

Modernising the mining life cycle

Automation considerations for hard-rock mining

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Minserv

Mineral Development
& Research Services

Serving Responsible Mining



Approach to this Presentation

1

**We are hearing
Digital, Digital,
DIGITAL**



Digital gives better
H&S and efficiency.
What are the issues
moving forward?

2

**The bigger
picture is mine
MODERNIZATION**



We started a
journey that may
well lead to
autonomous mining

3

**Mining readiness
for AI and mine
AUTOMATION**



What is happening?
Digital brought AI into
the workplace!
What now?

4

**Automation
considerations for
hard-rock mining**



Us humans better
prepare for robots in
the workplace
Now!

Mine digitalization is not new

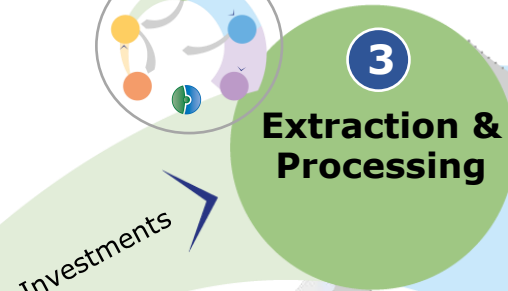
Mine Planning & design
Mine evaluation
Production systems
Health and safety systems

EFFICIENCY
Health & Safety

Exploration & Geology
Ore body modelling
Resource estimation
Mining cadasters



Enabling the MLC



Investments

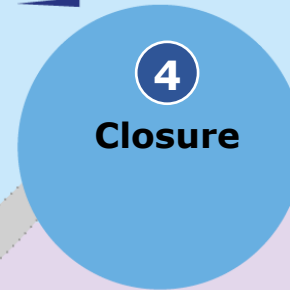
M&As

Exploration companies

Digital gets Smart when we link value chain activities along the MLC



Serving Responsible Mining



Value Dispersion

Responsible closure

New opportunities



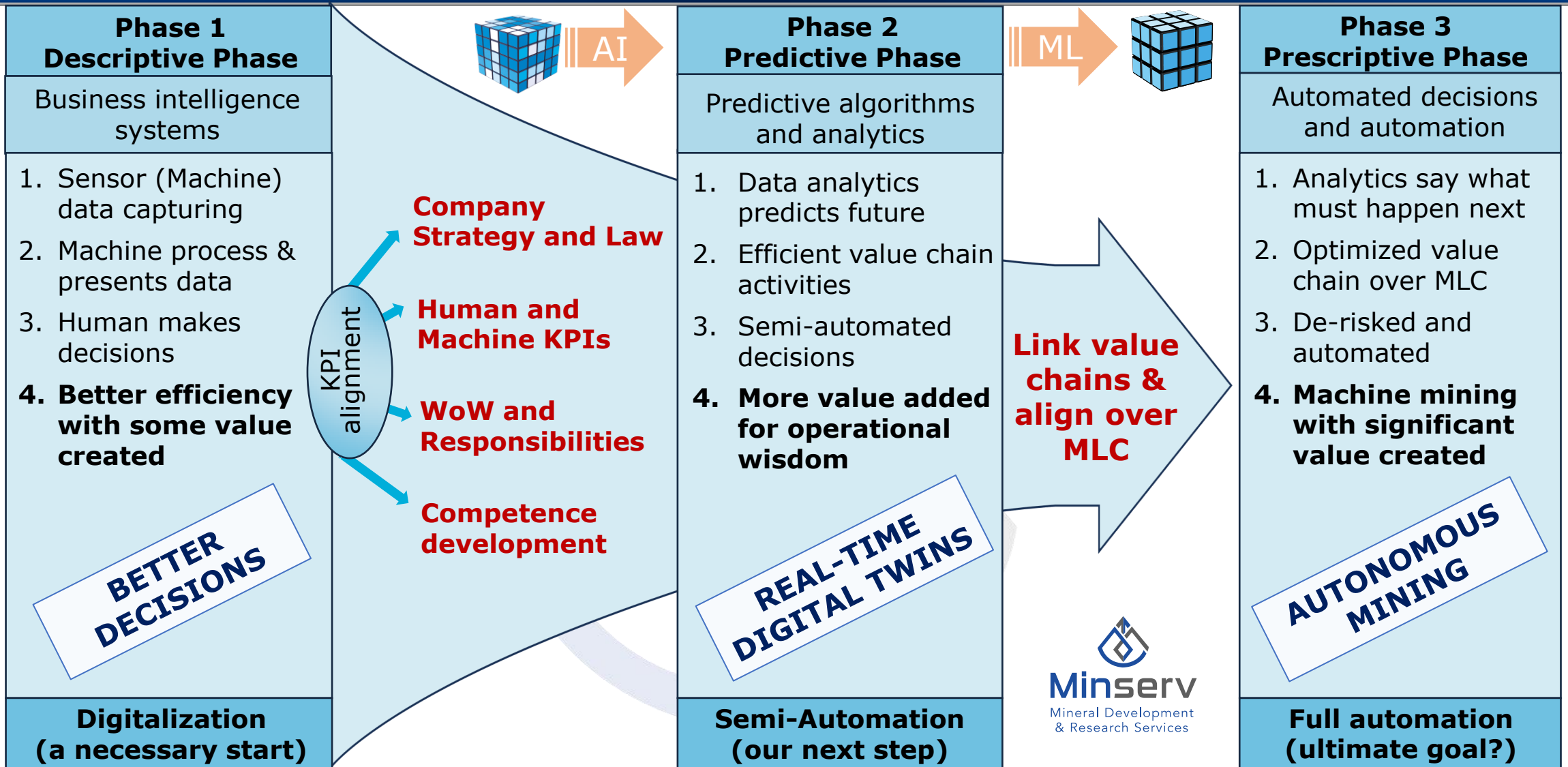
Lasting benefit

Mine to market reconciliations
Mine valuation
Financial reporting softwares

BENEFIT
Responsible

Closure planning
Volumes & Landfill
Using VR to visualize future development

The mine modernization process: Three levels of analytics



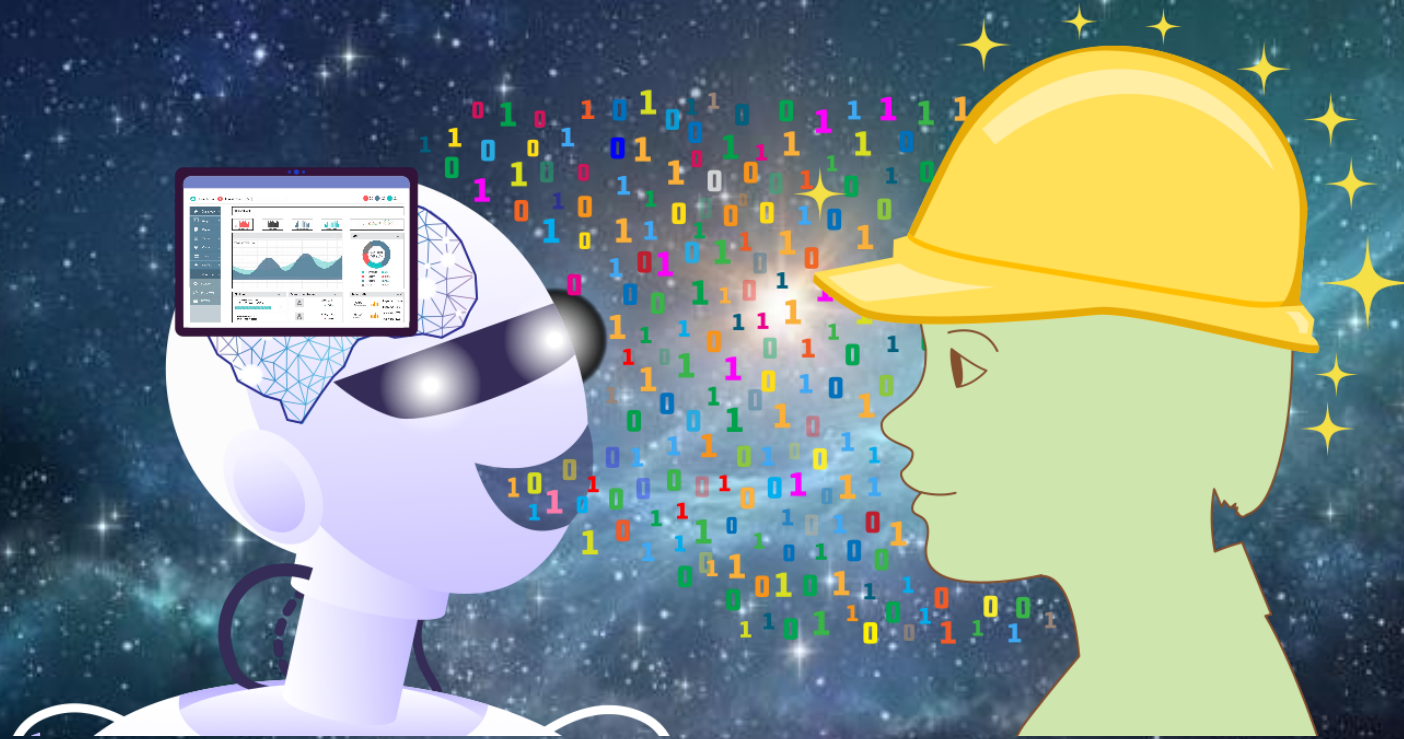


The Man-and-Machine conundrum

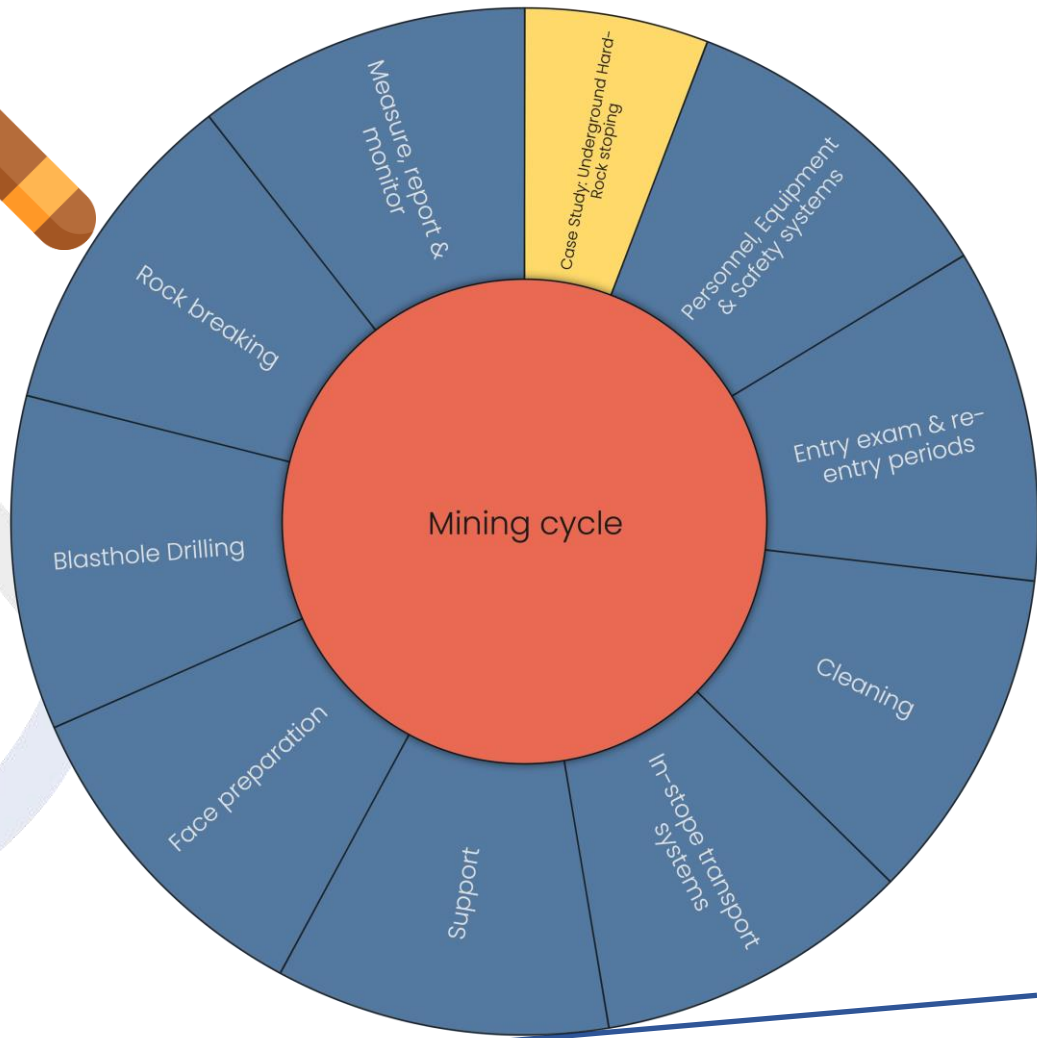
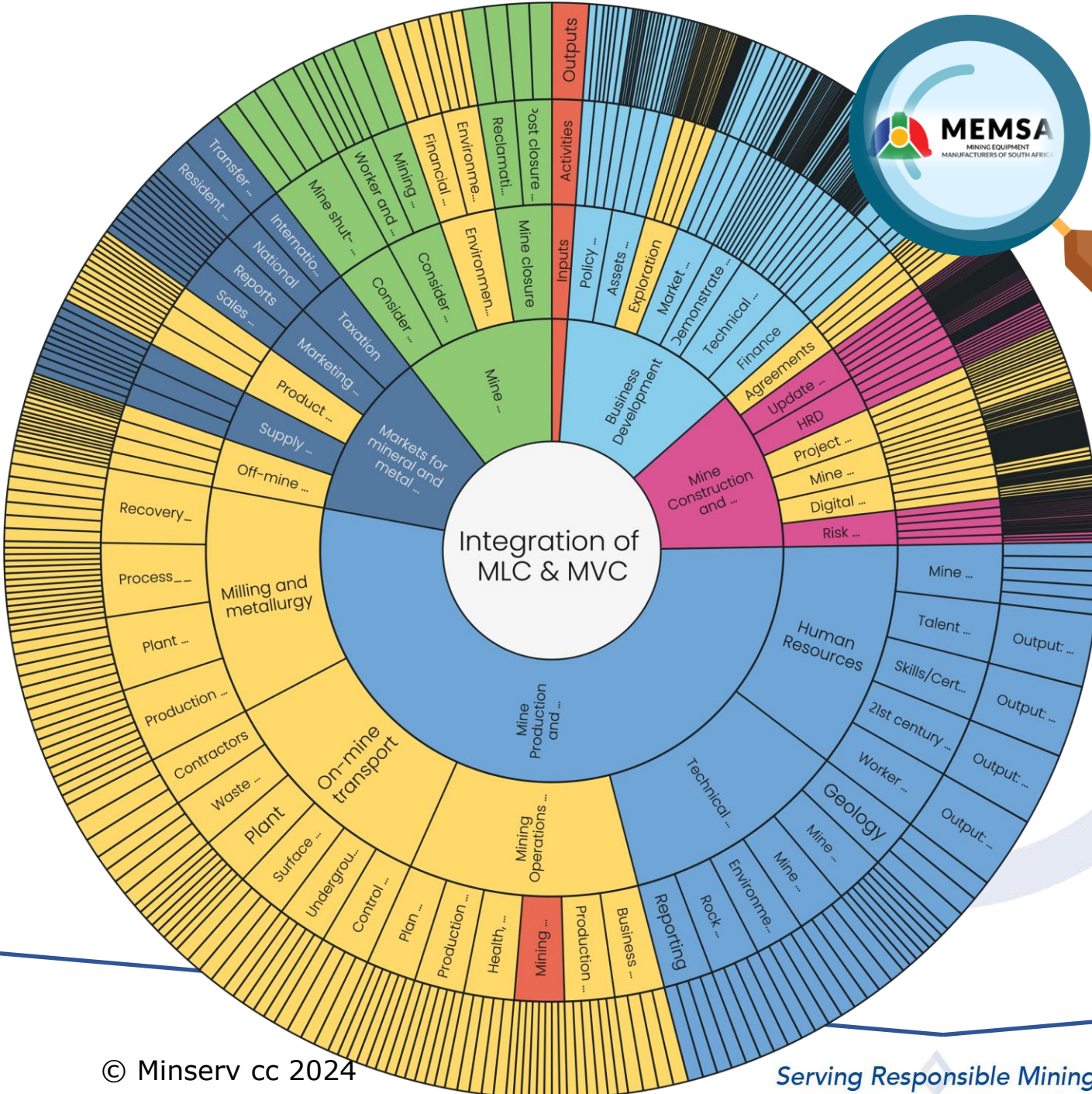
The Different Levels of modernization have Different Worlds Of Work

1. For mechanical equipment, the Human's job is to be the Driver/Operator of...
2. Human's job is still the same, but parts thereof are handed to machines (Digital assistants)
3. Digital assistant recommends job options, but a Human decides what to do (Safety systems)
4. Machine determines on best option and then request Human approval before doing the job itself
5. Machine tells the Human what it did through a report. The human can intervene to correct actions
6. Automation, in mining meant for environments where it is unsafe for humans to be in or where we reached the limits of "knowledge to create safe environments for humans"

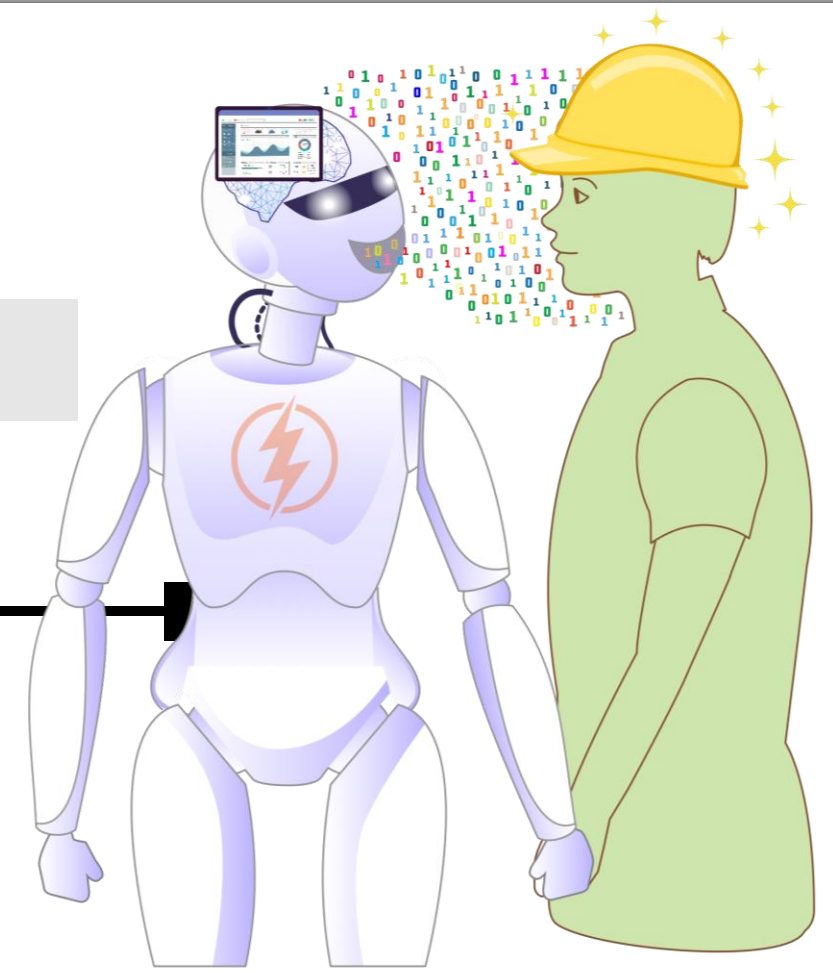
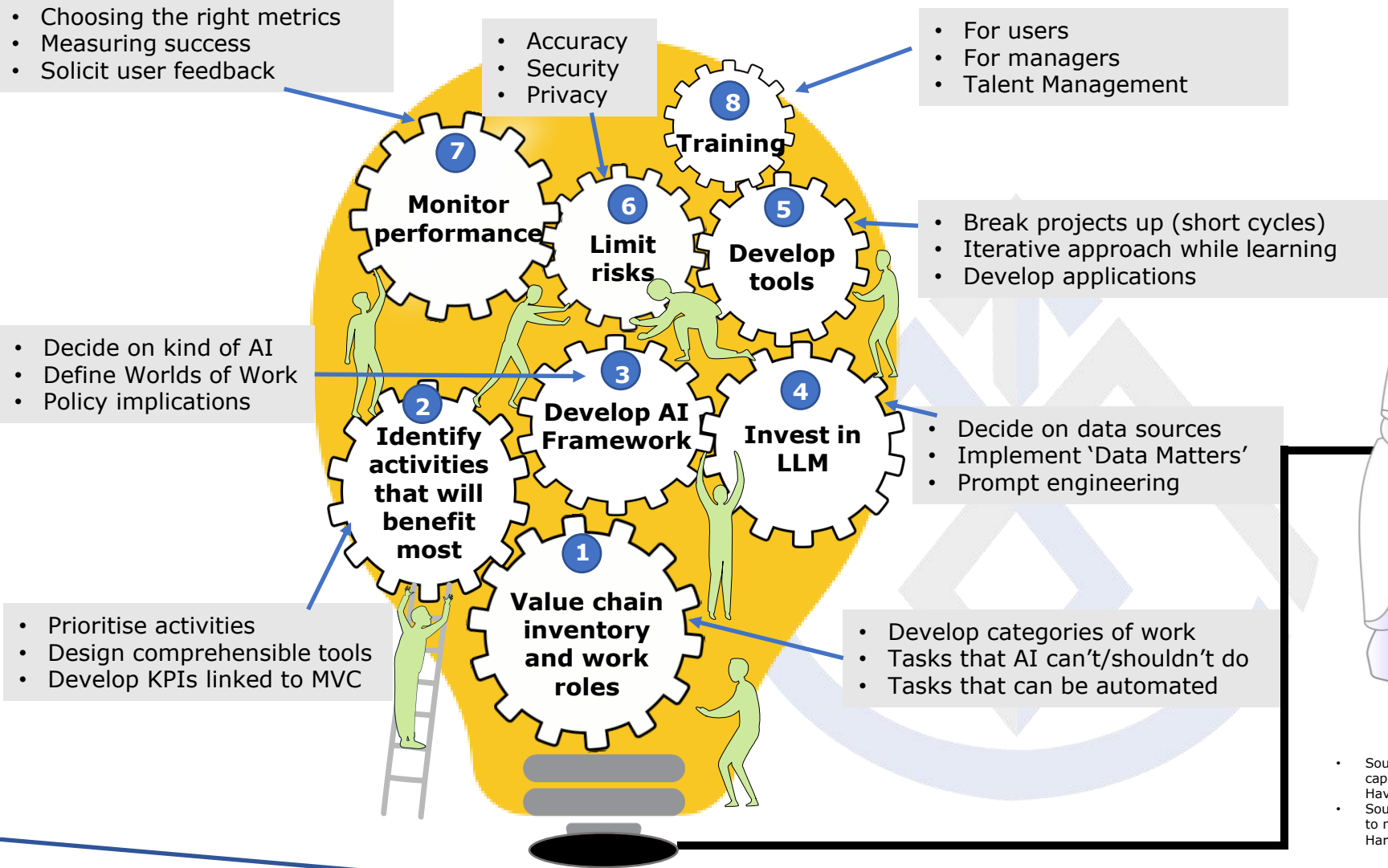
World of Work and skills needs are different for each stage



*Man and machine collaboration is no longer avoidable.
We must develop the skills for this world of work.*



Building an AI-powered organization



- Source 1: (Modified for mining): McAfee, A., Rock, D., and Brynjofsson, E. How to capitalize on Generative AI: A guide to realizing its benefits while limiting its risks. Harvard Business Review November - December 2023, pg 42-48
- Source 2: (Modified) Leonardi, P. Helping employees succeed with generative AI: How to manage performance when new technology brings constant and unpredictable change Harvard Business Review November- December 2023, pg 49-53



Considerations – MEMSA level

Remain relevant by getting system functionality right early - 'Blueprint' for installations

Support solutions-thinking – The DATA MUST FLOW into a System-of-Systems

Ensure data accuracy – Mistake/Error propagation

Enable good decisions for given contexts - Dashboard analytics linked to human KPIs

Develop user-centric systems – Work with users to identify leading practices

Explore AI to combine LLMs with dashboard analytics - Workplace prompts for users

Know your industry - Visits, leading practice experiences (This event)

Support 'Local-is-Lekker' –Locally developed systems and user skills programmes

Remember - Accurate decision-making when it matters = Value



Considerations – Personal level

Appreciate that mine modernization can't be done without skilled people

Remain relevant – Develop more skill on top of your qualifications

Let digital assistants do mundane parts of your work – Focus on doing your job better

Know that machines can't create anything that did not exist before – Imagine new ways

Understand the MVC processes over the MLC - Acquire knowledge adjacent to your tasks

Develop analytics, process maps and align these with the mining business priorities

Focus on being the best you can be, be interested and the rest will take care of itself

Your opportunity - Designing your own occupations, re-inventing yourself

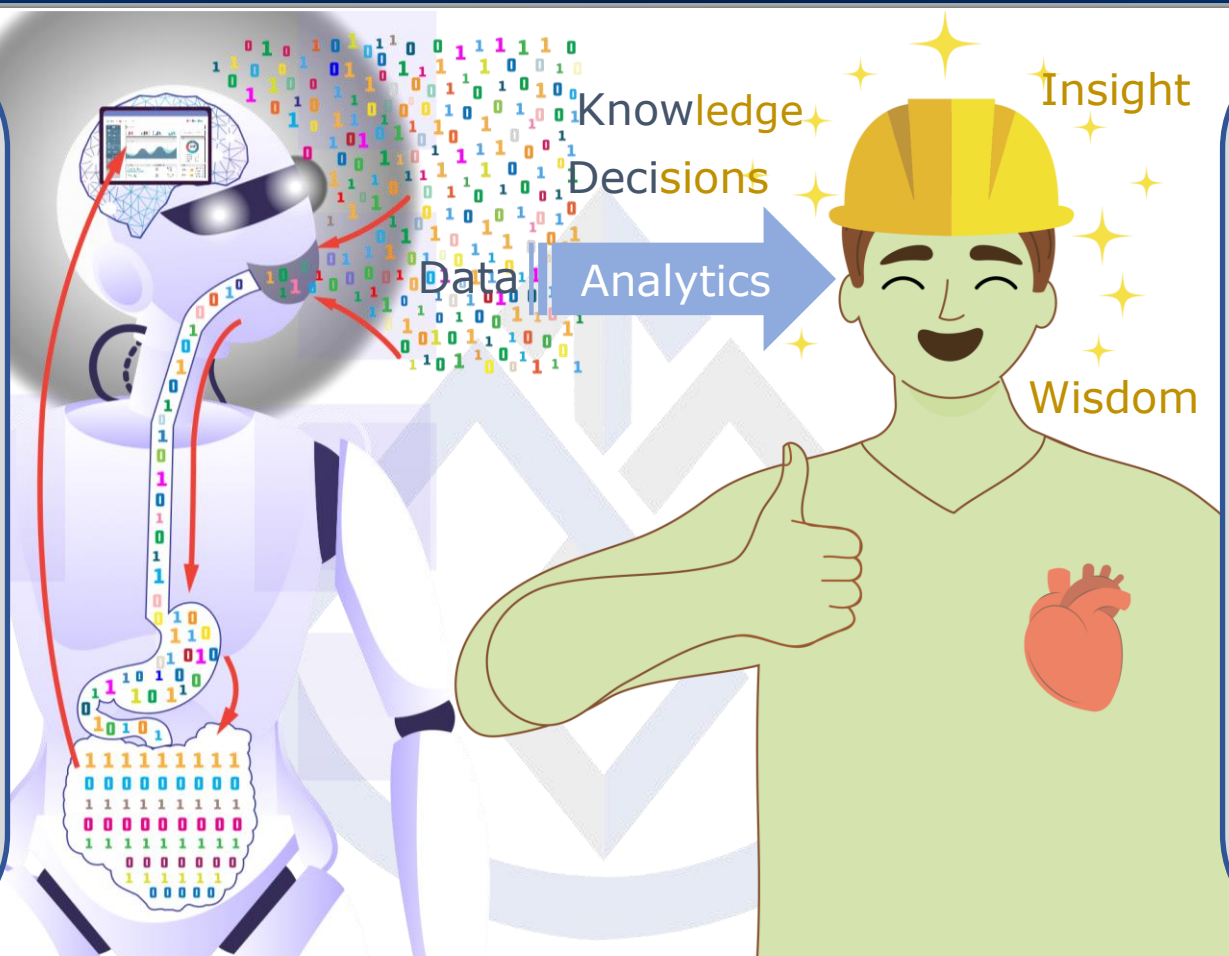
The golden rule - Don't automate what you cannot do yourself!



Back to the Man-and-Machine conundrum

Two questions to ask
(HBR, 2023)

1. "When does it make sense to shift from traditional human-centred methods to greater automation of analytics and decision-making?"
2. "How can we get an appropriate balance between the two?"



Our response will determine our future

1. Can we communicate with machines?
2. Can we design / build / install / maintain machines?
3. Can we question machine answers?

**If yes, you are
in this WoW**

THANK YOU