



*Successful Application of Technologies
Centred Around People Programme*



Study Tour

CSIR Learning Factory



Exploring the Future of Mining: A Mining Modernisation
Immersion Study Tour at the CSIR Learning Factory

25 August 2024

Organiser: Tshepo Chabalala -
Project Administrator CSIR

Facilitator: Rina Muller - Director
of SML4change

Delegates attended: 11 from
MMP, UJ, Westcol, AOK, LOCM,
and MMS

Hosts: Belinda Matebese, Mhlali
Tapi, Derryn Wenhold, Michael
van Schoor, Thapelo Pechu

Authors of this report: Riandi van
Rensburg & Sivuyile Mkhonoweni



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"This tour has brought so much relief in better understanding these machines."



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Introduction

On Monday, 25 August 2024, the Mandela Mining Precinct, through its Successful Application of Technology Centred Around People (SATCAP) Programme of the Mandela Mining Precinct, facilitated an insightful Study Tour at the Council for Scientific and Industrial Research (CSIR) Learning Factory in Pretoria.

The AOK, LOCM, and MMS interns were welcomed by Rina Müller from SML4change for this engaging exploration of Fourth Industrial Revolution (4IR) technologies and their potential to revolutionise skills development in the mining sector.



Purpose of the visit

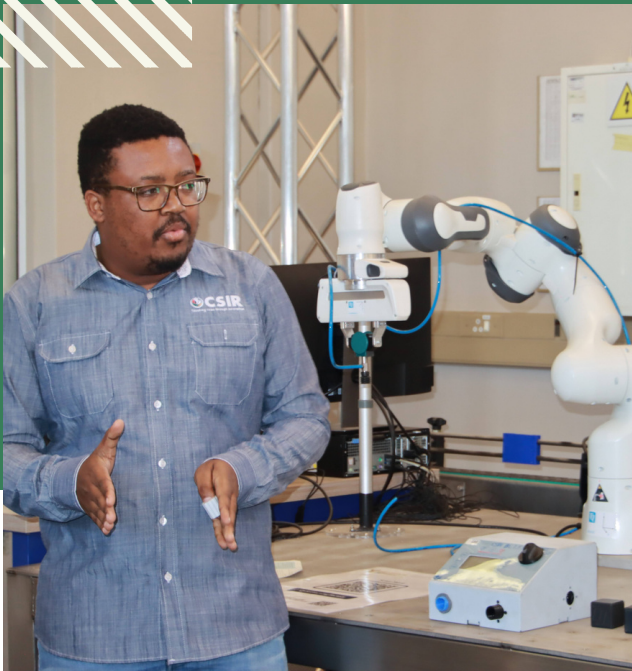


The primary goal of the Study Tour was to immerse young stakeholders in the mining industry into the evolving landscape of modern mining. The initiative aimed to foster awareness, understanding, and capacity-building around 4IR technologies, which are becoming increasingly integral to mining modernization. By providing practical exposure to these technologies, the tour sought to bridge the gap between theoretical knowledge and real-world applications, offering students a glimpse into the future of mining operations.

What made this visit unique was its focus on how 4IR technologies not only support the modernisation of mining processes but also play a crucial role in skills development. The students were introduced to a wide array of technologies, including robotics, the Internet of Things (IoT), cyber-security, simulation, and additive manufacturing. These technologies were presented not just as abstract concepts but as practical tools that can be harnessed to enhance safety, efficiency, and innovation within the mining industry.

The visit also highlighted the importance of continuous learning and upskilling, emphasizing that the rapid pace of technological advancement requires professionals to remain adaptable and open to acquiring new skills throughout their careers.



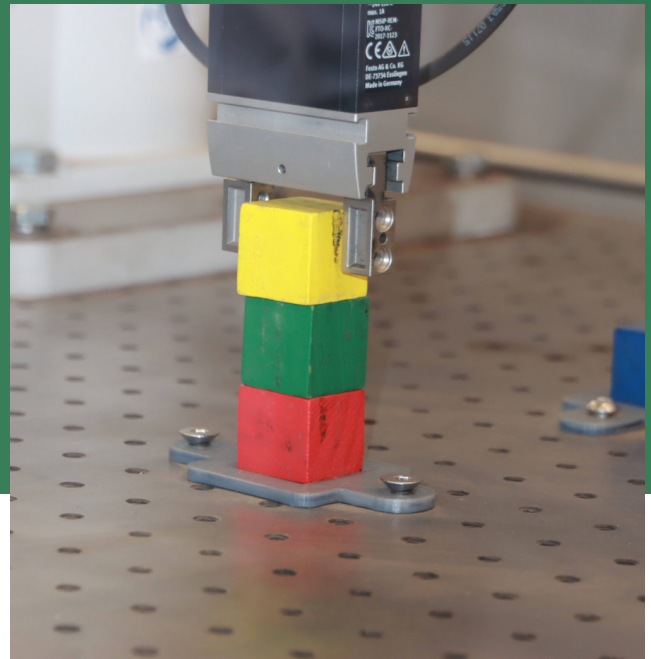


Format of the tour

Rina started the tour by explaining that SATCAP is a programme aimed at upskilling skills in the 4IR without eliminating human capital, since the projects under SATCAP are human-centered. Belinda Matebese and her colleagues from the CSIR then guided the participants through the four learning packs offered in the Robotics and Future Production modules, which include: 1) Theory, 2) Augmented Reality (AR), 3) Practical Cell, and 4) Application Cell. The purpose of the visit was to explore 4IR technologies and suggest how these technologies could address some of the challenges in the mining industry.

Automated Production Area

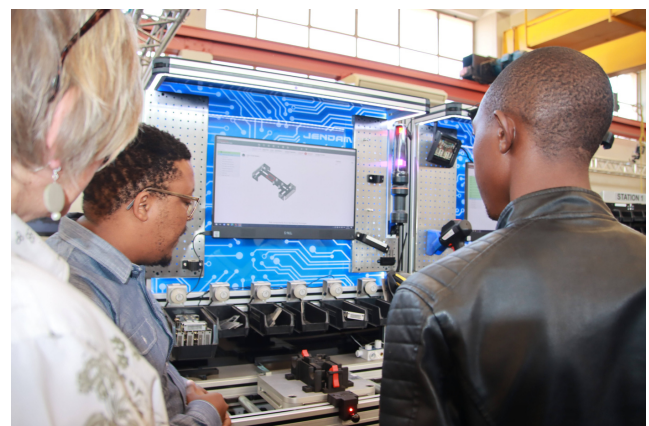
The tour then moved to the Automated Production Area (Figure 1A-B), where participants were introduced to Cobots (collaborative robots). Before the demonstration began, the Cobots were calibrated and set up, which involved significant human interaction. The user teaches the robot what to do, and the robot then imitates what it has been taught through coding. Operating Cobots requires both computer literacy and coding skills, as a computer and a communicator between the robot and the computer are needed, along with specialized coding software.

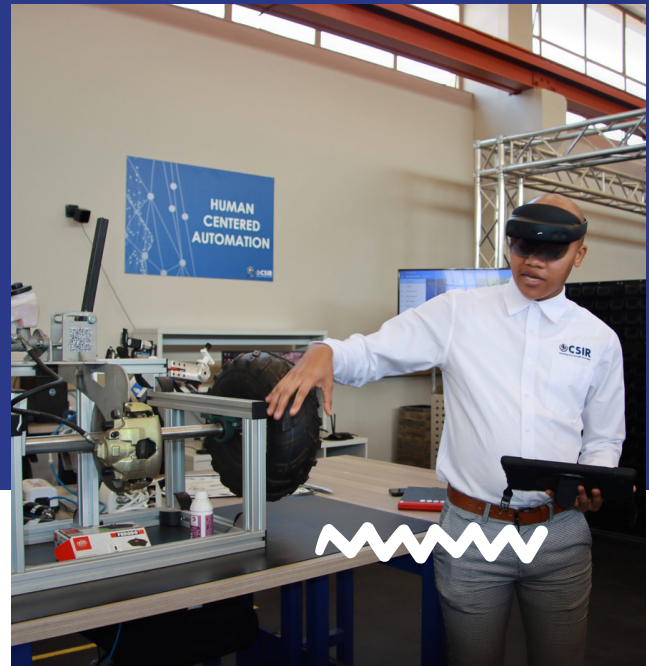




ODIN Workstation

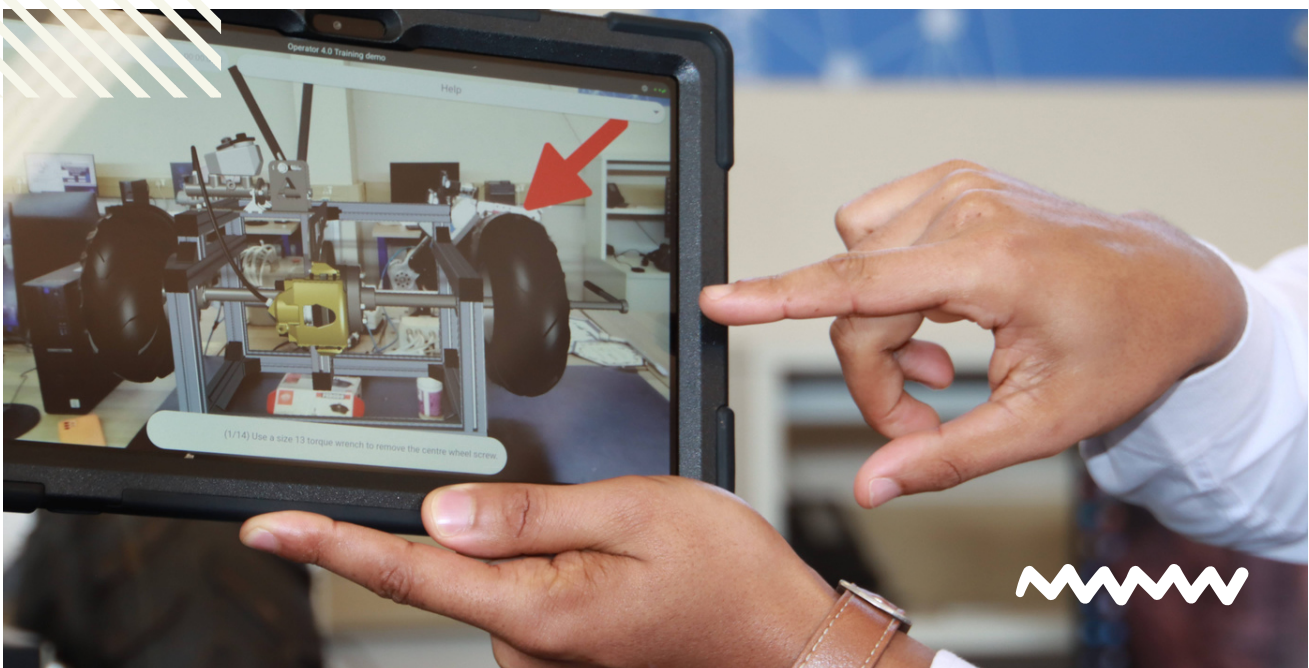
Next, the 4IR Assembly Working Station was introduced, also known as the ODIN workstation (Figure 1B-C). This technology guides the user through the sequence of tasks, ensuring that no steps are missed, even during routine operations (Figure 1C-D).





Human-Centred Automation

Lastly, participants visited the Human-Centred Automation section, where we explored Virtual Reality (VR) (Figure 1E) and Augmented Reality (AR) (Figure 1F) technologies. The VR technology is used for training purposes, utilising visual and auditory instructions to guide the user. It helps strengthen muscle memory and is also applied in training for underground mining. AR, also known as mixed reality, overlays virtual elements into the real world, allowing users to experience different environments without physically being there. This technology is currently used at some mines, like Bafokeng, for training purposes but has not yet been deployed underground.



Insights, Questions, & Key Learnings



After being exposed to the technologies, participants engaged in an interactive question and answer session. Everyone was given the opportunity to share what they had learned, their thoughts on the technologies, and to identify issues in the mining industry that could be addressed using some of the technologies we observed.

The Study Tour prompted students to reflect on the implications of 4IR technologies for their future careers and the broader mining industry. Their insights highlighted both the excitement and the uncertainties associated with these advancements:

Fear of job displacement:

Some students initially feared that robots might take over jobs. However, the tour helped them understand that humans still play a crucial role in guiding and managing these technologies. This realisation underscored the need to diffuse fear and promote a balanced view of technology in the workplace.

Continuous learning:

Students recognised that the fast-paced evolution of technology demands continuous upskilling. They noted the importance of not only formal education but also short courses and on-the-job training to stay current with industry developments. This mindset shift emphasises the need for lifelong learning to remain competitive in a rapidly changing job market.



Insights, Questions, & Key Learnings



Practical training and cost efficiency:

The use of virtual and augmented reality (VR/AR) for training emerged as a key advantage. Students appreciated how these technologies can provide hands-on experience without the risk of damaging expensive equipment. For instance, teaching artisans through AR and VR before allowing them to operate real machines can significantly reduce costs and improve safety.

Security and ethics in technology use:

The possibility of using cameras with facial recognition to detect illegal miners raised ethical and security questions. Students pondered the balance between leveraging technology for safety and maintaining privacy and ethical standards. They also wondered whether the increasing reliance on technology might lead to complacency, questioning if it could make people lazy.

Application of robotics and AR in mining:

Students explored how robots could be used to perform physically demanding tasks, such as carrying rocks or working in high-risk areas, potentially reducing the strain on human workers. They also questioned whether robots could assist in emergencies, like carrying injured workers to safety. Additionally, students saw potential in using AR for diagnostics and machine repairs in underground workshops, leading to discussions on why such technologies are not yet widely adopted in the workplace.





Student Feedback

- Sivuyile Mkhonoweni

I learnt so much, especially from the 4IR aspect. Before I attended the tour, my understanding of 4IR technologies was quite limited and it was centred around fear, that these technologies would increase the unemployment rate by taking over people's jobs. However, after the explanations, demonstrations and understanding of the role of humans and the skills required to operate these machines, my perspective has completely changed. This tour has brought so much relief in better understanding these machines, and I know there is a need for better articulation, through such tours, because 4IR technologies have made many anxious regarding the future, but I know that I can share and advise others on this topic because of this tour. Additionally, I got exposed to how different courses such as IT, Industrial Engineering and Advanced Mathematics can collaborate in robotics and as an older cousin, I get to advise my younger cousins with making better career choices.

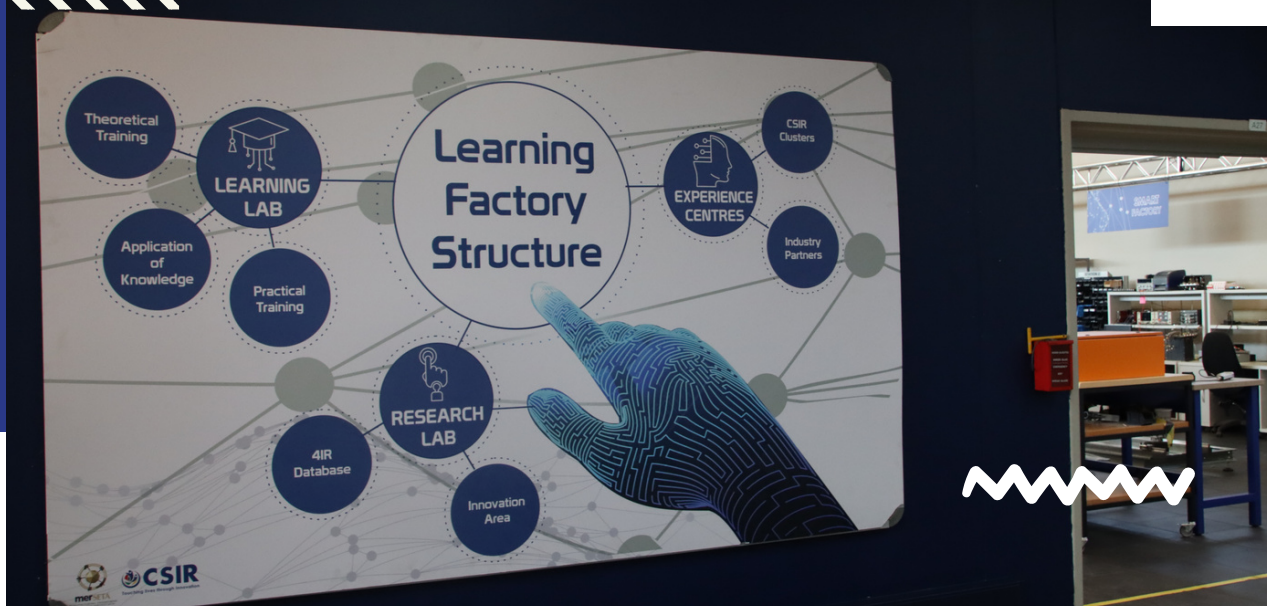
I would love to express my gratitude to everyone who took us through the tour, Sherin Ramparsad for organising the Study Tour and my manager, Michelle Pienaar for supporting and encouraging my attendance of the tour, I really enjoyed it, and I got to learn really cool stuff outside of my field of study!

Conclusion

The Study Tour at the CSIR Learning Factory was more than just an introduction to 4IR technologies; it was a catalyst for critical thinking and future planning among the young stakeholders. By providing a platform for these students to engage with cutting-edge innovations, the tour not only enhanced their technical knowledge but also encouraged them to consider the broader implications of technology in the mining industry and beyond.

This event underscored the importance of integrating technological advancements with human-centric approaches, ensuring that the future of mining is not just about machines, but also about empowering the people who will work alongside them.





ABOUT THE CSIR

The CSIR Learning Factory, launched in March 2021, is a cutting-edge platform for advancing skills development and innovation in 4IR technologies. A collaboration between the CSIR and merSETA, it focuses on applying digital technologies to drive the fourth industrial revolution in South Africa.

As a pilot site, the CSIR Learning Factory provides:

- Skills Development: Training, upskilling, reskilling, and cross-skilling tailored for industry professionals.
- Test-Bed Platform: A safe environment for stakeholders to test and de-risk 4IR technologies.
- Technology Transfer: Facilitating the transfer of technology to SMMEs, supporting re-industrialisation efforts.
- Research Enabler: A platform for applied research, driven by stakeholder needs and focused on 4IR innovation.

The factory offers practical exposure to 4IR technologies, including robotics, IoT, cybersecurity, and additive manufacturing, with applications in areas like manufacturing and smart energy optimization.

Plans are in place to establish 18 more Learning Factories across South Africa's TVET institutes, expanding the reach of 4IR skills development and preparing the next generation of professionals for the modern industrial landscape.