HACKING QUARRY ECONOMICS

NEW INTEGRATED TECHNOLOGIES ARE "READY FOR PRIME TIME", MAKING IT EASIER FOR QUARRIES TO CHART A COURSE TO RELIABLE PROFITABILITY AND FLEXIBILITY

By Ralph Smith, Director of GEOVIA Centre of Excellence, Dassault Systèmes

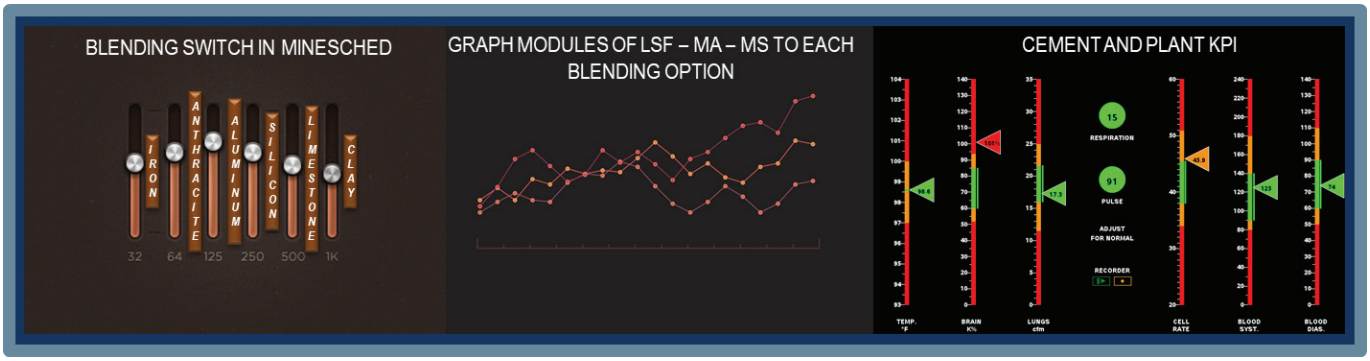
Pity the poor quarry manager! They have never been under such tight pressure to meet seemingly conflicting business imperatives: On each order, they must adhere to quality and consistency requirements. While processing is typically complex and dependent on multiple variables, the plant manager must follow a recipe where the ingredients vary during the production process in grade, cost and blending requirements. Of course, we must deliver at the lowest possible cost and, ideally, with minimal impact on existing assets and additive reserves. The need to meet regulatory and environmental requirements is always at the back of one's mind, especially in order to avoid any penalties for exceeding emission caps. Last but certainly not least, we need to meet and deliver orders at a profit to key stakeholders.

The ugly truth of the industrial minerals business is that quarries don't have the luxury of perfect sources from which to draw and deliver their products. Gone are the days of Carrara-like quarry sources with unblemished blocks from which Michelangelo could liberate the Madonna for his Pieta! Now product requirements are much more sophisticated and putting unprecedented demands on how quarries are exploited. Being able to mine intelligently is crucial to profitability and ongoing operational success.

BUILDING A PLATFORM FOR SUSTAINABILITY

Many of our customers are already running lean teams, particularly when it comes to geological modeling and mine design. Often mining engineers are responsible for multiple quarries and need to consider optimizing their use of these different assets to ensure an orderly and profitable extraction to meet ongoing business needs. They found that the use of properly implemented and structured geology and mine planning software with intuitive interfaces enabled effective training of staff and contractors, resulting in increased productivity at the plant and operations that scale with demand requirements. They found that this resulted in increased user productivity by reducing time to process, as well as minimizing the number of manual activities required.

Most importantly, the process of putting in place a consistent and reliable workflow upon which to ensure key tasks and deliverables are met, becoming less process-focused and putting mine planning in place, built a measure of operational stability into the business. This enabled them to start tackling some of the trickiest issues such being able to consider medium to long-term planning, doing some pre-development drilling to serve as a kind of inventory audit, and cleaning up consistently inaccurate surveys of their sites.



Several improvements were reported. For example, quarry plans were improved and included all the factors for safe and effective operation, including geological, geotechnical, environmental and operational considerations. A rolling plan was developed to ensure there was a clear indication of who needs to do what and when. Schedules showed what material will be available at what time and in what quantity and accurately identified quarry development requirements. Stakeholders were able to quickly develop a clear understanding of the geology of their deposit, allowing greater control over ore and waste extraction. Finally, quarries had the luxury of being able to create more efficient, easier to mine quarry and blast designs.

ENABLING CONTINUOUS IMPROVEMENT

Once our customers have built a platform that provides a degree of operational stability for their quarrying operations, they can build upon it by plugging in medium- to short-term planning tools to facilitate haulage and scheduling requirements to meet demand.

Unsurprisingly, our quarry customers encounter the same causes of instability in their operations as our other mining customers: There is insufficient planning of all required tasks and activities. Not all planned tasks are robustly scheduled based upon requirements (such as sequence, time, duration, tons, grade, maintenance, safety, regulatory compliance, etc.). Not all scheduled tasks are completed or tracked to specifications. By capturing data centrally, allowing you to accurately control your data and distribute effectively throughout remote sites, enhancing communication and ensuring one version of the truth, a great deal of variation can be reduced. When utilized effectively, planning and operational data can provide rapid insight into how well activities are being performed, enabling fast adjustments as operating conditions change. The analytics it enables will also drive continuous improvement.

Our quarry customers have leveraged their use of GEOVIA Surpac for both mine planning and geological modeling, leveraging its ability to synchronize with GEOVIA MineSched for medium-term scheduling. Some of them are taking it even further, leveraging our Product Lifecycle Management framework enabled with our **3D**EXPERIENCE platform to save their data models to a shared central data repository, allowing it to be available globally and securely.

However, this opportunity for continuous operational improvement is only part of the story.

A DIGITAL ASSISTANT FOR TACTICAL BLENDING

One of the most seemingly intractable challenges that industrial minerals companies face is maintaining product quality. Their product needs to be blended with third party additives to achieve a predictable and consistent result. The cement industry in particular struggles with the calculations required to blend the chemical characteristics and mining parameters necessary to extract material from the mine with keeping the cost of third-party additives to a minimum, and at the same time achieving product specifications and maintaining a consistent, quality product.

There might be additional considerations that make product blending even trickier. Some of our customers identified an imperative to ensure they stay below emission caps. With varying orders with different blend requirements, the risk of exceeding these caps can be perilously high. At best, this would negatively affect the production of the plant; at worst, it could stop the plant altogether, or that could trigger a partial shutdown of the plant.

Frequently the calculations required to ensure product quality are completed in a spreadsheet or by guesswork resulting in excess additive cost and an increase in product variability. What if quarry production managers could figure out the absolute best tactical production plan: a plan that is feasible, achievable and meets all the conflicting production requirements?

What if they could have a “digital assistant”?

Recently, Dassault Systèmes has launched a solution to this issue that makes it simple to solve this complex problem. Working with some of our most demanding customers in the cement industry, we’ve developed a solution that extends agility to companies looking to overcome the vast complexities of blending.

It’s a tough problem to solve reliably and efficiently for each and every different scenario in which there are several constraints that may vary during the course of the production cycle. Even more importantly, solving this problem isn’t intuitive and doesn’t lend itself to standard thinking because there are too many inputs and variables to consider in a standard analysis. Tens of thousands of possible configurations need to be considered and the outputs need to be captured and mapped in a way that allows users to quickly identify the best and most feasible solution that meets all the underlying constraints.

Called “Tactical Blending”, this solution combines our targeted mine scheduling algorithms with an iterative simulation tool to optimize the right solution every time. Tactical Blending compares hundreds or even thousands of blending alternatives and presents the consolidated output in a series of intuitive easy-to-interpret output formats that characterize the best options available under the current constraints. These consider a myriad of different drivers, including haulage, the cost of the 3rd party additives, their chemical characteristics, and the mining parameters employed to extract material from the

mine. Using Monte Carlo simulation and parallel optimization techniques the Tactical Blending solution allows industrial minerals companies to save time and address uncertainty in the blending process whilst ensuring a reduction in costs and consistent quality standards.

The solution can take as input 100+ types of blending material with different cost and chemical qualities, and then run 10,000+ scenarios with different mine schedules according to the blending material, and finally monitor plant and cement KPIs to match schedules with each blending set.

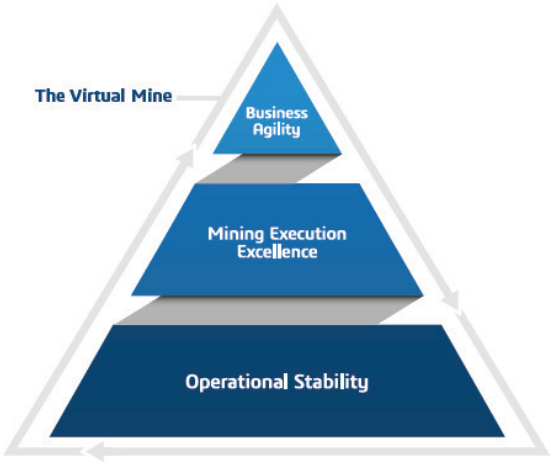
When focusing on being able to reduce truck hours considering mining directions, production rates, plant throughput and grade targets, one of our customers was able to identify ways to reduce haulage by 15%. When reduction of additive costs was considered along with mining directions, production rates and material ratio targets, another of our customers was able to eliminate unnecessary and costly 3rd party additives by as much as 76%.

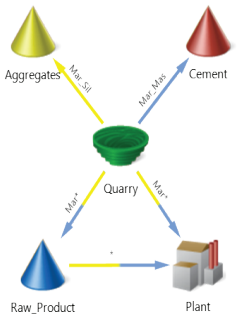
These results are significant and should give quarry managers everywhere encouragement that a solution is out there.

BUSINESS AGILITY IS ONLY POSSIBLE WHEN THE FOUNDATION IS SOLID

Being able to utilize sophisticated optimization relies upon ready access to a solid foundation. By having a geology and mine planning solution in place that considers the entire operations, and gives unfettered access to the current geology and resources available, quarry operations realize a significant measure of Operational Stability. Having this interact flexibly with mine scheduling that can develop enhanced production schedules that are immediately responsive to the plant's changes in demand or changes within your quarry environment, provides for global control of the business and the opportunity to continuously improve operations.

Being able to respond quickly, decisively and with the full confidence that the best possible plan is available can be achieved with industry-leading simulation and optimization tools. In our case, our customers leverage the easy configurability and target-scheduling capability of GEOVIA MineSched with SIMULIA's Isight iterative simulation tool. The results have been tangible and feasible and we've only just scratched the surface of what this "digital assistant" technology promises for our quarry customers worldwide.





Iteration	MRT 1	MRT 2	Aluminum	Silica	Mix	Iron	Additive Cost
1	0.5	3.2	1	1	1	1	$212,000
2	0.7	3.5	2	1	1	1	$254,000
3	0.3	4.2	2	2	1	1	$209,000
4	0.9	4.1	3	2	1	3	$266,000
5	1.2	4.5	2	3	2	1	$198,000

For more information, visit ifwe.3ds.com/natural-resources/industrial-minerals-revolution

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