AI reshapes the fundamentals of value creation

Mining and Metals

December 2025

BCG

Executive Perspectives

Executive summary | Value creation with AI in Mining and Metals (M&M)

WHY
Proven AI value and industry dynamics make adoption imperative

- There's plenty of **AI hype in mining and metals (M&M)**, but after past tech efforts overpromised and underdelivered, **leaders are skeptical**
- That said, over the past decade, M&M companies have unlocked value by **reshaping core operations** (e.g., optimizing the mine-to-mill process, boosting throughput by 2%–5%; improving outbound scheduling; and making operations more efficient by real time planning)
- Industry dynamics **(e.g., shrinking margins due to more frequent commodity market cycles, volatile supply chains, high capital intensity, changing ore composition, talent crises and rise of Gen and Agentic AI)** make AI adoption a necessity
- **The M&M industry is catching up to peers in AI maturity**; countries, including China, Australia, and India, have made strides in areas such as **end-to-end network optimization and machine language (ML) based set point optimization**

WHAT
Multiple opportunities exist across the value chain with AI leaders seeing significant impact

- AI transformation opportunities in M&M can be classified in three ways, depending on AI maturity:
  1. **Mature applications** (e.g., autonomous haulage, ML optimization models for throughput gain, maintenance)
  2. **Applications in early-stage adoption in M&M** (e.g., agentic maintenance, AI enabled exploration, AI based asset design)
  3. **Proven applications in other industries** (e.g., procurement optimization for charge backs and tail spend optimization)
- **AI leaders are driving E2E transformation across functions and achieving tangible gains in cost, productivity, and growth** (e.g., a mining company drove a large-scale AI program to transform mine-to-port E2E scheduling, achieving ROI in 3 months)
- We see potential in key areas **(e.g., maintenance, production, commercial, operations planning and exploration) for AI-led value creation in M&M companies** and recommend that executives explore these as they adopt AI

HOW
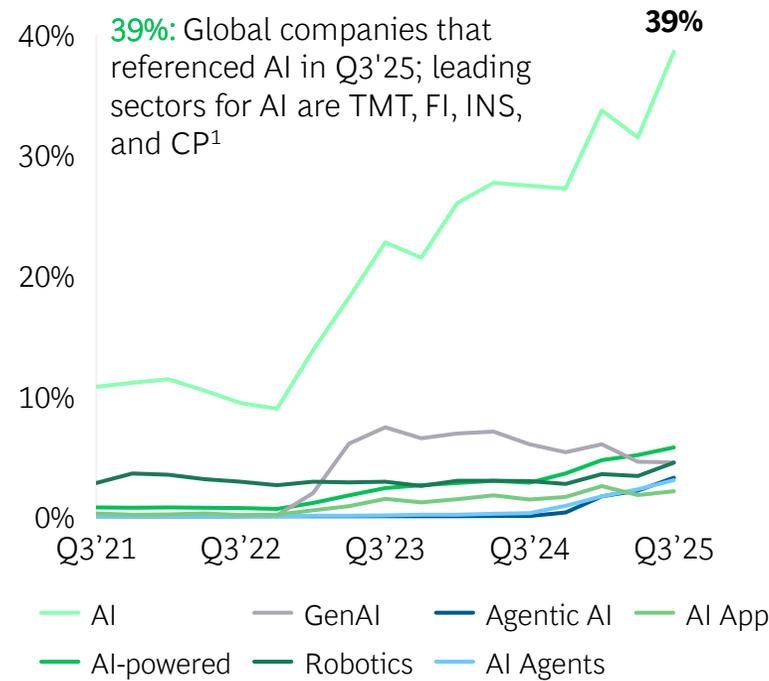Winners take a value driven approach, focused on people and processes to drive sustained impact

- Companies should take **a value-driven approach focused on real business problems**, led by operations, finance, and HR, with a strong bias toward execution and change—not buzzwords, science-fiction visions, or tech for its own sake
- About 70% of success **depends on people and processes,** calling for **new processes, upskilling, a redefined organization structure, robust governance, and clear change management**; 20% depends on data; and 10% depends on technology
- **Data foundations must be just good enough**; start with usable data, deliver quick impact, and improve quality iteratively
- Companies must **reshape process flows, the organization structure, and operating models to achieve impact** (e.g., an agentic maintenance process includes three agents for diagnosing issues, establishing the root cause, and making recommendations via a new closed-loop process or system)
- Completing the AI transformation journey requires **identifying clear value points, strengthening foundational elements, developing focused minimum viable products (MVPs), streamlining operating models, and scaling and sustaining change**

Source: BCG analysis.

AI has been top of mind for M&M CEOs and investors for many years, but skepticism persists regarding its potential to drive tangible results
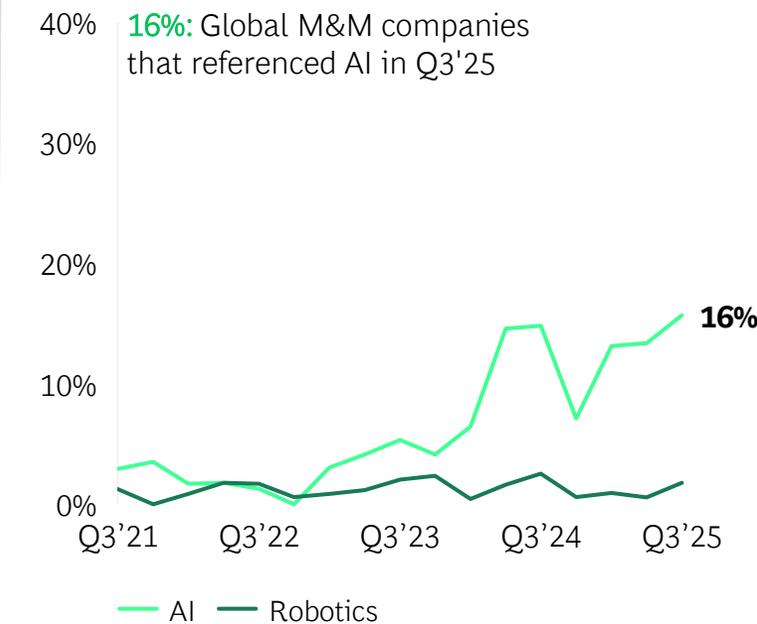
The focus on AI continues to grow year after year across M&M companies and their global peers

Share of companies that mentioned AI or related keyword at least once in their earnings call

Global (N = 6,108)

39%: Global companies that referenced AI in Q3'25; leading sectors for AI are TMT, FI, INS, and CP[1]

39%

40%

30%

20%

10%

0%

Q3'21   Q3'22   Q3'23   Q3'24   Q3'25

— AI   — GenAI   — Agentic AI   — AI App
— AI-powered   — Robotics   — AI Agents

Mining and metals (N = 223)

16%: Global M&M companies that referenced AI in Q3'25

16%

40%

30%

20%

10%

0%

Q3'21   Q3'22   Q3'23   Q3'24   Q3'25

— AI   — Robotics

1. TMT = Technology, media, and telecommunications; FI = financial institutions; INS = insurance; CP = consumer products.
Sources: BCG Market-Sensing Portal; BCG marketing analysis, Oct 2025; CEO Topic Rader, Q2 2025.

Yet, M&M leaders remain skeptical of AI

Companies struggle to realize value and face challenges such as:

- **Lack of clarity** on what AI is and where to start
- Not having **right talent** —those who have used AI before
- **Data gaps** and **non-codified knowledge**
- **Fragmented** AI initiatives vs. **unified** scalable roadmap
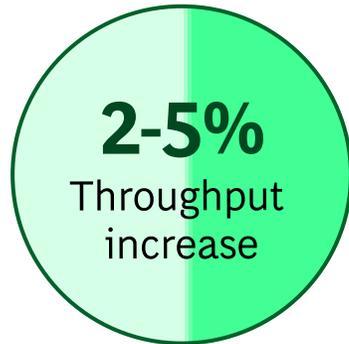- Teams **not sustaining** change

" AI tools led to modest impact due to variability in ore quality and mining conditions.
- President and CEO, North American metals company

" Data consistency and contextual understanding has been biggest challenge in AI deployment.
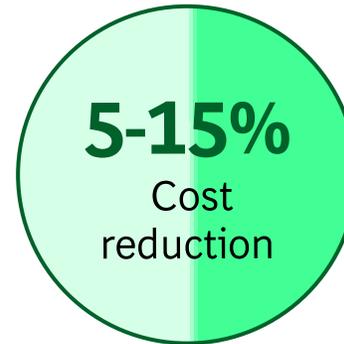- President and CEO, US Mining Company

However, many companies have realized proven value by leveraging AI to transform their core operations over last decade

Mine-to-market operations[1]

2-5%
Throughput increase

Maintenance

5-15%
Cost reduction

Scheduling and outbound logistics

2x
Scheduler productivity

Operational Planning

2-4 pp
EBITDA impact

Metal recycling

5-10%
Yield increase

⬤ Metals   ⬤ Mining

1.. Spans across upstream (drill, haul), mid-stream (crush, grind, process) and down-stream (smelting, refining, commercial) operations for mining and metals value chain
Source: BCG Analysis.

Evolving industry dynamics and other factors make AI adoption a necessity, not a choice

1 **Margin pressures driven by more frequent market cycles:** AI-driven process optimization improves recovery and throughput, thereby strengthening margins

*Details upcoming

2 **Resource nationalism, tariffs and volatile supply chains:** AI-enabled operational planning (covering demand, supply, logistics, and inventory) enhances real-time visibility and makes the supply chain resilient

3 **A capital intensive, asset heavy industry:** AI can help maximize asset utilization and productivity through smarter predictive-maintenance processes and crew optimization

4 **Changing ore compositions (including grades and impurities):** AI solutions that leverage digital twins can dynamically adjust processes to stabilize recovery and quality
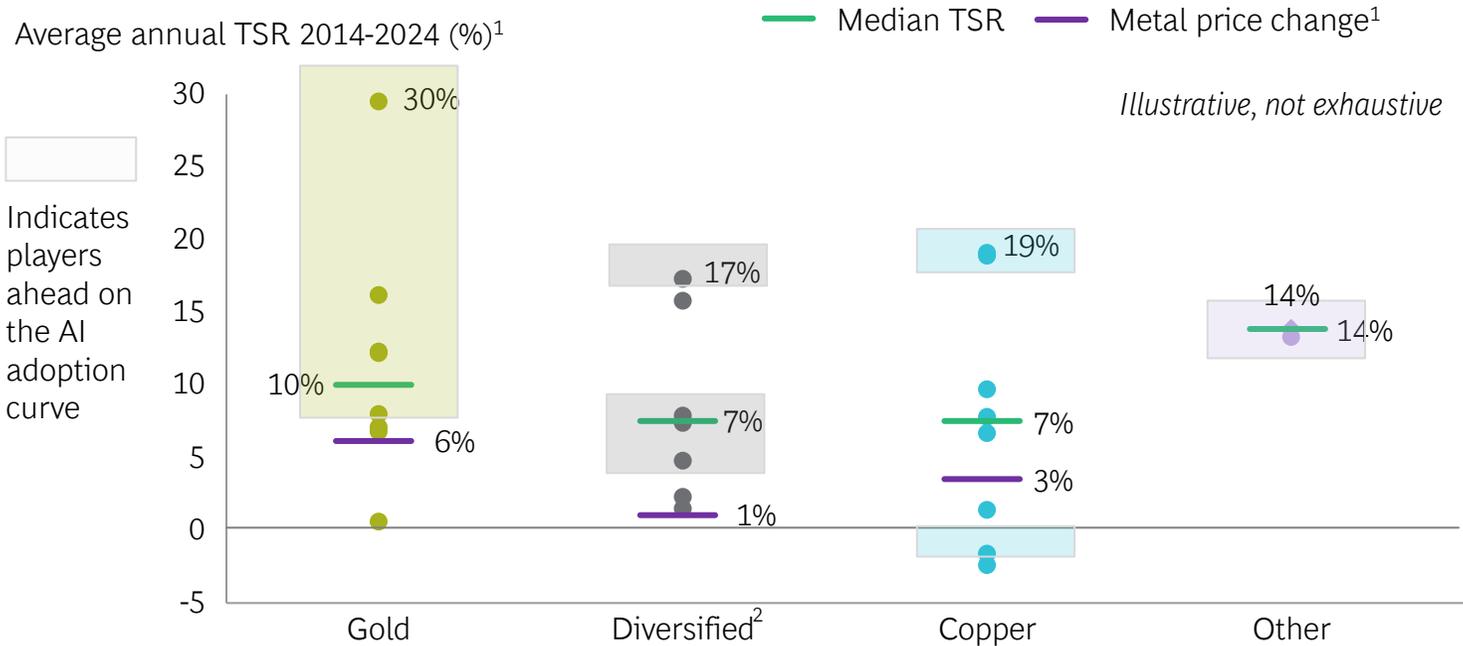
5 **Talent crises:** AI can help mitigate talent shortages by automating tasks, freeing up human capacity for critical work, codifying institutional knowledge, and so forth

*Details upcoming

6 **The advent of GenAI and Agentic AI:** New opportunities for models to solve more complex problems with greater intelligence

*Details upcoming

Top miners outperform peers within each commodity despite market cyclicality…

Average annual TSR 2014-2024 (%)[1]

— Median TSR   — Metal price change[1]

Illustrative, not exhaustive

Indicates players ahead on the AI adoption curve

	Gold	Diversified[2]	Copper	Other
Median TSR, 2014–2024 (% p.a.) [1]	10	7	7	14
Commodity price change, 2014–2024 (% p.a.)	6	1	3	N/A
Commodity price, Sept. 2024	$2,500 per troy ounce	$93 per dry metric ton	$9,200 per metric ton	N/A

V1. CAGR from December 2014 through December 2024, calculated in US dollars. 2. Iron ore used as a reference.
Source: S&P Capital IQ; World Bank "Pink Sheet" data; BCG ValueScience Center.

…with portfolio reviews, cost discipline, and digital- and AI-enabled operational excellence

1. Top miners frequently review and optimize portfolio and asset mix

2. They maintain production planning and cost discipline

3. They are early movers in **improving operational productivity using latest technology and digital and AI toolkit,** implementing initiatives, including:
   - Autonomous haulage and drilling
   - Remote operating centers
   - AI driven predictive maintenance
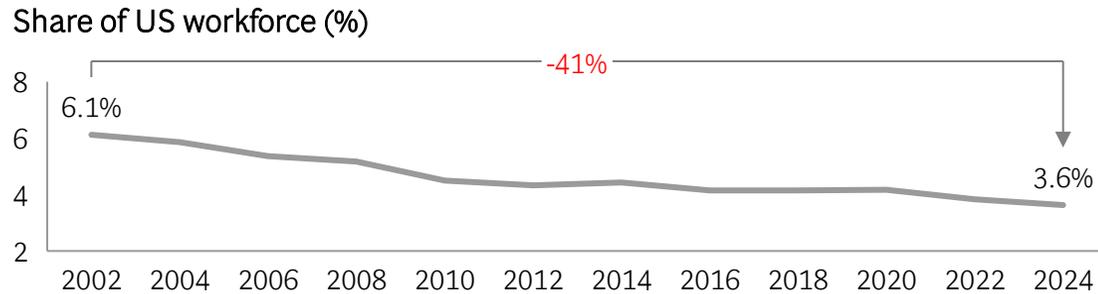   - Digital twins and models to adjust process metrics in real time, improve throughput, and so forth

Early movers are now **moving rapidly toward advanced AI use cases** such as agentic mine planning and E2E scheduling optimization

A shrinking workforce and broken hiring pipeline are driving a structural labor crisis in Process Industries

Process industries' workforce as percentage of US workforce[1]

Share of US workforce (%)

Process industries' hiring-to-opening ratio is consistently lower than that of other industrial peers, signaling ongoing talent shortages

Industries	2020	2022	2024
Process	0.6	0.7	0.7
Construction	1.1	1.0	1.2
Trade	0.8	0.8	0.8

The J-curve in process industries' workforce age distribution highlights a structural risk

US workforce age distribution, 2024

Share of US workforce (%)

Employee Age →

Change between process industries and others

— Process — Other Industrial Manufacturing — Retail & Trade

- Over half of the process industries workforce is aged 45 or older, while only 23% are 25–34, lagging industrial peers
- Retirements outpacing replacements, risking institutional knowledge loss; companies must accelerate next-generation talent development

1. Process industries include building materials, chemicals, metals, mining, and forest products, paper, and packaging (FPPP) industries; all industries are indexed to 2002.
Source: BLS.

AI evolution | From rule-based AI to rise of GenAI and large language models, AI has unlocked new opportunities for the M&M industry

Deterministic

Probabilistic

Predictive AI

GenAI, LLMs, and agentic AI are gaining popularity:

Choose the right solution for the problem—
complexity doesn't always equal effectiveness

Traditional
Machine Learning

Deep
Learning

Rule-based

Generative AI

LLM

| Encoder | Decoder[1] |

Agentic AI

| Observation |
| Plan |
| Action |
| Final Answer |

Follow a programmed
set of rules

Learning from large amount of data (and pictures
in case of deep learning) to find patterns and
make prediction based on that

Trained on vast and diverse data; **reasons
across context and enables intuitive,
conversational interaction for operators**

**The integration layer on top of GenAI
acts autonomously** and invokes models,
runs simulations, fetches data, and triggers
workflows

Let's view maintenance in mining and metals through each AI lens

When a machine is run
for 500 hours, it
automatically triggers
a maintenance ticket

ML models trained on **sensor data**
(e.g., oil temp.) **predict the likelihood of asset
failure** within next 72 hrs

Model **automatically drafts
maintenance summaries** or **root-
cause analysis report**s using **data
from sensors, logs,** and **technicians'
notes**

Fully autonomous process with
**multiple AI agents working
together** to identify failures, test root-
cause hypotheses, and make decisions

Under implementation at a mine:
*Details ahead

1. Example Generative AI model; note some Generative AI models are encoder or decoder only

Industry Adoption │ AI maturity in M&M aligns with the cross-industry average, bolstered by strong APAC performance

AI Laggards ⸺⸺⸺⸺⸺⸺⸺⸺ **AI Leaders**

| AI stagnating | AI emerging | AI scaling | AI future-built |

2025 M&M Avg

2024 Cross-Industry Avg

2025 Cross-Industry Avg

2024 M&M Avg[6]

BFFxAI 2025 maturity score[1]

Taking **minimal or no AI action, lacking foundational capabilities**, and are failing to **generate value**

Developed **foundational capabilities** and started **initial experimentation** but are **struggling to scale and generate value**
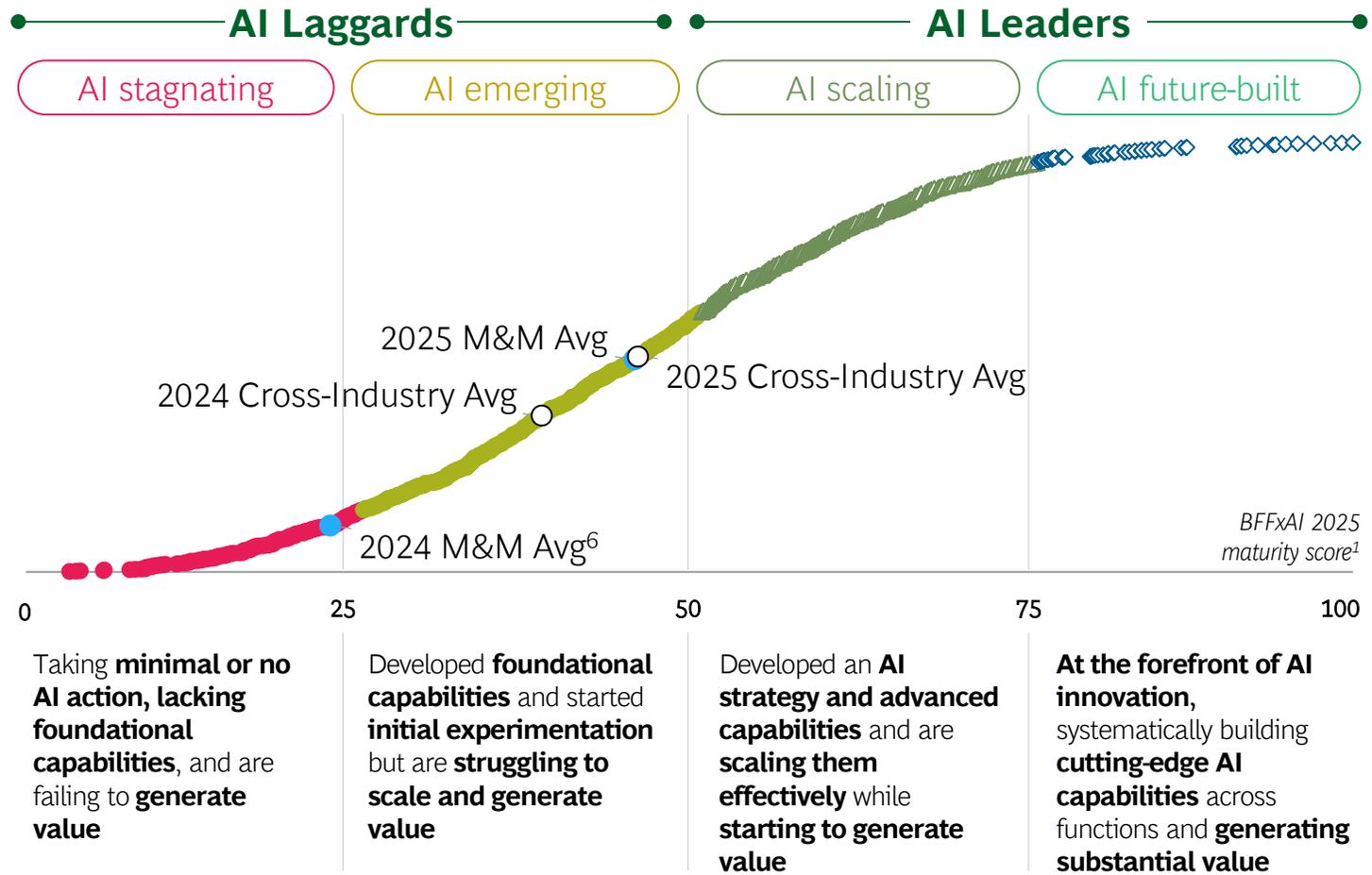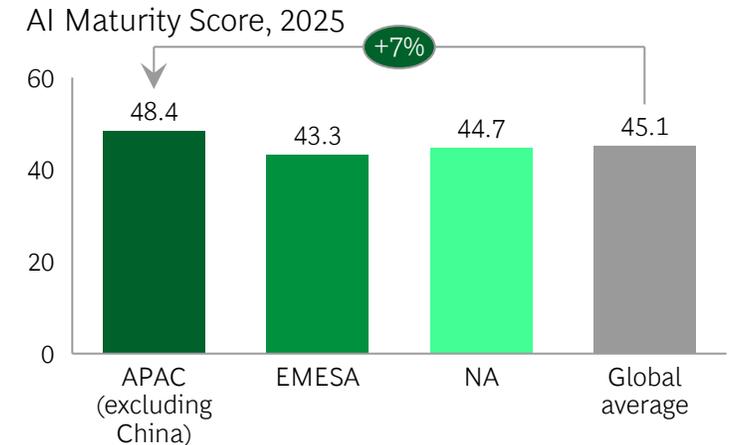
Developed an **AI strategy and advanced capabilities** and are **scaling them effectively** while **starting to generate value**

At the forefront of AI innovation, systematically building **cutting-edge AI capabilities** across functions and **generating substantial value**

M&M is now on par with cross-industry AI maturity

Note: APAC = Asia-Pacific; EMESA = Europe, Middle East, South America, and Africa; NA = North America.
Source: BCG Build for the Future 2024 and 2025 Global Study.

APAC leads in AI maturity in 2025 among M&M peer group

AI Maturity Score, 2025

+7%

APAC (excluding China)	EMESA	NA	Global average
48.4	43.3	44.7	45.1

- A few companies are leading in AI efforts in **India and Australia** by deploying solutions, including E2E network scheduling, ROCs[1], ML based set point optimization models

- In the **metals** industry, **China (the world's largest steel supplier) leads global AI-transformation efforts** and has leveraged AI to optimize **smelting efficiency**, advance **materials recycling,** and automate **supply chain operations**

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Non exhaustive

	Upstream			Midstream		Downstream		

Mining value chain ◄────────► Metals value chain

	Exploration and mine development	Extraction and transportation	Processing and concentration		Primary processing, including smelting and refining	Forming, finishing, and rolling	Distribution and sales to end customers
Core M&M processes	**Autonomous mapping drones**	**Autonomous haulage fleets**	ML optimization to maximize recovery by redefining **blend mix**		ML optimization models for steel, aluminum such as **furnace control, charge balance, coke blend, precision ferroy alloy dosing**	AI-driven **process control** (and digital twins) for continuous casting, rolling, or extrusion	**Market intelligence and** sales bench-marking agent and offerings
	Sales to metals companies		ML-based digital twin model recommending **semiautogenous grinding mill set points to maximize throughput**				
	Predictive ML model enabling miners to identify high-value smelters and capture incremental margin opportunities		**Beneficiation yield uplift** (e.g., leveraging data models from 1000+ sensors to improve **flotation extraction process**)		**Real-time anomaly detection** and operator support system		
Maintenance		**Traditional ML-based predictive** maintenance of mobile and fixed assets			**Connected worker technology** to link maintenance needs with available techs in real-time		
Operational planning	**AI-driven E2E planning for metal companies** (demand, supply, inventory, production scheduling) leveraging **digital twins**				**End demand forecasting using ML models** trained on **commodity prices and end sector demand**		
Network opt. and logistics			**E2E network scheduling** (route and timing optimization from **rail to port to customer**)		**AI driven logistics optimization** (across transport routes)		
Recycling and energy				**Smarter material recovery** via **enhanced mix scrap classification**	**Energy opt./scope 1 emissions monitoring**		

Source: BCG analysis.

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AI-enabled exploration: AI models (e.g., from Earth AI) to discover and validate mineral deposits faster than traditional timelines

Agentic AI driven maintenance: Autonomous forecasting, diagnosing, reasoning, and acting for maintenance activities via agents

AI guided drilling and extracted and automated bench creation: AI-guided robots (e.g., from Petra and Novamera) to drill rocks without blasting, enabling precision drilling and downhole imaging to extract ore safely

Agentic AI driven quality mgmt.: Sensors and machine vision technology capture data, GenAI models analyze data and Agentic AI autonomously take corrective actions driving quality outcomes and automating audits

AI-enabled circular mining: AI models predict waste flows, optimize reuse of water and tailings, and minimize carbon emissions for more sustainable operations

AI-based designing: AI-optimized design and planning (currently being deployed at a large mining company) to automate, de-risk, and accelerate asset development using best-practice flowsheets and past lessons
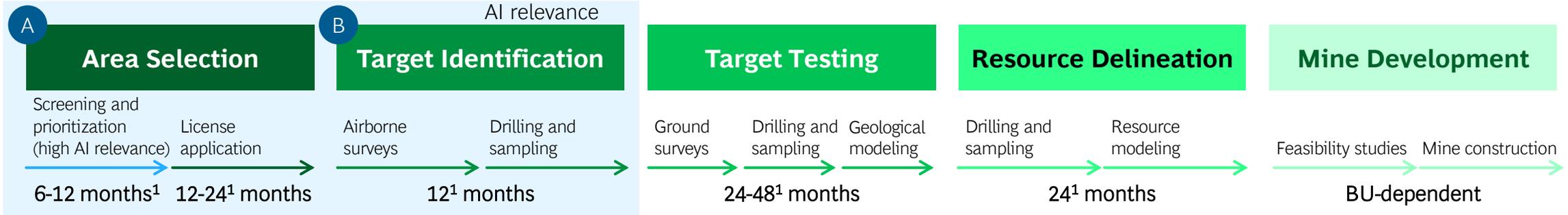
AI-driven mine planning: Predictive models (currently being deployed at a large mining company) to select the best mine plan combinations based on ore quality, maintenance schedules, and demand forecasts

Key:
- Mining applications
- Metals and mining applications

Source: BCG analysis.

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Total exploration timeline is 8 – 10 years[1]; AI can help shrink the screening time of 6-12 months significantly

AI relevance

A Area Selection	B Target Identification	Target Testing	Resource Delineation	Mine Development

Screening and prioritization (high AI relevance)	License application	Airborne surveys	Drilling and sampling	Ground surveys	Drilling and sampling	Geological modeling	Drilling and sampling	Resource modeling	Feasibility studies	Mine construction

6-12 months[1]	12-24[1] months	12[1] months	24-48[1] months	24[1] months	BU-dependent

AI helps narrow down survey- & drill-ready targets much faster and more accurately

A **Targeted mineral type and data sources** as inputs

- 50 yrs of exploration data (geological, geochemical, geophysical, and so on)
- Prior drilling data
- 3P geological maps

A **ML and AI algorithms (classification and pattern-recognition)** to identify correlations between known deposit sites and geological and remote sensing features

Generates **heat map of mineral targets**

B **Follow-up exploration**

Geophysical surveys

Analysis of survey data

Drilling

Further, BCG has partnered with oil and gas companies to build agentic solutions; e.g., Seismics.AI reviews seismic images to spot errors faster, reducing effort, accelerating interpretation, and enabling faster, more accurate exploration in both energy and mining
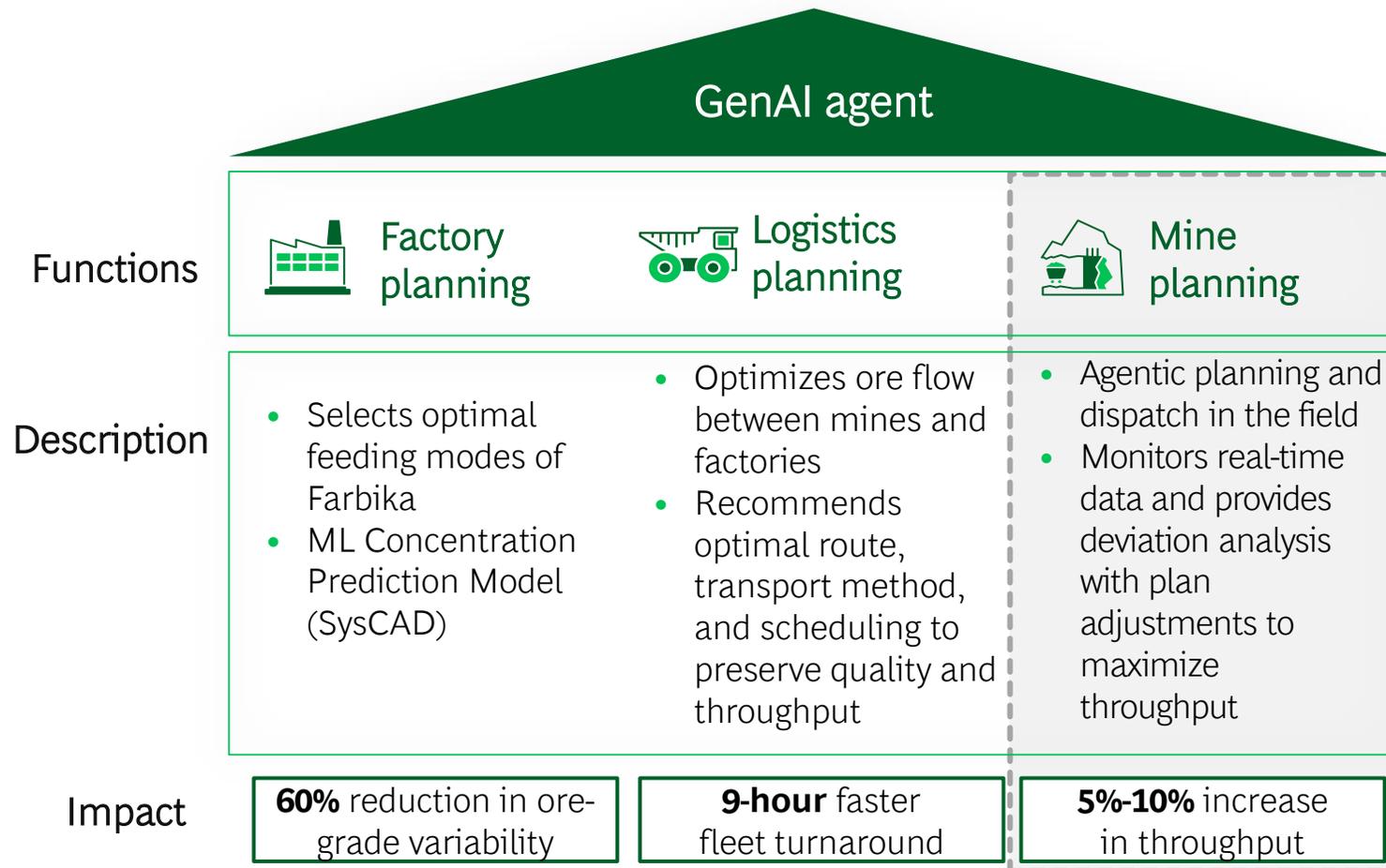
Examples of good and bad quality FBPs that our AI solution reviews

Players, including **Kobold Metals and Earth AI,** are focusing on AI-lead exploration and have seen initial success; full commercial potential yet to be established

1. Above process and timelines are indicative for greenfield exploration and might look different in different geographies
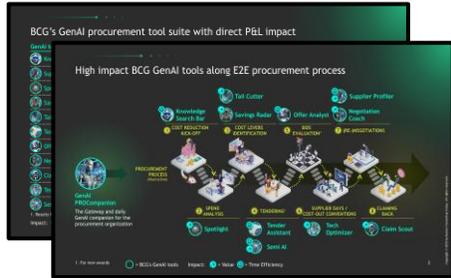Source: BCG analysis

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Visualizing the AI-driven planning process

GenAI agent

Mine planning solution architecture

- Planning Calculator
- Comparison of plan and fact
- Analytical dashboard
- Tile chatbot menu for entering prerequisites for changing the plan
- Regulations, instructions and safety advisor
- Logistics inside the mountain
- Two-way notification system
- Monitoring cone distribution
- Winch monitoring

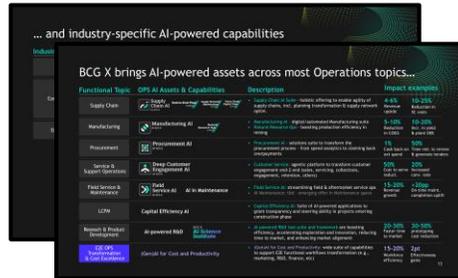|	Factory planning	Logistics planning	Mine planning
Functions	Factory planning	Logistics planning	Mine planning
Description	• Selects optimal feeding modes of Farbika • ML Concentration Prediction Model (SysCAD)	• Optimizes ore flow between mines and factories • Recommends optimal route, transport method, and scheduling to preserve quality and throughput	• Agentic planning and dispatch in the field • Monitors real-time data and provides deviation analysis with plan adjustments to maximize throughput
Impact	**60%** reduction in ore-grade variability	**9-hour** faster fleet turnaround	**5%-10%** increase in throughput

Source: BCG analysis.

Procurement[1]

- Automated spend-leak detection and charge-backs from suppliers (based on contracts)
- Tail spend optimization
- Automation of routine, manual tasks (e.g., RFP bids, tender, etc.)

Workforce productivity

Automation of routine tasks to redeploy human time to higher-value work

Commercial

Sales copilot tools to empower reps with real-time product knowledge and insights, for pre-sales coaching, sales negotiation, and post-sales communication (e.g., automated email generator, based on conversation and outcome)

Finance

AI-based forecasting dynamically updates budgets and scenarios (such as P10, P50, P90) using real-time operational data

Impact

5%-10%
spending reduction for indirect, capex, and tail spend at European OEM

10%-15%
labor costs reduction and uptime increase for Asian OEM

4%-6%
EBITDA increase in pilot regions expected for a chemicals company

1. Indirect, capex, and tail spending excludes direct commodity spending.
Source: GenAI in Procurement, OPS AI Narrative.

More details in "how"

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M&M players have been able to create large-scale impact through holistic transformation efforts

Successful players have taken a holistic view to **achieve greater impact**

Player 1: Global mining company

- **Five-year AI-driven transformation for the world's largest integrated bulk supply chain**, transforming **mine-to-port E2E scheduling, capex spending, and worker productivity**

- Impact across multiple areas, including a **5% capex** reduction from fleet efficiency optimizer and **a three-months** ROI from scheduling platform

Player 2: European steel company

- **AI-led transformation of steel supply chain and production,** creating an optimized and connected steelmaking value chain

- Delivered impact like **2-4%** EBITDA uplift and cost savings E2E (e.g., **€3–5 per ton** cost reduction within blast furnace silicon optimizer)
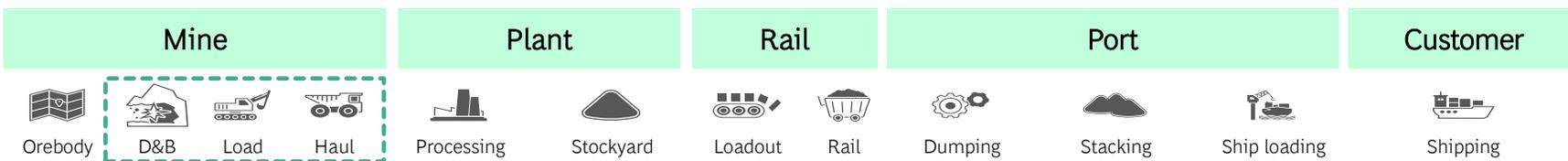
Player 3: Base metals miner

- **AI- and ML-powered commercial transformation,** redefining the miner-to-smelter deal process through **smarter demand, product portfolio, and operations alignment**

- Captured premiums from smelters, to get **2%-3%** long-term revenue uplift

Player 1 | A five-year E2E AI program for the world's largest bulk supply chain improved planning, scheduling, operations and capex design

Context and challenges: A leading global mining company with fully owned and integrated complex iron ore supply chain, facing thousands of scheduling trade-offs, high volatility in demand, and fragmented data systems

BCG partnered in 2020 to build an E2E AI solution that optimizes scheduling, productivity, and capex

AI programs at the leading global mining company

Mine				Plant		Rail		Port			Customer
Orebody	D&B	Load	Haul	Processing	Stockyard	Loadout	Rail	Dumping	Stacking	Ship loading	Shipping

Future scheduling platform (*deep dive on RHS*) — **Three** months ROI
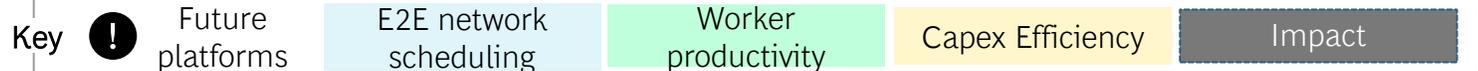
(!) Medium-to-long-term planning: 1) Optimized ship ordering 2) Mine plan selection 3) Major shutdown optimization

(!) Mine-to-mill operations: Optimized mine design, ore extraction sequencing, and ore blending for consistent feed quality

Design Efficiency Optimizer: AI asset management agent that detects overdesign, cuts engineering costs/efforts, and ensures compliance — **1%-2%** cost savings

Fleet / Mobile Assets Efficiency Optimizer: Optimizes fleet utilization and decreases amount of mobile assets necessary — **5%** capital cost reduction

Workforce Training Optimizer: Optimize worker training assignments based on certifications and prereq. progressions — **5x** productivity increase

Key — (!) Future platforms | E2E network scheduling | Worker productivity | Capex Efficiency | Impact

(★) Future scheduling program

Rail scheduling: Automated rail scheduling using optimization, simulation and heuristics, with **refreshed processes** and ways of working

Port scheduling : Optimizes car dumpers, stockpiles, and shipping through advanced algorithms, with an **enabled internal team to maintain and expand solution**

Execution scheduling: Allocate and split trains between **car dumpers and load-outs** to **minimize deviation**

First successful scheduling modernization program after failed attempts with other vendors led to:
- **Increased throughput**
- **90%** reduction scheduler onboarding time
- **Three months** ROI

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Player 2 | Predictive supply chain planning and operations transformation brings 2%-4% EBITDA uplift for large European steel company
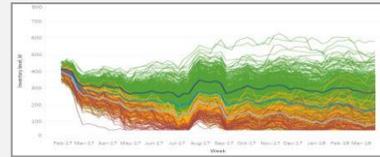
Client context A large European steel player had a highly complex supply chain that was managed through a forecast-driven push system, resulting in limited end-to-end visibility and high demand volatility

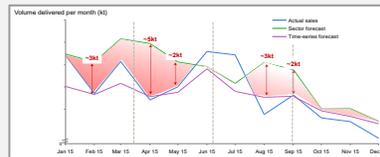## AI-driven platform enabled a predictive, optimized, and connected supply chain

Predictive analytics platform — Enables **proactive capacity planning** to align production with logistics and varying market demand
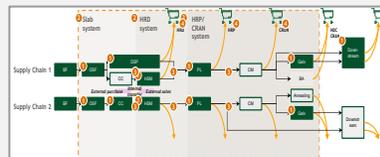

Production simulation engine — Models **7B+ production weeks** to **optimize inventory and shipping** within cost constraints

Integrated system view and data lake — Offers **real-time visibility** and **faster decisions** across extraction, processing, and logistics

Impact
- **2x** customer service levels
- **4–10** days of inventory reduction in 2 years
- **2%–4%** EBITDA impact in 3 years

AI operations transformation (across multiple mills) spanned the steelmaking value chain

ML-based optimization models

Key Activities	Impact
Coke blend optimizer	**5%-7%** reduction in coke cost
Blast furnace thermal control model	**€3–5** per ton cost reduction
Steel plant charge balance model	**€3–5** per ton cost reduction
Hot strip mill production throughput maximizer	**3%-5%** increase in throughput

Source: BCG Analysis.

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Player 3 | Predictive modeling and an ML-based dashboard unlocked an incremental margin of 50–100 bps and premium gains for a metals player

Client context

A base metals miner aimed to improve **commercial performance** and realize **gains from market inefficiencies** caused by product variability and information asymmetry

Approach : Comprehensive ML based model linking customer demand, portfolio optimization and operations

1 Quantify **smelter appetite and premium potential** for products by combining **assay, flow, smelter, and market data**

2 **Optimize product portfolio by evaluating margin implications** of product allocations and contract renegotiation decisions

3 Aligned **operations with commercial priorities** by analyzing and incentivizing margin-improving shifts

Before dashboard: miner-to-smelter deal process

Step 1: **Miner provides spec sheet of concentrate**

Step 2: **Smelter runs specs through internal economic model which determines:**
   1. Quantity of smelter recovery from concentrate
   2. Blend with other materials the smelter is buying
   3. Optimized economics based on deleterious elements and processing limits

Step 3: Smelter calculates an expected margin

AI supported value capture in current and future operating models

Revenue uplift (including margin)

Near-term value

0.5%–1%

Long term value (venturing into trading)

2%–3%

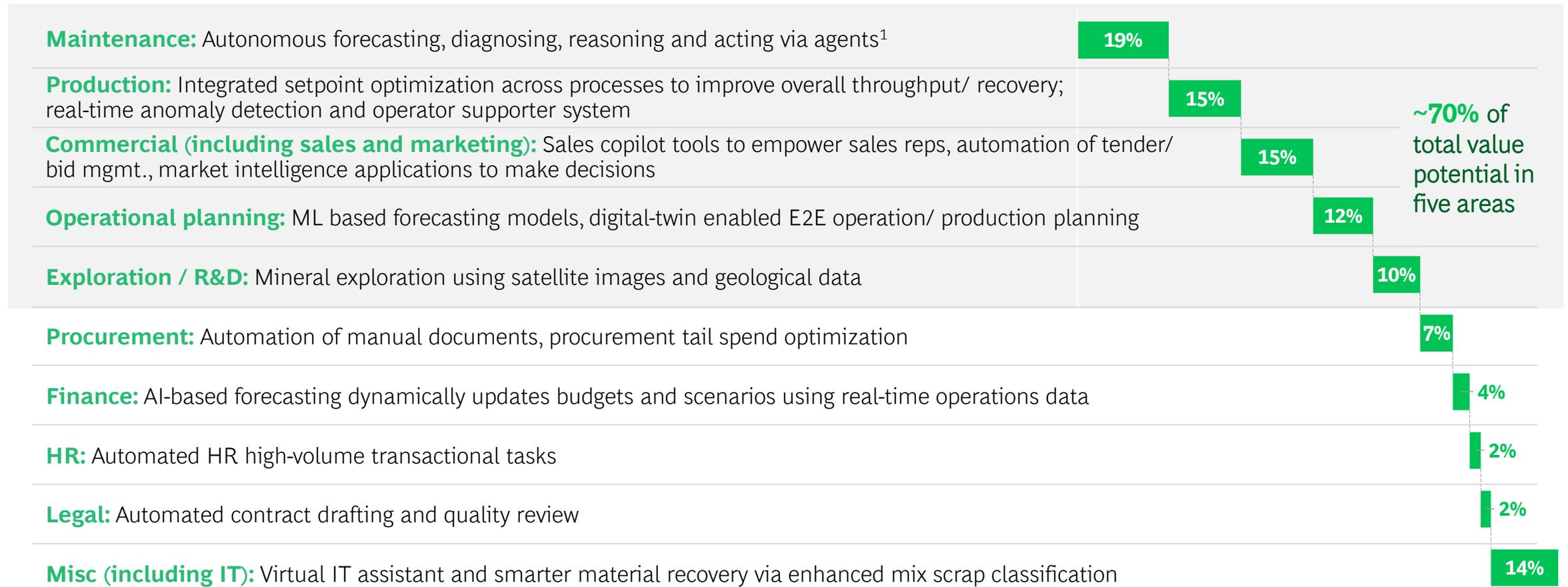## With AI: reimagined miner to smelter value extraction

Now, miner can singlehandedly:
- Quantify smelter's margins
- Identify which smelter would value their product the most
- Capture premium opportunity and align operations accordingly

Maintenance, production, commercial, operational planning, and exploration stand out as key areas for AI value creation in M&M

Distribution of AI value potential across value chain (with illustrative, noncomprehensive applications examples) in 2025

Maintenance: Autonomous forecasting, diagnosing, reasoning and acting via agents[1] **19%**

Production: Integrated setpoint optimization across processes to improve overall throughput/ recovery; real-time anomaly detection and operator supporter system **15%**

Commercial (including sales and marketing): Sales copilot tools to empower sales reps, automation of tender/ bid mgmt., market intelligence applications to make decisions **15%**

Operational planning: ML based forecasting models, digital-twin enabled E2E operation/ production planning **12%**

Exploration / R&D: Mineral exploration using satellite images and geological data **10%**

~70% of total value potential in five areas

Procurement: Automation of manual documents, procurement tail spend optimization **7%**

Finance: AI-based forecasting dynamically updates budgets and scenarios using real-time operations data **4%**

HR: Automated HR high-volume transactional tasks **2%**

Legal: Automated contract drafting and quality review **2%**

Misc (including IT): Virtual IT assistant and smarter material recovery via enhanced mix scrap classification **14%**

1. Also includes onsite Service AI application and maintenance crew scheduling; Source: BCG Build for the Future 2025 Global Study

Winning in AI execution takes a value-driven approach led by business, not buzzwords

What works

Value-driven approach focused on solving real business problems and process pain points

Business-led ownership across operations, finance, HR, and other functions—not just IT

Change and adoption focus, embedding AI into day-to-day decision-making and workflows

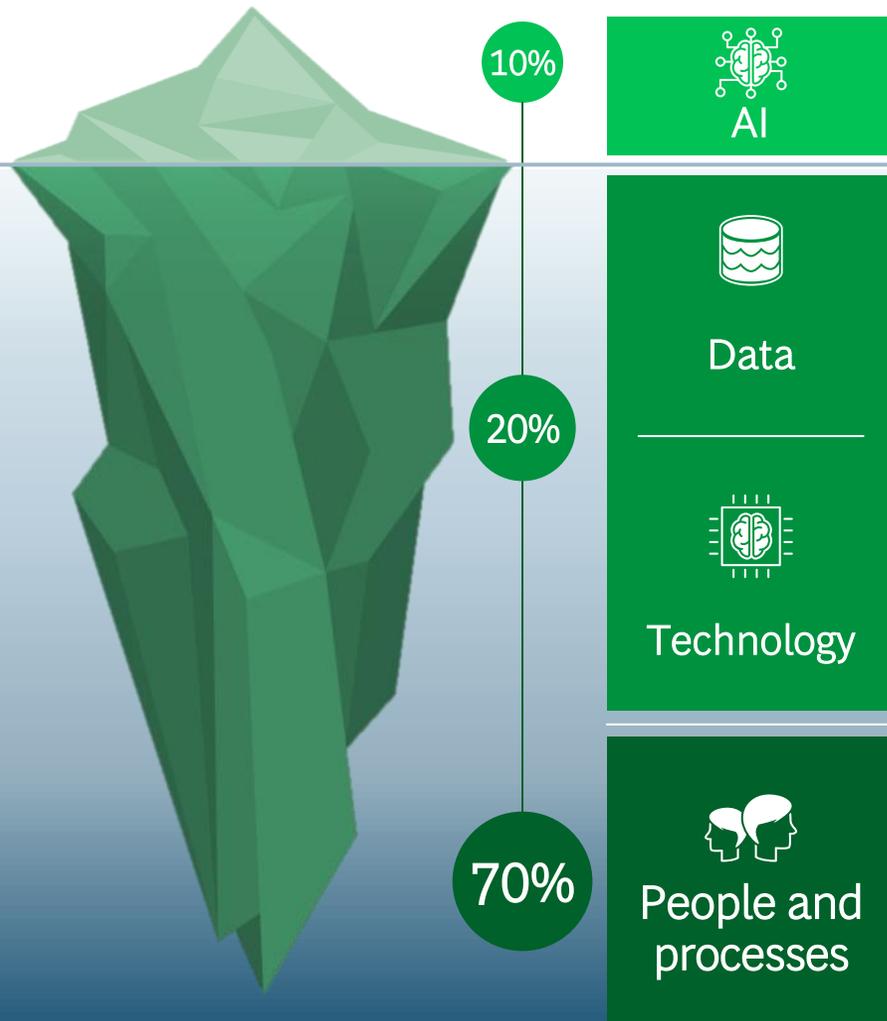**Clear link to measurable outcomes**, not just experimentation

What doesn't work

Buzzword-driven or futuristic concepts disconnected from business needs

Tech-first initiatives run by data or IT teams with limited business engagement

Overengineering and pilots with no path to adoption—impressive demos that never scale

"Innovation theater" without measurable impact—activity without outcomes

The 10-20-70 effort principle: Self-assessing an organization's AI readiness largely focuses on people, org, and processes

10%

AI

- How do I build **accurate AI models and intelligent decision** systems?

20%

Data

- Do we capture all the **right high quality data and have single source of data?**
- **How do we capture instituional and operator knowledge?**
- Do we define **clear ownership and decision rights** to ensure data quality across sites and enterprise ?

Technology

- Do we have the **right data center infrastructure** (compute, storage and network capabilties) to support data intensive AI operations?
- Do we have **unified cloud and data platforms to enable scalable, AI-ready data access and deployment** across the enterprise?

Data foundations must be just good enough; start with usable data, deliver quick impact, and improve quality iteratively

70%

People and processes

- Where should we **redesign current processes** vs build AI on top of existing processes?
- What tasks are **best handled by AI**? What by humans? What together?
- How do I **drive up AI literacy and incentize my team** to adapt to new ways of working?
- How do we **define and measure success** in this new model?

Not exhaustive

Example: A leading mining company wanted to fix its data foundation to become AI-ready and build an integrated solution to address bottlenecks across its value chain

Steps to build data foundation

- **Baseline: Started with latest technology stack choices for cloud** and data and a data services team

- **Standardized data across sites and built scalable data platform:** A unified model created one "data language" and common performance metrics

- **Established clear governance**: Defined roles, ownership, and decision rights to ensure data quality

- **Enabled transparent reporting:** Analytics and dashboards power real-time monitoring and AI applications
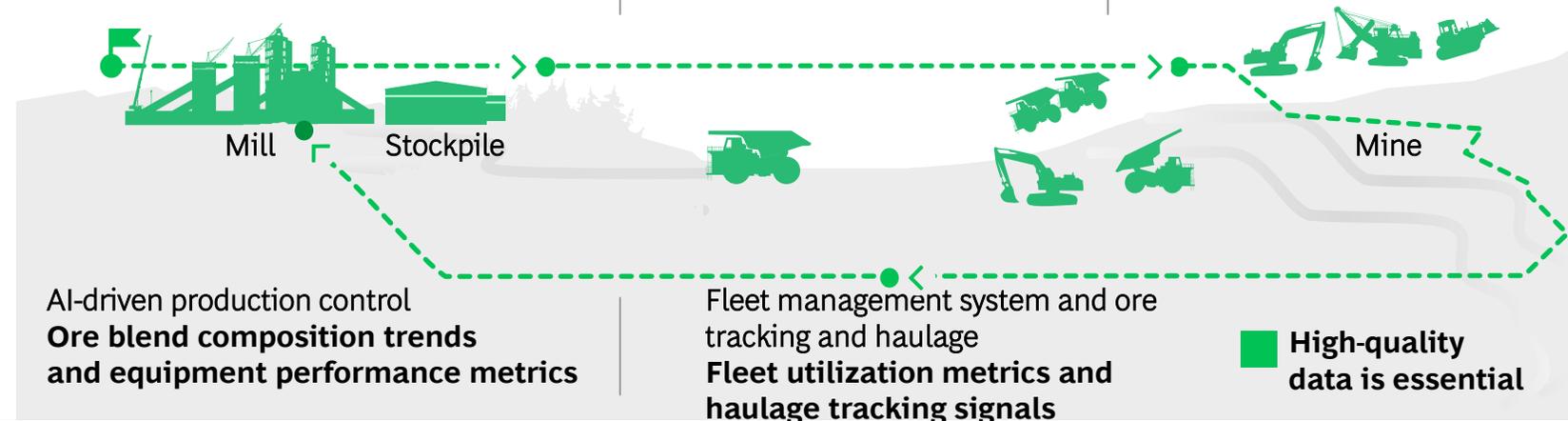
Integration of mine-to-mill applications based on unified, high-quality data

Geological modeling and ore properties
Block models and structural fault characteristics

Strategic planning and mine sequencing
Stockpile composition profiles and ore flow dynamics

Operational planning and shift-level ore blends
Operational assumptions and shift scheduling insights

Drill and blast control
Drill and blast design parameters

Mill   Stockpile

Mine

AI-driven production control
Ore blend composition trends and equipment performance metrics

Fleet management system and ore tracking and haulage
Fleet utilization metrics and haulage tracking signals

High-quality data is essential

Working in parallel on successful AI solutions should build on clean, connected data to:
- Automatically identify bottlenecks and improvement opportunities across the value chain (exploration and strategic planning → operations planning → drill and blast → hauling and ore tracking → production)
- Leverage Gen AI for system level throughput simulations

Expected impact
- +2%-5% recovery increase
- +10%-15% productivity growth

Source: BCG analysis.

COULD AI do it?

AI performance relative to human

Depends on

- Accuracy and robustness
- Speed and scale
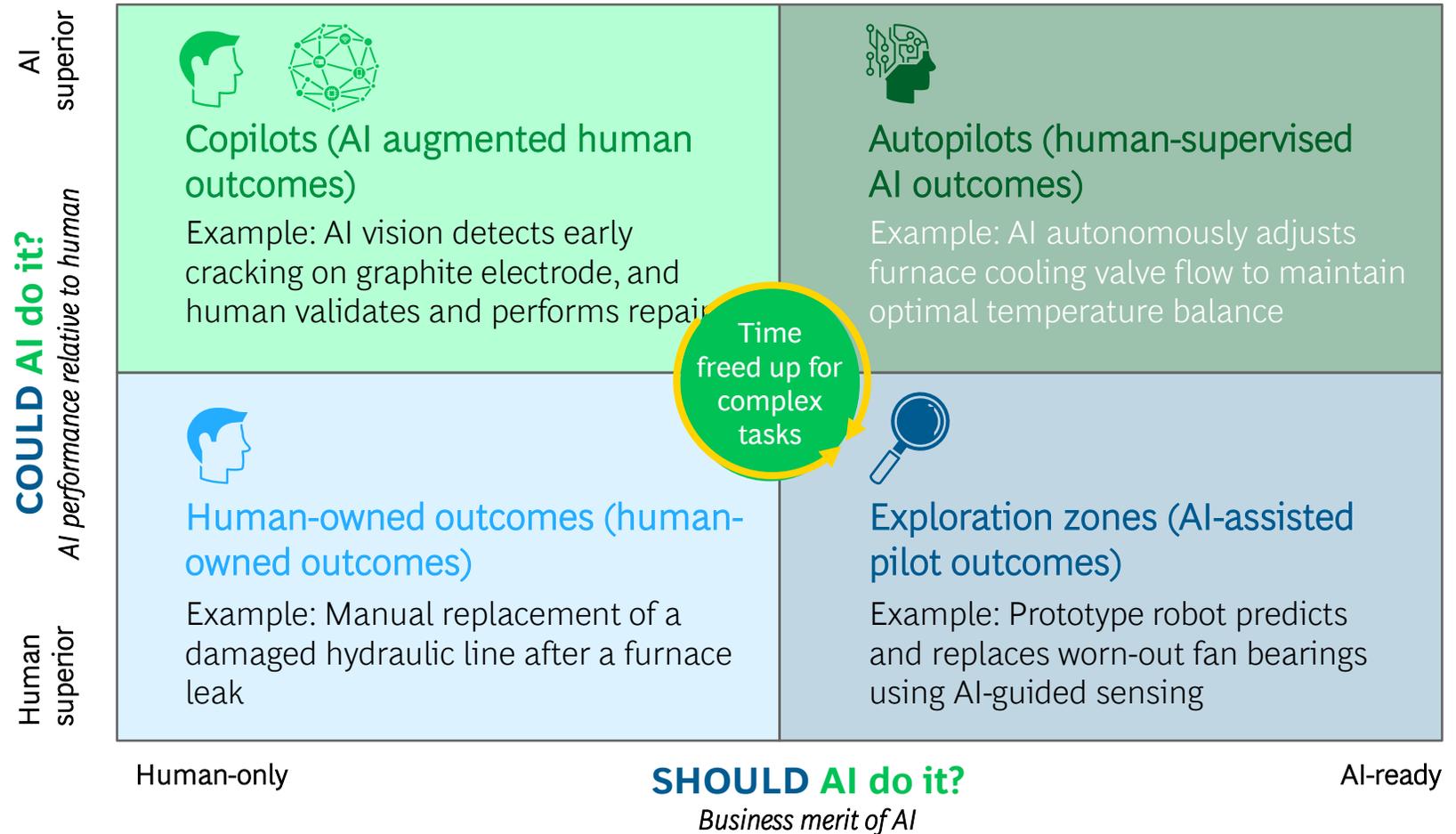- Technical feasibility

SHOULD AI do it?

Business value-add vs humans

Depends on

- Regulatory risk
- Ethics and safety
- Financial merit
- Cultural preference
- Task criticality

AI can free up human capacity for highly critical tasks in steel reliability

COULD AI do it?
AI performance relative to human

AI superior

Copilots (AI augmented human outcomes)

Example: AI vision detects early cracking on graphite electrode, and human validates and performs repair

Autopilots (human-supervised AI outcomes)

Example: AI autonomously adjusts furnace cooling valve flow to maintain optimal temperature balance

Time freed up for complex tasks

Human superior

Human-owned outcomes (human-owned outcomes)

Example: Manual replacement of a damaged hydraulic line after a furnace leak

Exploration zones (AI-assisted pilot outcomes)

Example: Prototype robot predicts and replaces worn-out fan bearings using AI-guided sensing

Human-only

AI-ready

SHOULD AI do it?
Business merit of AI

Context: A steel company drove multiple digital and AI initiatives (**e.g., set point optimization for casters and ferroalloy addition, furnace throughput uplift, and an ML-based value-in-use model** for coal procurement) from 2021 through 2024 to achieve 2%-4% revenue uplift

Cocreation, AI impact center, and gamification was needed to drive change with people and processes

Cocreation of solution design with cross-functional team members
- **Design thinking** and **structured brainstorming sessions** conducted in industry-specific vernacular
- **Reimagine and improve process flows** by ensuring maximum efficiency while leveraging institutional process expertise

AI center of excellence enabling consistency, transparency on progress and collaborative environment
- Drive **consistency in AI solution** roll out across functions, regions and organization; mix of subject matter experts and digital experts
- Identify, prioritize and implement AI apps. in collaboration with businesses
- Mechanism for **governance and measuring performance** by rigorously tracking KPIs and employee engagement

Gamification to enhance learning and drive engagement
- Leadership dashboards and rewards with different "levels" of performance for top adopters
- **Change management** through **coaching, incentives, and enforcement**

Impact was sustained using three levers:

Initiatives led by a joint team – AI center of excellence, executive leadership, Plant and BCG

Closed-loop system design with easy HMI design
- Human-centric design leveraging engagement and feedback with key stakeholders

Capability building in organization
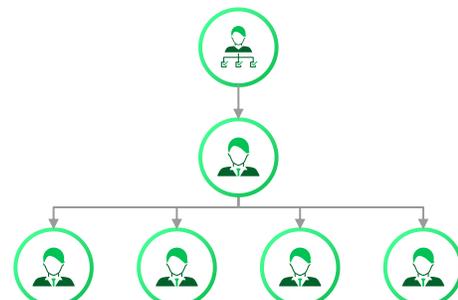- Training and enablement embedding "new" ways of working and capabilities in L&D

An AI Center of Excellence is the central hub to monitor transformation activities and expedite implementation

Rigorously track program performance and employee engagement

- What are the **priorities** for the **transformation** and how are we tracking?
- How are the **program initiatives** and **individual milestones** progressing?

Refocus discussions on critical decisions not status

- What are the **biggest risks** or issues that require **action** by leadership?
- How are **interdependencies** being managed?
- Do we need to adjust our strategy or **course correct** initiatives?

Reinforce agile ways of working

- Focus on **interaction** and repeatable **templates**
- Empower **stakeholders** to own all **information** and be involved in **decisions**
- Ensure the **right people** are in the room and **eliminate delegation**

Cocreation, gamification and capability building are key for adopting and sustaining change

Cocreation with three–tier implementation teams with data-scientists, AI engineers, IoT specialists and industry subject matter experts to identify and drive performance initiatives

Gamification for effective change management

Capability augmentation through monthly trainings on key topics

An AI transformation requires prioritizing opportunities, strengthening foundations, focusing MVPs, and sustaining capability building

Identification of opportunities

Identify and prioritize all AI related opportunities across the value chain

Assess and strengthen data, tech, and talent foundations

Build/enhance data lakes, connectivity, and historian integration for **reliable operational data**

Codesign AI use cases

Pair domain experts and data teams to define problems and build/tune models using site data

Scale validated solutions

Extend proven AI applications across sites, assets, and mine-to-market processes

Empower site champions and teams

Upskill site champions and train stakeholders to drive AI literacy and independent deployment

Sustain long-term adoption

Establish a **center of excellence** to track impact and guide a robust **change management program** for sustained transformation

Define success metrics

Define clear success metrics tied to throughput, recovery, and cost outcomes

Build digital and AI capabilities

Upskill data and operations team or partner with experts to co-develop solutions

Prove value through MVP

Launch pilots, measure impact in revenue and tonnes, and capture learnings for scaling

Streamline supporting functions

Automate back-office processes such as planning, maintenance, HR, and finance to free up capacity

Institutionalize AI-driven operations

Recalibrate production targets and process flows, aligning organization structure for continuous optimization

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BCG |
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