

APPLYING INNOVATION FOR SAFETY AND PRODUCTIVITY GAINS

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As demand once again returns to mining driving a resurgence in activity, the sector now finds itself operating against a backdrop of declining ore grades, a stronger focus on safety and the need for increased productivity. In this new environment, previous operational paradigms are becoming less appropriate resulting in a strong interest in exploring new operating models.

With technology driving rapid changes in other parts of the economy, the conversation in mining has naturally shifted to bringing a culture of innovation to the sector to address some of these issues. But what is innovation, and is there a process for implementation? If research can be thought of as the process of turning 'money into ideas', then innovation is the process of turning 'ideas into money'. As it turns out, there are many innovation processes, but finding and applying the right one is the key to delivering breakthrough thinking.

By way of example, when done properly, blasting can be the cheapest and most energy efficient form of rock breaking available to the modern mine. Complex blast profiles can be constructed to maximise blast performance and therefore commercial gain, through the use of sophisticated software packages. But, like all analytical tools, the outcome is directly impacted by the quality of input data. Identifying and developing new methods to improve and potentially automate the collection of data 'on the bench' through innovative techniques offers an opportunity for significant efficiencies and improved safety.

To add some perspective to the challenge, it is variously reckoned that around 200,000 blast holes are drilled worldwide each day. Once drilled, data on each hole including location,

diameter, depth, etc. are captured in the drill log as input to the blast plan. Currently much of this data is collected manually, often using paper-based systems and sometimes more than once before the blast plan is finally executed. All of this adds up to data reliability issues, and from a safety perspective, more time spent by personnel on the bench putting operators in harm's way.

Imdex, a global mining technology company, develops products to improve the processes of drilling and for collecting sub-surface data. Having already developed a number of survey sensors and paperless reporting systems for use in exploration, they were well placed to improve and automate data collection on the bench. As they looked at addressing this challenge, they turned to innovation to develop new ideas around 'digitising the bench'.



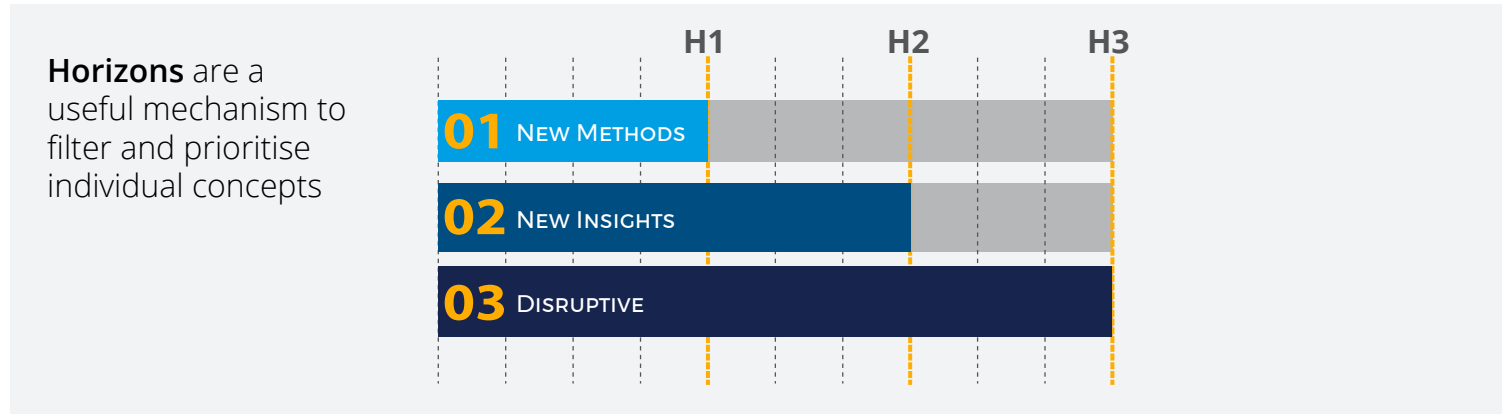
Exploring new ideas to automate data collection on the bench

Photo credit: Imdex

STARTING THE JOURNEY

Having identified the challenge, where can a company like Imdex start the innovation journey? Before answering that question, it is first useful to think of the journey as a series of 'horizons', each representing a more advanced step away from current

practice. This provides a useful methodology for classifying the solutions developed in response to a challenge. It also provides a form of technical roadmap that can be used to commercially structure entry of the solution into the market.



Solutions that can be classified as **Horizon 1** are generally a reworking of existing practice with an element of engineering novelty. With lower technical risk (but not necessarily effort) these are often used as the first 'toe in the water' of a new market.

Horizon 2 solutions are 'first of type' implementations that draw upon new insights generated from a deeper analysis of the problem combined with novel engineering techniques – often borrowed from adjacent industries. These are the 'work horses'

of the innovation process representing a significant step forward in current practice both technically and commercially.

Horizon 3 solutions are the industry disruptors, representing ideas that will break industry norms. These are typically characterised as involving deeper engineering investigation, longer timeframes and higher technical risk. When managed properly however the commercial payback can be significant.



Facilitated innovation at Imdex

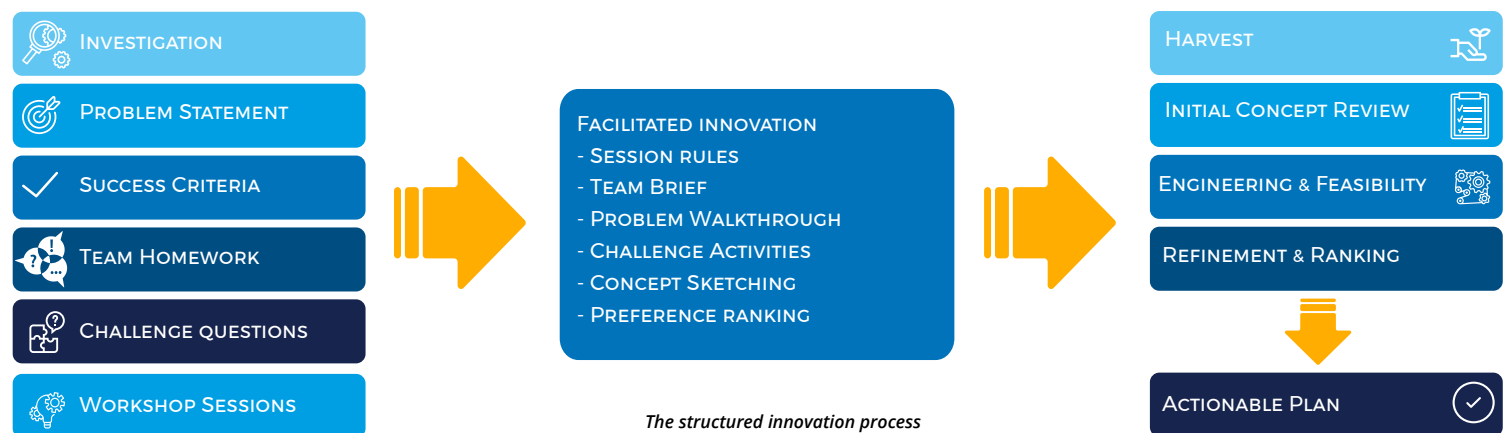
WHICH INNOVATION PROCESS IS RIGHT?

Trial and error will sometimes produce a workable design solution, but there is a substantial library of tools available to allow teams to produce 'innovation on demand'. These include well-known techniques such as brainstorming, through to the more esoteric like TRIZ. Each has its strengths and weaknesses and knowing which to apply in response to a problem is critical, particularly where technical challenges need to be solved within commercial timeframes.

For more technically constrained problems one or two subject matter experts conducting desktop research is a useful approach. For more expansive challenges opening up the

problem to a broader audience is a better approach. In so doing new perspectives and cross-industry knowledge can be added to in-house expertise to move the problem towards new solution spaces.

The 'digitisation of the bench' challenge, with its constraints and need to build a roadmap of future Horizon 2/3 solutions, falls into the latter category. In this instance the process used was framed around an Ideation workflow adapted to include a strong focus on technical feasibility. The process is outlined in the diagram below.



STRUCTURED INNOVATION

Using a small 'lead out' team, the first step is to explore the problem as currently understood and to investigate any solutions identified to date. Defining key success factors should be done at this stage to provide a yardstick against which to measure the developed concepts. The team can then drill down into the core issues to develop a set of challenge questions around particular aspects of the problem. Some of these questions, together with worked solutions, may also be sent to the team as pre-work to stimulate thinking. This is where a structured innovation process differs from general brainstorming in that the aim is to focus participants onto resolving a few critical aspects of the problem rather than general solutions to the whole.

A structured and facilitated workshop comprising one or more sessions is the next step in the process. During these sessions the key questions uncovered during pre-work are systematically presented to the team to generate ideas. It is often thought (hoped) that the workshop phase will spontaneously uncover the silver bullet solution to the problem at hand. While this sometimes happens, often the real value in the workshop is in defining what the solution is not and where the answer is more likely to be, based upon shared experience and expertise. This is particularly true of deep technical challenges where an idea may require further investigation.

Part art, part science, it is the 'harvesting' phase that is the core value-add of the innovation process. It is here that ideas are reviewed, combined, assembled and disassembled to produce an initial set of concept solutions. The concepts are assessed against the key success criteria and then presented for discussion by the workshop team. The aim of this activity is to arrive at 2-3 concepts to be refined over subsequent weeks through further investigation and assessment for technical and commercial feasibility.

The final phase is one of review and down-selection to a preferred candidate. Each refined concept now includes a more thorough assessment of feasibility but, more critically, a list of identified knowledge gaps and risks. It is the investigation of these gaps and risks that forms the next stage of work for the engineering team.

The selection of the final candidate can be done purely on technical ranking but often other factors such as commercial opportunity, resolution timeline or time to market come into play. It is at this point that concepts can be cast into one of the three Horizon solution categories to help bring clarity to these other, non-engineering, aspects of the problem.

INNOVATING WITH IMDEX

Running over a period of eight weeks, the Hydrix and Imdex teams undertook a program of preparation, workshop sessions and follow up analysis to identify and refine a number of concepts. Some of the key success factors for assessment were usability, cost, suitability for automation and technical performance. In addition, solutions that reduced time spent on the bench by personnel were favoured as these directly resulted in cost savings and improved operational safety.

Through leveraging existing know-how, Imdex had already identified some possible Horizon 1 solutions. One example is the use of existing downhole sensor technology combined with

robotic vehicle deployment. This approach has shown significant promise during field trials and is already helping to move industry thinking in the area.

Ideas falling into the Horizon 2 category included instrumentation of the bench using ultra low cost disposable sensors which in some cases were suitable for deployment by drones. A handful of Horizon 3 approaches using non-contact technologies were identified with some potentially offering game-changing outcomes. These solutions will be placed in the longer-term development roadmap after further research.

CONCLUSION

The inconsistent measurement of a number of on-bench parameters continues to add cost and risk to mining operations. Delivering good blast outcomes requires reliable data and this is at the heart of Imdex's move to bring its expertise to open cut bench operations.

When faced with a number of possible paths forward, and an underlying suspicion that there may be further alternatives, it is often valuable to step back and 'cast the net wider' when taking on complex challenges. This is where applying an appropriate and structured innovation process, together with the right expertise, can deliver clarity and value.

Reflecting on the journey, Dave Lawie, Chief Technologist for Imdex's Mining Technology division, commented "The Hydrix team helped us to structure and explore the problem in a systematic way, and we saw great value in the process".

As for Imdex, they are now well placed to continue their development journey to further explore and contribute to the improvement of operations on the bench, armed with a roadmap of innovative ideas to progressively develop and commercialise.

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Dave Lawie

Chief Technologist, Mining - Imdex

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