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Introduction



In 2017, Deloitte and NORCAT,

one of the world's leading advanced manufacturing and mining technology innovation centres, entered into a

partnership. The goal was to highlight key trends emerging from NORCAT's Underground Centre, a unique, state-of-the-art operating mine in Sudbury designed to enable start-ups, small/medium enterprises, and international companies to develop, test, and showcase new and innovative technologies in an operating mine environment. In an ongoing series of thought pieces, Deloitte and NORCAT will offer insights into those trends, demonstrate some practical examples, and discuss why and how each trend has developed. In this, the first of the series, we discuss Human-Centred Design in Mining.

A spotlight on human-centred design

While mining is an asset intensive industry, it is at its heart very much a people's business, which as the industry adopts new technologies and drives new innovation, requires day to day operators to enable the change and bring these technologies into day to day processes. Many of these technologies are designed to tackle some of the industry's major challenges such as reducing risk of human injury and fatality, reducing energy use, and bringing communities and mining organizations closer together. But for many years, this is an industry that has been slow to adapt and to adopt.

In recent years, businesses across industries have begun to adopt a more user-centric approach to innovation. Rather than tweaking existing products and solutions in a bid to innovate, organizations are reimagining the entire design process by explicitly tying the development of new products, services, and solutions to their end-users' desires and operational environments. It's called human-centred design (HCD) and its aim is to ensure that any new design first meets end-user requirements. The adoption success that

has been seen in many industries can perhaps now be replicated in mining through this user-centred approach to design. This would create impact in an industry that lags many others.

While HCD got its start in the tech world, it is now used for a broad range of applications—and is quickly making its way to the mining sector. As mining companies adopt HCD, users—in this case, mine operators—get access to systems designed with their needs and behaviours in mind. In the process, companies can improve operational efficiency, drive greater productivity, and even reduce the number of safety incidents—better positioning them to earn a sustainable license to operate.

To succeed in these efforts, however, organizations need to understand how to:

- integrate HCD into their design process,
- realize its potential benefits, and
- leverage best practice learnings from companies that have already adopted HCD.

“This shift in consumer behavior, driven largely by technological advances in mobile devices, e-commerce, and social platforms, has elevated the role of design thinking, a methodology for solving problems by drawing lessons from the world of design in the pursuit of innovation.”¹

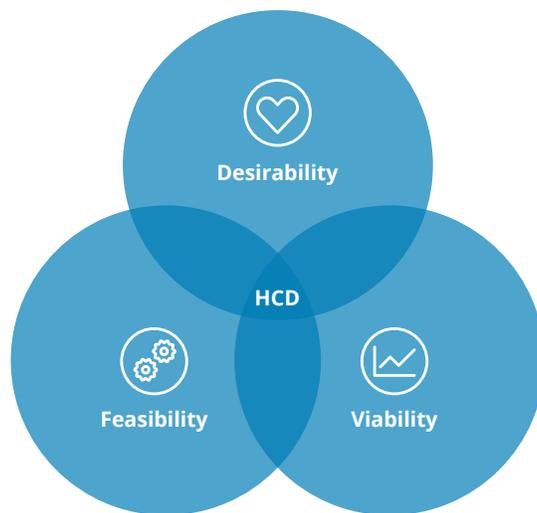


Integrating HCD into the design process

As with any new approach, integrating HCD requires the adoption of an established framework—in this case, one that encourages new ways of innovating by ensuring that designers ask the right questions throughout the four phases of the innovation process: concept, prototype, pilot, and launch/scale-up.

The Balanced Breakthrough Model (BBM) is particularly useful in this regard. It has three core components—desirability, feasibility, and viability—that are variably applied at different phases of the innovation process.

Elements of the Balanced Breakthrough Model²



During early stages, designers focus on desirability in an effort to prove that the solution serves unmet needs that will resonate with consumers. In later stages, the focus moves to feasibility—a demonstration of the company's ability to produce the offering, and viability—proof that the solution can succeed in-market.

Desirability is the first step of the HCD process as it both underpins and informs the other two components. The key is to build the solution to align directly with its users' desires, needs, tasks, and

operating environments. By consulting users and other stakeholders at each stage of the process—and drawing from both industry trends and competitive insights—multi-disciplinary teams of researchers, designers, developers, ergonomic experts, and usability champions gain a clear understanding of the end-users' requirements and constraints. Using an iterative design process, they can then integrate the solution into the organization's wider work stream and customize it to adapt to the conditions prevalent at different mine sites. This varies considerably from miners' traditional product development approach, which typically focuses on a

“The key aspect is a continual focus on mine site users, their actual tasks and the mine site environment/use context.”³

product's feasibility and viability with little regard to the day-to-day needs and activities of the mine operator.

Once desirability is established, it's up to the engineers, technology architects, and regulatory experts to determine the solution's **feasibility**. This requires an understanding of the company's current initiatives, capabilities, assets, and partnerships—as well as familiarity with emerging digital technologies—to assess if the company has the operational, technological, legal, and regulatory ability to develop the offering.

Finally, the company's analysts, executives, business experts, and market researchers must prove the solution's **viability**. This involves determining how to test the offering in-market, if the company's business model can accommodate the solution, and what economic benefit the company hopes to realize upon rollout.

Through this approach, HCD becomes a process of discovery where the needs of the user influence the feasibility and viability of the solution under development—ultimately assuring its utility and value before it is ever designed or implemented.

Reaping the rewards



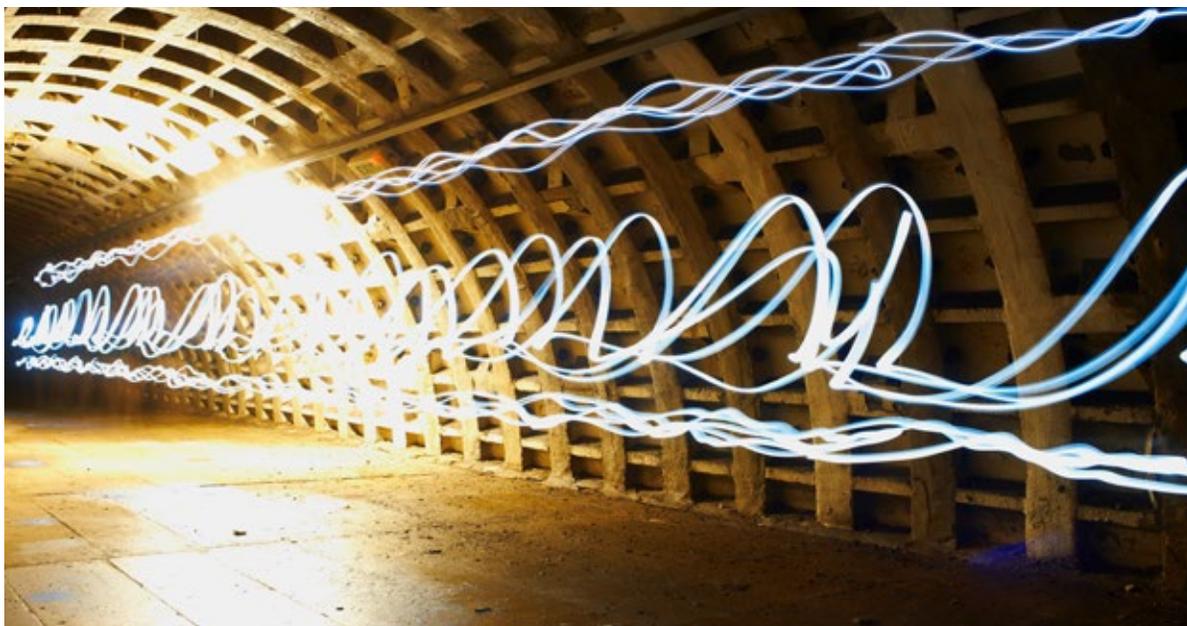
The benefits of HCD

- Increased user productivity as a result of enhanced system usability and a more effective human/machine interface
- Reduced user errors and decreased reliance on user support thanks to improved operator understanding
- Lower costs for training and development due to the creation of fewer unnecessary system features
- Greater compliance with procedures, higher levels of product advocacy, and more rapid system adoption

The use of an efficient, multi-phased research and development approach has already yielded results in the HCD field, with the industry seeing increasingly rapid deployment of automation, sensors, smart devices, and other game-changing technologies. By leveraging HCD when adopting these solutions, mining companies can ensure that they meet end-user needs for safety, efficiency, and ease of use. Consider, for example, the benefits of deploying a new app in a mine site to provide operators with real-time information on process performance. By assessing how to make the app more desirable to users—for instance, how operators will react to the information on the interface and what neurological triggers will be activated—a company can not only help optimize the human machine interface, but also drive higher user adoption rates and help change behaviours.

As the case studies overleaf show, these are precisely the outcomes mining companies are realizing through the application of HCD.

Learning from the leaders



Despite the utility of HCD, mining companies remain justifiably reluctant to implement new solutions without real-world use cases that demonstrate their benefits. In recent years, NORCAT has worked with several mining technology companies that have embraced HCD.

To understand how these companies' product development processes differ from those of traditional approaches, Deloitte teamed up with NORCAT to conduct a series of interviews with their executives. We spoke to five leading companies that have successfully adopted HCD development approaches—such as **continuously engaging with end-users, creating working prototypes, and applying onsite observations**—into their current processes. Their stories make a compelling case for the desirability, feasibility, and viability of HCD in the mining sector:

For three of our five companies, **continuously engaging with end-users** throughout the design process,

including internal staff and external clients, has had a tremendous impact on their solutions' success:

- For instance, cloud-based software solution designer **Minalytix Inc**, whose products help maximize the value of drilling data, uses a variety of iterative design techniques to get its products to market. Before beginning product development, Minalytix identified user requirements, assessed similar competitive products, and hired a UX product design expert. As development progressed, Minalytix continued capturing user feedback and involving end-users in its iterative design process, including sharing solution demos online, tracking the most-used product features, and soliciting customer comments. Even after release, the company continued the process, allowing it to refine its product in response to evolving user needs. For example, a planned feature to let workers tag database objects to enable global search was deferred, while “social feed” functionality, initially considered a nice-to-have by Minalytix, was kept and its development accelerated.

- **HLS Hard-Line Solutions Inc.** took a similar approach, relying on user feedback to effectively develop and refine its product line—autonomous mining machines that can be controlled remotely, eliminating the need for operators to work underground during the loading and dumping process. The company began the product development journey by conducting in-house research that involved both technical and operating staff. Once a viable product was developed, Hard-Line began testing with partners, mine operators, and mechanics—as well as actively observing workers putting the technology into action—to get ideas on what could be improved or tweaked. In one case, Hard-Line learned via user feedback that its “no-sound” model created an issue; operators felt they needed to hear the machine working. In response, the company integrated a microphone to include sound level from the drift, resulting in improved customer satisfaction.
- **WipWare Inc.** is a provider of photographic analysis software technology that enables real-time material size analysis, allowing mining companies to enhance sizing accuracy while eliminating manual processes. Always looking to refine its product, WipWare took a full-on interactive approach to leveraging feedback: once the software had been fully rolled out and implemented by its customers, the company hosted a series of think tanks to gather end-user responses. From these consultations, WipWare learned that data access was posing a bigger problem for workers than data creation, so it decided to make its software available as an iOS app. This gives workers real-time access to the information they need, whenever they need it. Beyond using current, “in-process” feedback to refine product development, WipWare also reviews historical client data to refine its software algorithm on an ongoing basis, allowing it to continually improve system accuracy.

Shifting the focus of its HCD development approach somewhat, **K4 Integration**—an industrial instrumentation company whose solutions track people, material, and equipment in mining operations—is focused on **creating working prototypes** to drive product evolution and to gain acceptance in the mining industry. Further to the surveys conducted with multiple mines and industry experts, the company produced a mock-up of its electronic tag-in board and tested it at various stages of the design by inviting end-users to interact with it. This prototype-centred process has proven its value, generating key learnings from end-users. For instance, it brought forward the requirement for a fail-safe review and as a result the company implemented a board heartbeat feature so power interruptions could be noted and acted upon. From subsequent discussions with end-users, K4 Integration also developed data driven business rules, such as the tracking of hours spent underground by all employees and contractors; and if an invalid tag is detected, the system will alert the operations team automatically.

Maestro Digital Mine is a provider of underground ventilation and network communication solutions that allow users to measure, monitor, and maintain ventilation data from anywhere in the mine. The company has achieved consistent HCD success by **applying onsite observations** during its product development process. To gather the appropriate information, the company sends consultants to personally visit mining operations, observe specific on-site product implementations, and meet and interview end-users to collect relevant feedback. As a result of this approach, Maestro Digital Mine discovered that many companies were not installing the product’s diagnostic function; this was due to organizational and information silos existing between those responsible for the control station and those responsible for underground elements. To close this gap, Maestro Digital Mine developed a new product called MaestroLink™, which provides ventilation teams with a visual interface to the company’s air quality product.

Using HCD to drive innovation



It's no secret that the mining industry faces a range of endemic challenges, including declining productivity, rising costs, and mounting risk and uncertainty. To counter these pressures, most mining executives agree that the sector requires greater investment in innovation. As the above success stories suggest, the adoption of HCD represents a critical step in that direction.

Our research shows that companies that take their users' real-world requirements into account when designing new systems stand to realize a host of benefits—including accelerated product development, more rapid product buy-in, faster adoption, and reduced development costs. More critically, these benefits accrue to the actual end-users—providing mine operators with access to safer, less costly, easier-to-use solutions that can enhance their productivity and quality of life. As an upshot, the industry as a whole advances—making HCD a true win/win/win proposition.

To discover some best practice approaches for the adoption of HCD, or to discuss how the BBM framework can help you improve product design, contact us today.

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Endnotes

- ¹ *The Wall Street Journal*, May 24, 2017. "Using Design Thinking to Innovate," by Deloitte. Accessed at <http://deloitte.wsj.com/cmo/2017/05/24/using-design-thinking-to-innovate/> on July 20, 2017.
- ² Deloitte/Doblin Framework
- ³ *19th Triennial Congress of the International Ergonomics Association*, August 2015. "Human Centred Design for Mining Equipment and New Technology."

About the Deloitte/ NORCAT partnership

Deloitte, one of Canada's leading professional services firms, provides audit, tax, consulting, and financial advisory services. Deloitte LLP, an Ontario limited liability partnership, is the Canadian member firm of Deloitte Touche Tohmatsu Limited.

NORCAT is the only non-profit regional innovation centre in the world that has an operating mine designed to enable start-ups, small/medium enterprises, and international companies to develop, test, and showcase new and innovative technologies in an operating mine environment. This unique facility anchors one of the world's leading advanced manufacturing and mining technology clusters and represents a "one-stop shop" to see future technologies and innovations that are poised to transform the global mining industry.

As part of their strategic partnership, Deloitte and NORCAT are taking steps to help the global mining industry better understand emerging mining technology and innovation trends. Their goal is to combine on-the-ground insight gained from companies that have installed emerging technologies at the NORCAT Underground Centre with the market knowledge of the Deloitte global mining team.

Special thanks

We would like to thank Minalytix Inc., Hard Line Solutions Inc., WipWare Inc., K4 Integration and Maestro Digital Mine for agreeing to participate in this study and sharing their design process with us. Also we would like to acknowledge Magesh Pillay and Jean Davin for their work on this thoughtpiece

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Designed and produced by the Deloitte Design Studio, Canada. 17-5079T