conventional schedule.

EFFICIENCY

Finally, the solution has to improve efficiency and the decision-making process. Technology underpins effective decision support by making 'what if' optimization of the critical path possible in a reasonable timeframe. This enables project directors to make informed allocations of priority and resources based on the overall best value to the business. Our experience shows that a planner or scheduler can be over 300% more productive by using better tools and technology.

> "Our experience shows that a planner or scheduler can be over 300% more productive by using better tools and technology...

ROADBLOCKS TO SUCCESS

A number of roadblocks still need to be surmounted to seize this opportunity. These primarily center around overcoming the cultural inertia that often spans multiple business functions at a mine, as well as the supply and project delivery chains. This can result in the lack of a single point of accountability that can initiate, resource and lead improvement.

A breakdown of the various stages of a project demonstrates how **key stakeholders** (in bold) become bound by their task requirements and tools, creating barriers for any single group to implement change.

1. Work packages are tendered and controlled through **procurement**, which requires the use of certain tools as pre-requisites for tenders and subsequent delivery.
2. **Mine technical services** may use Deswik tools in production planning, but the mining studies component of a PFS/FS/DFS might be delivered by **mining engineering studies groups or consultants** in multiple other scheduling tools.
3. **EPC contractors** may be required by contracts required to deliver schedules in P6, which will be rolled up and assessed by the **owner's team** lead by the **project director**.
4. **Design contractors** will refine infrastructure design throughout the project, in packages like REVIT.
5. **Site (infrastructure) engineering** are tasked with delivering site engineering services and need to integrate with the study owners team and EPC contractor, they cannot 'go it alone'.
6. **Project planners** within the EPC contractor, owner's team, and site engineering teams have skills in P6 rather than the new tools, thereby requiring capability building.
7. Additionally, there is a limited pool of suitably skilled planners in the labor market, whereas P6 skills are readily procured.
8. **Deswik** would be required to support the building of capability across multiple stakeholders.
9. **Technical services, operations and mine management** are required to keep people safe, deal with emergent hazards and clashes, as well as meet production commitments.
10. For brownfield projects there is no single handover, so this involvement spans from the commencement of early works through to construction, operational readiness, ramp up and into full production.

THE PATH FORWARD

Deswik is offering a technical solution that simplifies the existing process. We can do this by:

1. Integrating all influencing tasks into a single planning environment for pro-active identification and resolution of issues;
2. Establishing a common data model used by all stakeholders that enables spatial and metadata integration. This in turn allows analysis and planning both of what must happen and where it must happen, across all functional domains and stakeholders;
3. Providing a single unified calculation of quantities and cost to allow for rapid cost scenario and tradeoff analysis;
4. Fostering updated work practices that maximize the potential of the technology; and,
5. Cultivating a capability strategy to underpin the above. It is the people who will make this solution a success, rather than the software itself.

> "It is the people who will make this solution a success, rather than the software itself...

LEADING CHANGE IS CRITICAL TO SUCCESS

Successful implementation requires proactive leadership from a position of seniority. This leader must have the influence and authority to cut through inertia and unite disparate stakeholders in a common cause of safety, value, and efficiency. Furthermore, stakeholders must have sufficient resources to support effective change management, thereby enabling frontline teams to deliver a first class result.

Deswik®

deswik.com