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Diggers & Dealers 2017

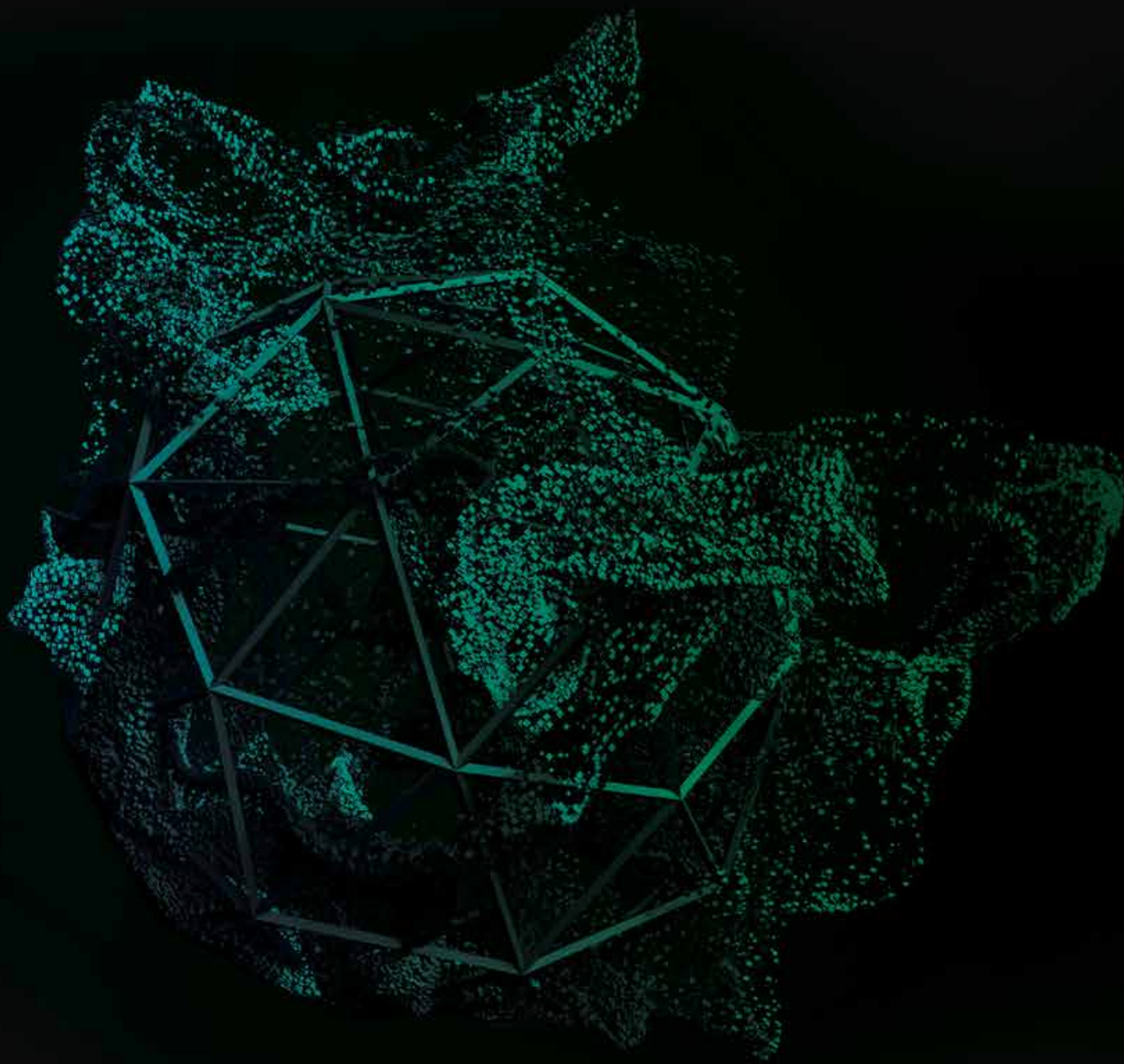**The digital mine**

What does it mean for you?

Diggers & Dealers 2017

" Every other day I open the paper and read about some fancy new technology at Rio or BHP: driverless trucks and trains, autonomous ships, and drones.

But I don't have the kind of budget or team that the majors have, so how do I know where to start and what technologies I should invest in to get the best bang-for-buck for my business? "

Earlier this year, Deloitte published "*The Digital Revolution: Mining starts to reinvent the future*", which explores how mining organisations can take advantage of digital technologies to create value, and describes a future digital mine, with reference to real examples of what is possible.

While the majors have been investing in automation and technology innovation for several years, 2017 is the year in which we are seeing the digital agenda moving into the domain of the broader mining industry. Rapid advances in technology along with decreasing costs overall has meant that harnessing the power of digital has become more practical and achievable - to the extent that it is now becoming an imperative.

However, in discussing this topic, many mid-tier and junior miners are asking: "How do I know where to start with digital, and what technologies should I invest in to get the best bang-for-buck for my business, when I don't have the kind of budget or team that the majors have?"

To help answer this question, we refer to the "Digital Mine" framework introduced in the "Digital Revolution" paper, in which we have envisaged the future state digital mining organisation and how this might transform the core mining processes, the flow of information, and supporting back-office processes.

Core mining processes – automating physical operations and digitising assets

There are five key features in the core operational processes of the "digital mine":

1. **Automation and remote operation**
   The majors have shown how autonomous mining equipment (including drills, trucks and trains) and remote operations can improve safety, productivity, and reduce cost in large scale operations. Whilst automation may not be feasible for smaller players' existing operations, they should consider it as an option for new mines, leveraging the capability and investment being made by many of the equipment manufacturers and service providers.

2. **Real-time data capture**
   Advances in Internet of Things (IoT) technology are enabling a connected network of low cost, highly capable sensors to capture data in real time, to enable integrated planning, control and decision support. These capabilities do not require major investment, and are increasingly being bundled into the offerings of the equipment manufacturers and service providers.

3. **Digital twins – Digitised geological, engineering and asset data**
   A digital model of the physical environment, constructed using geological, engineering and asset information, can be continuously updated with data from sensors and location-aware mobile devices. This enables better planning, prediction, and simulation of future outcomes. This doesn't have to cover all operations and assets, it can be focused where the potential value is greatest, and should be considered in the planning and design of new operations.

4. **Drones**
   As the capability of un-manned drones improves and their cost continues to reduce, they can be used for data collection, inspection, stock control, condition and safety monitoring.

5. **Wearables**
   Similar advances in wearable technologies make them worthy of consideration for field maintenance and real-time machine inspection instructions, improving operator-based care and safety.
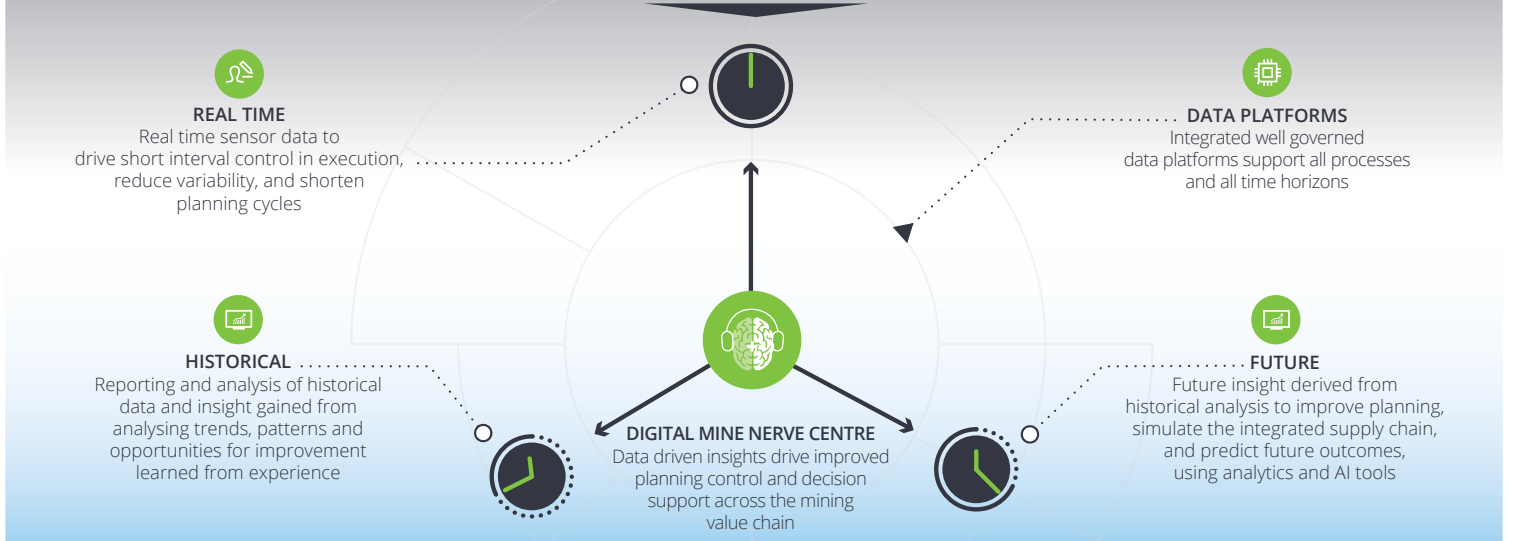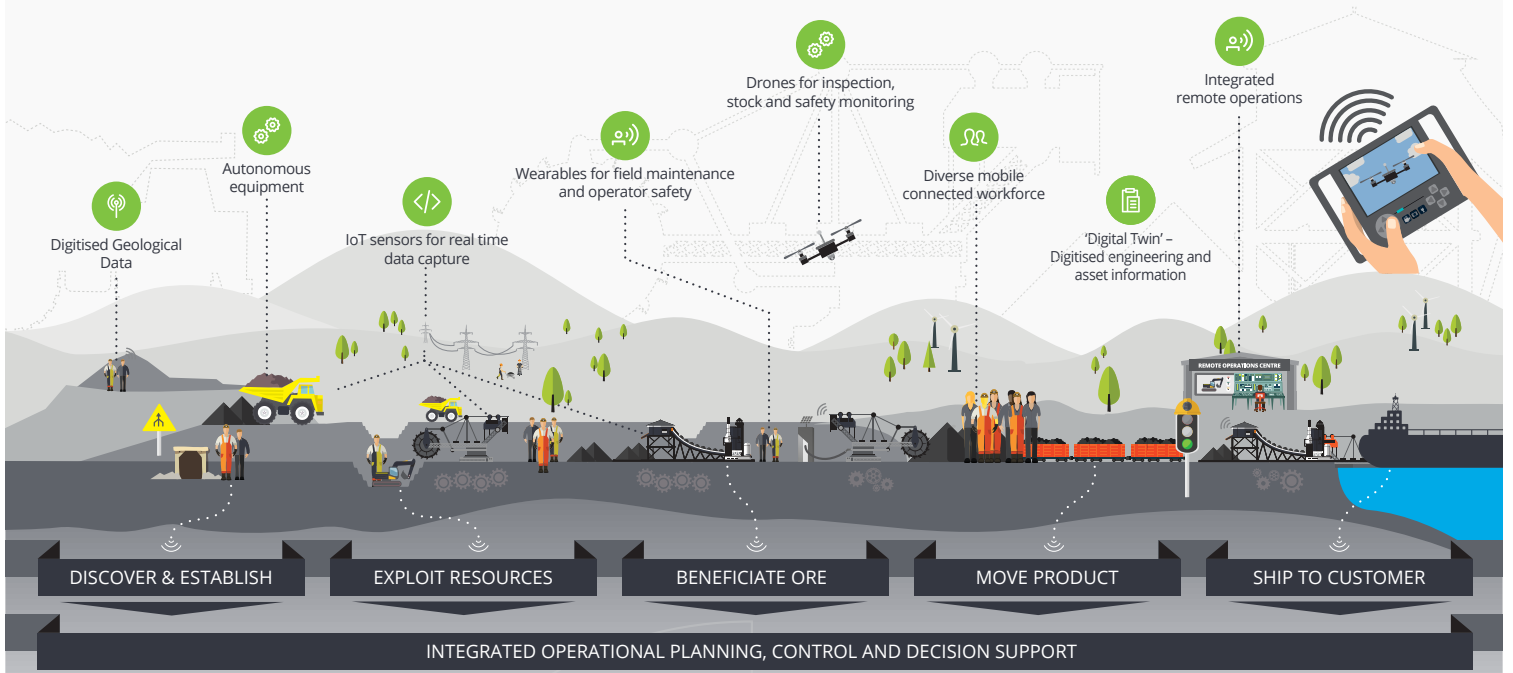
Digital in action
Resolute Mining is planning for its Syama Gold Mine in Mali to be an example of an Underground Mine of the Future. It aims to establish fully automated loading and hauling, automated fleet and production management and scheduling, real–time tracking, monitoring and data analytics. This is expected to lead to improved safety, greater productivity and lower operating costs.

Source: http://www.rml.com.au

Digital in action
Evolution Mining introduced a live online data monitoring system to the Mungari mine which improved the average payload of trucks by 4% in the commissioning phase.

Source: http://www.asx.com.au

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Drones for inspection, stock and safety monitoring

Integrated remote operations

Autonomous equipment

Wearables for field maintenance and operator safety

Diverse mobile connected workforce

Digitised Geological Data

IoT sensors for real time data capture

'Digital Twin' – Digitised engineering and asset information

| DISCOVER & ESTABLISH | EXPLOIT RESOURCES | BENEFICIATE ORE | MOVE PRODUCT | SHIP TO CUSTOMER |

INTEGRATED OPERATIONAL PLANNING, CONTROL AND DECISION SUPPORT

REAL TIME
Real time sensor data to drive short interval control in execution, reduce variability, and shorten planning cycles

DATA PLATFORMS
Integrated well governed data platforms support all processes and all time horizons

HISTORICAL
Reporting and analysis of historical data and insight gained from analysing trends, patterns and opportunities for improvement learned from experience

DIGITAL MINE NERVE CENTRE
Data driven insights drive improved planning control and decision support across the mining value chain

FUTURE
Future insight derived from historical analysis to improve planning, simulate the integrated supply chain, and predict future outcomes, using analytics and AI tools

INTEGRATED ENTERPRISE PLANNING AND SUPPORT PROCESSES

| MAINTENANCE | SUPPLY | ENERGY MANAGEMENT | HSE & COMMUNITY | FINANCE | HR | IT | MARKETING |

Reimagined core systems on cloud platforms

RPA for support process

IT/OT convergence

Integrated communications network with cyber security

Diverse & inclusive workforce

Shared Services & COEs

The digital mine nerve centre – data-driven planning, control, and decision making

The "nerve centre" of a digital mine will bring together data across the mining value chain in multiple time-horizons, to improve planning, control and decision-making, in order to optimise volume, cost and capital expenditure, and also improve safety.

Mid-tier and junior miners can get significant returns by investing in the following:

6. **Improved visualisation, reporting and analysis of historical data**
   Improved business intelligence and visualisation tools can now be implemented more quickly and cheaply, integrating data from multiple sources, and reducing the reliance on legacy Enterprise Resource Planning (ERP) systems and excel spreadsheets.

7. **Short interval control and operational improvement**
   Real time data captured from processing equipment and machinery sensors during operation (as described previously) will enable short interval control to identify key drivers of process variability, and drive rapid and focused operational improvements. More timely data will also enable ore-body models, mine plans, and financial models to be updated more frequently, and shorten the planning cycle.

8. **Future modelling, prediction and simulation**
   Rapid advances in analytics and artificial intelligence (AI) tools are enabling insights to improve planning, simulate the integrated supply chain, and predict future outcomes.

9. **Integrated data platforms**
   Each of the three types of analysis described above can be enabled by an integrated and well-governed data platform, supported by specialist data scientists and analysts. This doesn't have to be major investment, it can start with a small focused team, or be purchased as a service.

Re-imagined ERP and automated support processes

The effects of digitisation will extend beyond the core operations to the supporting processes and systems of functions such as supply, HR, and finance.

Smaller mining organisations have an opportunity to go further than the majors, by avoiding legacy on-premise solutions, and achieving a more innovative back-office via the following:

10. **"Re-imagined" cloud-based ERP**
    Core systems such as ERP can be migrated to cloud-based solutions that have a low cost of ownership, and can be purchased "as a service". Smaller players who have previously not considered integrated ERP solutions due to the cost of licenses and on-premise implementation may now be able to afford them.

11. **Robotic process automation (RPA)**
    In the past two years we have seen very rapid growth in the use of RPA to automate repetitive human activities and reduce costs and errors in back-office support processes, especially in shared service centres. The benefits of RPA are also achievable on a smaller scale and should be considered for targeted pilots on process "pain points".

12. **Network connectivity and bandwidth**
    One of the historical constraints to leveraging the benefits of technology has been the limitations of communication networks, especially in remote locations. Use of the LTE spectrum, and capabilities such as software-defined networks, have reduced the cost of supporting a mobile workforce across all platforms.

13. **IT OT Convergence**
    The convergence and more integrated management of information technology (IT) and operational technology (OT) will enable automation and digitisation of both core and support processes

14. **Cyber security**
    Cyber security will mitigate the risks of greater connectivity (as more equipment and devices are connected to the internet).

Impact on people

The people implications of the digital mine should not be under-estimated.

As the digital mine becomes more of a reality, our interpretation of what work is and how it is delivered is changing rapidly. The digital revolution will impact work, workers and the workplace in a multitude of ways.

Whilst there is a lot said in the media about the impact of automation on jobs, history shows that as various industrial and technological revolutions have taken place, there has in fact been a positive impact on jobs. Whilst some roles decline, new roles are created.

Technologies will enable work to be moved to locations which can support a more diverse and inclusive workforce, with increased human-machine interaction, and new and different skills.

The future mobile and connected workforce will increasingly expect an enhanced user experience consistent with the home consumer experience.

Digital in action

Newcrest Mining also plans to introduce drone technology into its operations to reduce both risk and cost. Application includes infrastructure inspections, heat mapping, flora and fauna investigation, and dam breaches.

Source: http://www.newcrest.com.au

Digital in action

Oz Minerals has used drones at Prominent Hill copper-gold mine for mapping, and to measure the heaps of ROM (run-of-mine ore) to measure remaining resources.

Source: http://www.adelaidenow.com.au/business/ sa-business-journal/drones-provide-quantum-leap-in-mapping-accuracy


How can you identify and prioritise the opportunities for digital technologies to add value to your business?

Digital opportunity identification and prioritisation is a key part of Deloitte's recommended approach to digital strategy.

Consistent with key themes of speed and agility, we suggest this can be achieved via a 'Digital Strategy in a Week' as described on the following page.

Each of the identified digital opportunities should be assessed in terms of their potential business value to the organisation versus the feasibility of implementation, as illustrated in the diagram.

The assessment of value and feasibility should consider the questions below.

Opportunity prioritisation

Core processes
Digital Mine nerve centre
Support processes
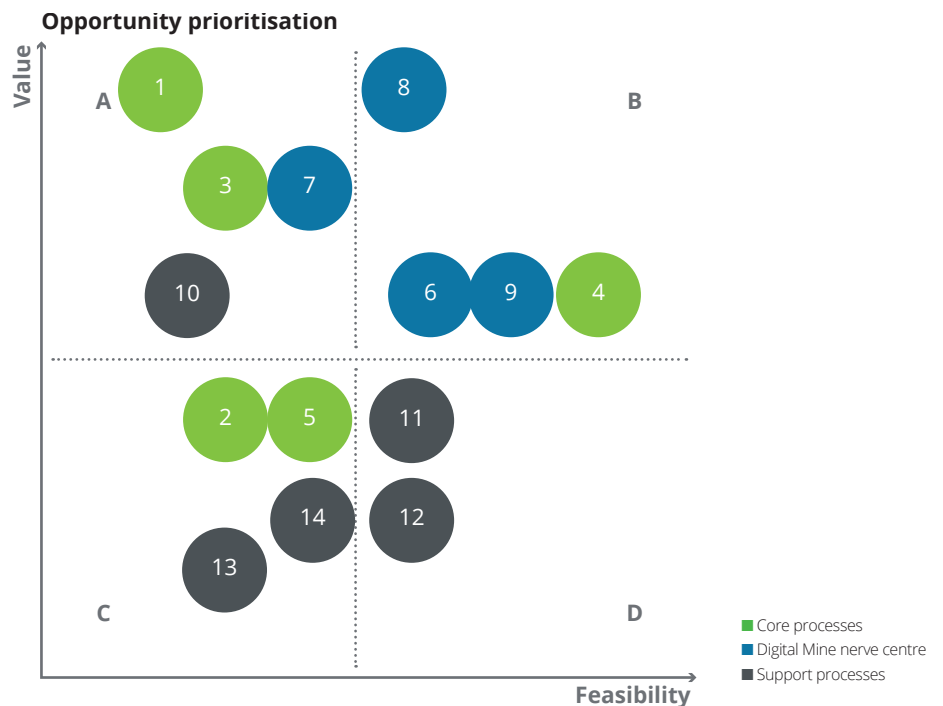
How valuable is this opportunity?

• Does it eliminate harm? ....

• Does it increase productivity? ....

• Does it reduce CAPEX or OPEX? ....

• Does it increase flexibility and agility? ....

• Does it improve the user experience? ....

How feasible is this opportunity?

• How long will it take to deliver? ....

• How much will it cost to deliver? ....

• What degree of technical risk will there be? ....

• What degree of business change is required? ....

• What will be the impact on people? ....

Deloitte 'digital strategy in a week'

A rapid, agile process focused around an interactive workshop, which will:

1. Identify and prioritise digital opportunities, focused on value for your business (*see next page for checklist*)

2. Define and creatively illustrate a future state vision and strategic choices

3. Define where to invest and where to start delivering value…using the Deloitte digital mine framework as a starting point.

Days 1-2

Current state analysis
and opportunity identification:

❏ Interview key stakeholders at corporate/
head-office

❏ Complete Digital Maturity Assessment
survey (online)

❏ Conduct rapid site-based IT/OT analysis,
using reference architecture opposite

❏ Identify opportunities by answering
the questions on the back page.

Deloitte IT/OT Reference Architecture

Day 3

Greenhouse visioning workshop:

❏ Engage key stakeholders in interactive
workshop format

❏ Prioritise opportunities based
on value using the Deloitte Enterprise
Value Map opposite, and prioritisation
framework below

❏ Agree vision and strategic choices:
where to play/how to win.

Deloitte Enterprise Value Map for Mining

Deloitte Greenhouse Interactive Workshop

Days 4-5

Digital Vision and Strategy summary
and next steps:

❏ Identify strategic programs/projects,
and clarify next steps with stakeholders

❏ Develop Digital Vision and Strategy
summary, including creative
visual outputs

❏ Present summary to sponsor/other
key stakeholders.

Opportunity prioritisation
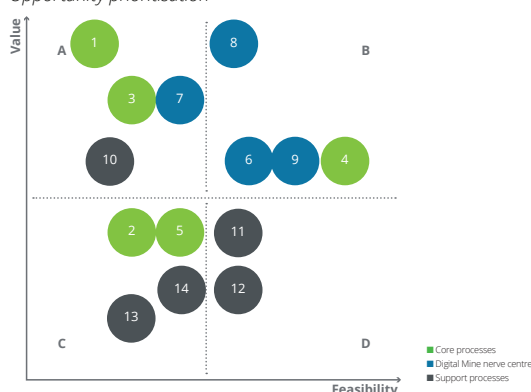
Deloitte digital strategy in a week – Opportunity identification

The following checklist can be used to help identify opportunities:

Core mining processes – automating physical operations and digitising assets

- ❏ How could automation improve my productivity and safety? ....
- ❏ How could I use drones in field work, inspection, or security monitoring? ....
- ❏ What real-time data do I need to support better planning and decision making? ....
- ❏ What benefits could I get from creating a "digital twin" of my ore body and assets? ....
- ❏ How could I build in digitisation when I plan and develop a new mine? ....

The digital mine nerve centre – data-driven planning, control, and decision making

- ❏ How could I improve end-to-end planning and decision-making across my business? ....
- ❏ How could I use predictive modelling to optimise production and maintenance? ....
- ❏ How could I use Artificial Intelligence (AI) to augment human decisions? ....
- ❏ How could I use more of the real-time or historical data that I already capture? ....
- ❏ What issues do I have with the reliability and integrity of data? ....

Support processes – re-imagined ERP and automated support processes

- ❏ How much does it cost to support my ERP & other legacy systems, and how flexible are they? ....
- ❏ How could I take advantage of lower-cost cloud-based applications? ....
- ❏ How could Robotic Process Automation (RPA) reduce costs and free up time for more value-added activities? ....
- ❏ How well does my network support all these capabilities? ....
- ❏ What cyber security risks will I have from greater connectivity of operational technology? ....

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