The digital mine of the future

Hexagon Mining

The digital mine of the future is closer than you think. Big Data might be a convenient hook upon which to hang that vision, but Hexagon Mining is built around connecting people; people faced with countless variables in an industry whose only constant is fluctuation.

Faced with rising energy costs, scarcer high-grade ores, declining commodity prices, and tighter profit margins, it has never been more important for a mine to make sense of its data. Productivity depends upon it; so, too, will the digital mine of the future.

Within that data is a smarter way to mine. By seamlessly integrating design, planning, and operations technologies, mines can be safer, and more productive. Central to the challenge of connecting people and making sense of their data is the need for one version of the truth.

Operational staff and managers are increasingly being overwhelmed with huge volumes of data from multiple sources, much of it in real time. As data is collected, and distributed to various systems at the mine, it is replicated and massaged before countless hours are then spent reconciling and rationalising this information.

The result is:
• Multiple versions of the truth;
• Silos of data and practice; and
• Spreadsheets dominate as a planning and execution tool.

By connecting people across a mine, we can connect intelligence and processes. Decisions can then be made that make sense and drive efficiency. All data, if

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Optimisation and integration have never been more important for smart mines striving for productivity

managed and analysed correctly, can be important for understanding the performance of your project. Assembling all of this disparate data together and presenting it in a useful format is one of the largest challenges facing mining operations around the world today.

More and more data is collected via more automation and sensors. But not enough is being done with this data to make sense of it. Mine operators and mining executives are under tremendous pressure to meet profitability goals in an unfavourable market. Huge amounts of data are being collected from disparate sources every hour of every mining day. But neither operations, or mine management, or corporate executives can consolidate it, transform it, or analyse it on a timely basis.

Each day, data piles up and its value is lost as a tool to help mines do more, and do it better, faster, and more profitably. Add to that challenge the many variables and daily uncertainties inherent in the complex business of mining. Extreme environments, fickle weather, plus mechanical, geological, and engineering constraints are constants, as are fluctuations in the world economy.

Historically, mining has collected only the data necessary to operate. Some departments, such as maintenance and purchasing, do a much better job than operations in collecting and managing data. For productive mines seeking a competitive edge, this approach doesn't cut it anymore. Today, companies are under enormous cost pressure. Capital expenditures for projects have risen to billions of dollars. Operating expenses are extremely high due to wage competition in the past 10 years, along with increases in fuel and energy costs.

The need for a holistic view of the mine, one with clarity, accuracy, and timely reporting that everyone understands, is vital to move mining to its next level of productivity and financial performance. It will be the foundation of the digital mine of the future. Without that view, cost efficiency is not only lost, but escalating losses from under-informed decisions send ripples downstream costing millions of dollars from unintended consequences, money that could be going to the bottom line.

So what's the solution?

Cut costs by managing and using all data that affects the operation. How many drill bits used, how much fuel used, how many pounds of ANFO loaded? Those are all easy to measure, but how do you optimise them? You need to go back to the basics and look at the task at hand, which is building an accurate model of the mine, down to the level of geologic detail required to optimise engineering processes, while eliminating harm to staff and environment.

One of the key issues is collecting, filtering, and managing clean data in this realm. Because of the large amount of data being collected, it's essential to automate and manage in near or in real-time. The companies that make up Hexagon Mining have a long history of working closely with operational staff and providing accurate and robust solutions for daily work. As a result, we are uniquely positioned to not only collect the data, but provide the tools for analysing it.

Removing the impediments to efficiency, such as manual data collection, departmental silos, and Excel-driven reports is a quest all vendors are on. Mining companies are faced with an array of vendors who offer partial solutions. Smart mines need more than partial solutions. Optimisation and integration are essential for smart mines.

By focusing on business intelligence and business analytics, Hexagon Mining will help customers to identify lost time that's non-productive: breaks, crew stand-down times, lunches, and equipment breakdowns

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The combined experience, leadership, and expertise of Leica Geosystems Mining, MineSight, SAFEmine, and Devex Mining elevate Hexagon Mining to a unique position. Hexagon Mining is the only company to solve surface and underground challenges by uniting the world's leading software innovators. Together, they create an unprecedented spread of technologies within the mining vertical.

Central to efforts in mastering big data is our new Hexagon Mining Athena product. It's a unique solution based on the attractive synergies between our partner companies. Our goal is to understand the big problems, but provide practical, achievable, and scalable solutions in the short term.

HxM Athena imports, validates, analyses, and stores data from multiple input sources to a single data repository. It then presents the data in dashboard views that are easy to use and understand. The sources of data can be extremely varied, such as fleet management systems, (FMS) drill rigs, on-board fragment analysis cameras and general mine planning systems. In the future, dashboards for safety, and slope stability will be added.

Analysing and merging this data can answer questions like, "why are my shovels not meeting their production targets?" There could be several answers to this question, but one answer could be that the rock is not being fragmented efficiently, making it harder to dig.

It's a critical benefit for managers to be able to understand what is going on in

their operation across multiple areas of the mining value chain. Being able to track poor shovel performance back to a sub-optimal blasting process, for example, can give managers the confidence to change projects, improve practices, and track the results. This can be priceless information but it is easy to attach a value to this as well.

Tempted by technology such as laser scanners or HPGPS tracking, some companies are embracing data capture without the means to actually make good use of the data. HxM Athena is different because it offers both business intelligence and business analytics.

Athena allows data consumers to see their data on an attractive interface. For instance, being able to see the design and as-drilled blasthole locations and parameters together in one place can be hugely beneficial when you are trying to understand why a blast was good or bad. Better yet, Athena is mashing data from multiple sources, enabling you to understand why, as well as what.

The P80-versus-Dig-rate dashboard is a great example of this. It shows the
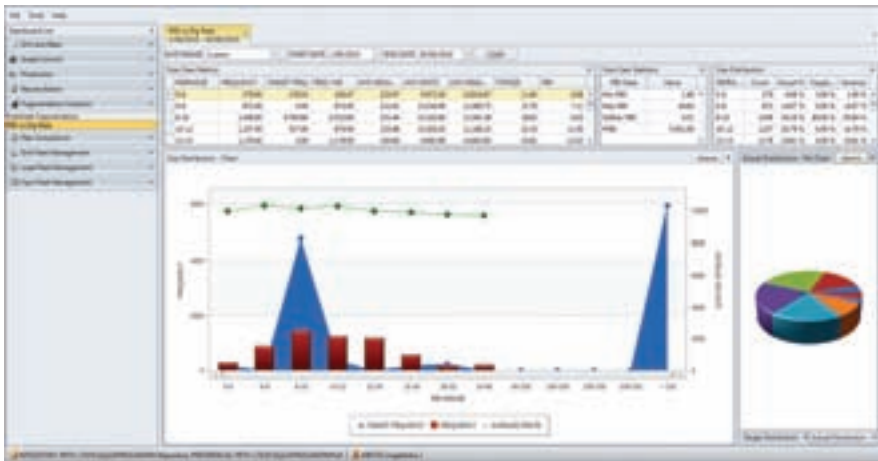
HxM Athena features dashboards showing the predicted fragmentation distribution curve versus the measured actual fragmentation curve, and compare them to the digrate of the excavators; a valuable tool for planning engineers

predicted fragmentation distribution curve against the measured actual fragmentation curve, and compares this with the dig-rate of the excavators. This is critical for planning engineers trying to understand why the mine plan objectives are being missed.

HxM Athena is central to plans for connecting with enterprise resource planning (ERP) systems. Athena's interchange data structure will allow customers to not only connect 'down' and 'over' to data sources, such as FMS, but also to connect 'up'

to ERPs, such as SAP. Athena will preside over all the data that flows in the operation of the mine, and will be the one source of information that everyone needs, including SAP.

Understanding the problem is one thing, fixing it is another. Hexagon Mining is tackling this as well. MineSight's short-term scheduling product, Atlas, will soon be able to import actual FMS information automatically so that the mine plan is evolving. The obvious value to use here is the productivity rate of excavators. This is related to the rock hardness and the blast's effectiveness. So if productivity is falling behind plan, the Atlas schedule will be updated on the fly, allowing engineers to predict problems before they happen and hopefully solve them.

This cycle of plan, do, act, check is repeated through all our operational tools, such as MineSight Axis for grade control and the soon to be released MineSight Blast for drill and blast design management.

The drill and blast cycle is integral to Hexagon Mining's vision. MineSight Blast will bring precision and dependability to one of mining's most challenging steps. Incorporating a modern design interface, MineSight Blast will design and manage drill and blast patterns interactively on screen while storing all of the design (and actual) information in a SQL database. Drawing upon visualisation and automation software, together with MineSight's Axis product, Hexagon Mining will focus on tracking grade and rock fragmentation. This part of the mining cycle is too important to get wrong.

Poor fragmentation has major implications for crusher energy, refining and the whole mining process. Get crushing and grinding right the first time and mines really save energy costs and decrease the hit on the local energy grid. Hexagon Mining is looking to close that loop via Leica's drill fleet management machine guidance, and MineSight's drill and blast modules.

The wider technologies on offer from the Hexagon family will be invaluable, as
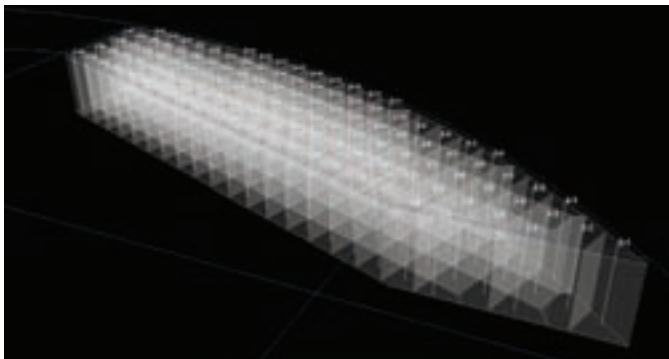
Viewing volume of influence solids and polygons will be among the compelling display features in MineSight Blast

Hexagon Mining cultivates other synergies to solve industry challenges. HxM Live Terrain, for example, integrates the disparate data from surveying and measure-

ment sources for a streamlined workflow. Those sources will include total stations, UAV, scanners, Lidar, and mobile mapping.

HxM Live Terrain assembles other technologies, from Leica equipment to Intergraph software, and combines it with data truthing and processing software, to build a database of all relevant data, ranked by fidelity.

Customers can select the area for which they need the latest terrain surface, and HxM Live Terrain will deliver it. This provides a much-needed tool for rationalizing a critical source of data for the mine – the topography surface as it is continually measured and mined. Hexagon Mining expects Live Terrain to be a huge benefit for a variety of users; from mine planning, to fleet management, to environmental, slope monitoring, reconciliation, autonomous mining, and regulatory. Better yet, Live Terrain can be a cloud-based solution.

> "Mine planning, design, fleet and production management, optimisation, fatigue monitoring, and collision avoidance software will be seamlessly linked for a comprehensive flow of data across all operations"

Hexagon Mining is not the first company to build products that make sense of so much data, but it is the first mining vertical company to be doing this. The mining industry's need for a complete, life-of-mine solution – not partial solutions – demands nothing less. Hexagon sees a great opportunity for miners to use its technology to integrate and converge with other solutions for a smarter way to mine. By eliminating silos, and sharing an open platform, Hexagon Mining believes it will be an attractive proposition to the industry, no matter what mine planning or fleet management systems are being used.

Knowing Hexagon Mining's products will work with those of their competitors should be a bonus for companies looking for technologies that can be integrated, be they for safety, asset management, or asset optimisation.

With a 360° vision, Hexagon Mining, will offer the competitive edge needed by productive mines. Mine planning, design, fleet and production management, optimisation, fatigue monitoring, and collision avoidance software will be seamlessly linked for a comprehensive flow of data across all operations.

Fleet management, for instance, represents a huge opportunity for mines to minimise energy consumption, reduce carbon footprints, and save money. Leica Geosystems Mining's fleet management and optimisation expertise can deliver immediate relief for companies facing tough times with rising capital expenditure and operating costs. Companies like African Barrick Gold (ABG).

ABG contacted Leica Geosystems Mining to address these issues at ABG's North Mara mine in Tanzania. North Mara is a high-grade open pit gold mine with

Leica Jigsaw makes sense of the data deluge, helping mine staff to solve problems in near-realtime

a life-of-mine estimated at 10 years, and the potential to process 8,000 tonnes of ore per day.

In September 2010, North Mara implemented the Leica Jigsaw Mine Management Solution on 70% of its production fleet. The goal was clear: improve time management; increase production; reduce costs. The results surpassed ABG's expectations.

ABG installed the solution across North Mara's entire production fleet and by 2012, Leica Jigsaw was at work across all three of the mine's open pit deposits.

North Mara's scale and size presented several challenges. Production spans several large pits 15km apart. Supervisors couldn't be present to constantly monitor all fleet-related activities in all of the pits.

Leica Jigsaw's introduction reduced average collection time of the first load truck and shovel cycle times by a third. North Mara's hourly output of 2,000t was boosted by an additional 450t per day. The tools used to complete this analysis satisfied one of the major goals set by North Mara dispatch supervisors: to produce up-to-the-minute, end-of-shift reports and loading details.

Within six months of adopting the Leica Jigsaw Mine Management Solution, North Mara mine reported a marked improvement in equipment usage and efficiency.

ABG uses a variety of Leica Jigsaw's tools, including Joptimizer. Before North Mara mine could benefit from using Joptimizer, it was important for the mine to understand the variables affecting production. The system had to be configured to account for these variables. Vehicles had to be assigned to circuits, according to Joptimizer's results.

Previously, supervisors would appoint assignments to truck operators regardless of their route after unloading at the dumping location. Trucks would go to their respective dumping locations and return to where they had originally loaded the truck.

Using Joptimizer, trucks now dump loads at the dumping location; then receive

new assignments leading them to alternate loading units with shorter distances. Assignment routes are shorter and more efficient. With Joptimizer, only 13 trucks were needed to accomplish assignments, compared to 15 trucks that were previously necessary to complete the isolated circuits. Time is saved and productivity is increased.

Originally, consultants created the North Mara mine design and recommended routes to and from each location. In one project, the consultants relocated a stockpile with an estimated one million tons of sensitive material to a more adequate location. The original route assigned to move the material was labelled Old Route.

After implementing Leica Jigsaw, North Mara mining engineers ran a simulation using Leica Joptimizer tools. The findings presented the Proposed New Route, as the shortest path that yielded the best output.

Operators began using the Old Route and recorded an average 21-minute travel time between points A and B. Joptimizer's Proposed New Route cut that time by a third. The optimised route meant increased truck productivity and significantly more output tons.

It costs US$236 per hour to operate a dump truck at North Mara mine; about $814 per hour to operate a Terex 170 shovel. Over 25 days using the Old Route, ABG would have spent $965,345. Using Leica Jigsaw, and specifically Joptimizer, ABG actually spent $663,068, saving more than $300,000.

One product respecting underground essentials such as process control logic, data communication challenges, safety standards, and environmental issues, is now a reality thanks to Devex's SmartMine l UG package

Underground, Hexagon Mining is also taking great strides thanks to Devex Mining. This month, Devex and AngloGold Ashanti Brazil wrote a new chapter in underground mine operations. After four years of collaboration, SmartMine|UG will be unveiled at the Lamego Mine, in Minas Gerais, Brazil.

SmartMine|UG is the world's most comprehensive system for managing

underground mine processes. Its creation began in 2010 when solutions for managing underground mines were mere adaptations of open pit mine systems.

Devex decided it was time to develop a product for underground operations; a product that respected underground essentials, such as process control logic, data communication challenges, safety standards, environmental issues, and other factors.

In mid-2010, Devex embarked on developing SmartMine|UG, the first system for managing underground mine process automation. Much of Devex's development team was mobilised to the project and a laboratory was established to test the modules being developed for the new product.

Devex recognised early on that the goals of the SmartMine|UG project converged with the needs of AngloGold Ashanti Brazil, a client with a history of joint development in customized solutions.

Six months of talks lay the foundations of a commercial partnership for the joint development of SmartMine|UG in Lamego. It was agreed that Devex would use Lamego's underground mine as a test platform for the system's development.

About 70 Lamego employees, from all hierarchical levels, contributed to SmartMine|UG, which was completed this month, becoming the world's most complete system for underground mine automation"

This would allow Devex to incorporate the experience and expertise of AngloGold Ashanti's mining professionals, and other customers could visit and see the progress at Lamego. The agreement established price advantages for AngloGold Ashanti in the final acquisition of all hardware, software, communication tools and services.

In 2011, work officially started on the SmartMine|UG project at Lamego, 26km from Belo Horizonte, home of Devex's headquarters. Devex developers worked tirelessly on this project, whose modules were developed with the support of Lamego's teams. Experts in each area of the mining process participated and explained their needs. They guided, tested and used each of the modules developed in partnership with Devex, considering not only the specifics of cargo and transportation, but all processes in an underground mine.

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Pivotal to Hexagon Mining's vision of smart change is safety. SAFEmine is the global benchmark for solutions that prevent mining accidents. Today, more than 20,000 mining vehicles in 45 mines worldwide are equipped with SAFEmine's Collision Avoidance Systems (CAS).

FatigueMonitor is an innovative solution that integrates data from fatigue detection and collision avoidance to minimise accidents involving mining vehicles

Now the Switzerland-based company has launched FatigueMonitor, which is integrated with CAS.

About two thirds of traffic accidents in surface mines are because of driver fatigue or exhaustion, according to industry statistics for open-pit mining. FatigueMonitor is an innovative solution that integrates data from fatigue detection and collision avoidance to minimise accidents involving mining vehicles.

It's mining's first multi-technology, fatigue detection system for monitoring driver alertness. It enhances SAFEmine's impressive suite of traffic safety solutions.

CAS protects vehicle operators from collisions in the constrained mining environment. SAFEmine's data shows that a lot of mining accidents happen due to fatigue. FatigueMonitor smartly fuses CAS data with PerClos and body clock inputs that can detect early signs of fatigue and prevent this type of accident.

In addition to the CAS and fatigue monitoring solutions, SAFEmine's versatile safety package includes SafetyCentre and ShovelAssist. SafetyCentre is made for haul trucks, displaying all relevant safety information via cameras and radar, and other sensors, such as tire pressure. ShovelAssist is a solution to avoid damaging light vehicles and clean-up equipment around shovels.

Hexagon Mining can make any mine safer and more productive today. The future is even more promising. With its commitment to shape smart change, Hexagon Mining does not just imagine bridging the gap between short term planning and operations, or connecting fleet operations with mine planning, or making analytics and business intelligence holistic and universal; it is working to make these solutions a reality.

While fluctuations in mining are guaranteed, Hexagon Mining aims to be the industry's other constant, the dependable foundation on which mines can build productive futures. Integration and automation across the entire mining chain is the goal. Representing more than 100 years of innovation and experience, the company has all the ingredients necessary to realise that goal.

And with it, the digital mine of the future.