The Minerals Council South Africa
A Case Study for the Implementation of the Knowledge Transfer Framework, pertaining to IRM of CPS in TMM

Provided by The IDM Business Academy (Pty) Ltd
June 2022 – v1.0

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1. Executive summary

1.1 The project objectives

To provide a case study exploring where CPS has been implemented and therefore:

- Identify lessons learnt from those situations
- Identify the relationship of those situations to the Knowledge Transfer Framework proposed in phase one
- Provide a practical guideline for effective and accelerated knowledge transfer

Ultimately, this report serves as a practical guide for the insourcing of IRM of CPS for TMM building on the theoretical framework proposed in phase one. The intent is not to shortcut the Knowledge Transfer Framework (KTF) but rather to provide a practical view on how knowledge transfer can be implemented. Given the variance in OTM business models, CPS technology and mining operations the KTF provides a holistic theory that can be applied in any situation. The case presented herein, may not cover all the unique challenges that mining operations are likely to experience, in the context of IRM, but the lessons from those that have been there before provides a useful starting point.

1.2 Key findings

The following key findings were identified while researching cases where CPS has been implemented on TMM:

- The cases outlined in section 4 of this report shows a 16-month installation process of TMM – the intent is to provide other member firms with an expectation of the extent of the implementation process as well as to set the stage for the key lessons. However, it must be emphasized that these timelines may vary significantly depending on OTM, size of fleet, age of fleet, size of operations etc.
- The required processes, personnel, and structures to perform IRM of CPS for TMM, post implementation, must be established prior to the installation process
- IRM duties are performed by external IRM technicians who conduct on-the-job training to internal artisans. The aim is to fully transfer the responsibility of IRM in-house, however, the complete handover of these duties is sometime compromised by a resistance to take full accountability of these duties.
- A lack of accountability and "blame" culture has significantly hampered the effectiveness of IRM duties, in the case studies investigated. More effective teamwork amongst TMM personnel has been identified as a critical solution.
- While the adoption of technical IRM skills is unique and critical requiring specialised training by the CPS suppliers, the effectiveness of knowledge transfer is mostly inhibited by non-technical skills related issues such as: discipline, change management, productivity over safety cultures, accountability, and teamwork.
- The technical functionality of CPS varies from supplier to supplier and therefore it is a requirement that to perform IRM of CPS, a technician must undergo training provided by the mine's CPS supplier.
- In terms of technical training in this case, the OTM provided 2 days of theoretical and practical training. This was then followed by ongoing on-the-job coaching, which was regarded as the most effective approach to skills development.
- OTM training is generally not accredited and OTMs do not sign-off on the competence of the attendees. Mine-houses provide a certificate of attendance. The formalising of IRM accreditation is important to ensure that accountability for work done is properly assigned.

1.3 Key considerations for future knowledge transfer

Mine operations must ensure that they are sufficiently prepared to tackle the various challenges associated with the knowledge transfer of IRM. This case study confirms the need to establish this prior to the installation of CPS. Therefore, the following process for skills readiness provides a guideline that mine operations should begin to implement prior to CPS installation:

1. Steering & Tender Committee Appointed
2. As-Is Analysis
3. Supplier Selection and Contracting
4. Implementation Team appointed
5. Implementation Plans agreed and committed to by suppliers and steering committee
6. Post Installation Planning
7. IRM Implementation

2. Background and context

2.1 Phase one: The Knowledge Transfer Framework

The report titled Knowledge Transfer Framework pertaining to IRM of CPS in TMM (February 2022), a universal knowledge transfer framework was proposed to guide member firms in their approach to transferring skills related to the Installation, Repair and Maintenance (IRM) of Level 9 Collision Prevention Systems (CPS) in Trackless Mobile Machinery (TMM), to prepare them for the lifting up of the suspended TMM regulations.

The Knowledge Transfer Framework (see figure 1) was developed following a thorough research process, which included interviews and online surveys with numerous Original Technology Manufacturers (OTMs), Original Equipment Manufacturers (OEMs) and Mining Houses. Data was also gathered through the analysis of information (e.g., training matrices, training curriculum and other training material) provided by the stakeholders as well as additional desktop research.

The purpose of the Knowledge Transfer Framework is to serve member firms with a theoretical tool to ensure that holistic considerations are made when transferring skills. Based on our various engagements it is evident that some of the elements proposed in the framework are already in place, or perhaps not relevant, given the specific context of the mining operation (e.g., type of OTM, type of mining, type of TMM). However, the framework should be applied irrespective of an operations CPS maturity.

2.2 Phase Two: Project Objectives

While the previous report details a theoretical framework that provides universal guidance to mining operations the objective of this report is to explore the experience of a few mining operations that have already walked a long journey in terms of CPS adoption of their TMM. The main aim of this case study is to understand what worked, what didn't and what could be improved upon using the Knowledge Transfer Framework specifically as it relates to the transfer of skills.

Furthermore, this report provides a more detailed understanding of the typical components of the upskilling of skills within the mining houses themselves to understand the complexities and elements involved. In particular:

- Required training
- Learning objectives
- Curriculum
- Duration
- License renewal
- Accreditations

Finally, this report aims to tie all the above together into a practical step-by-step guide that mining houses can use to ensure effective knowledge transfer of IRM for CPS.

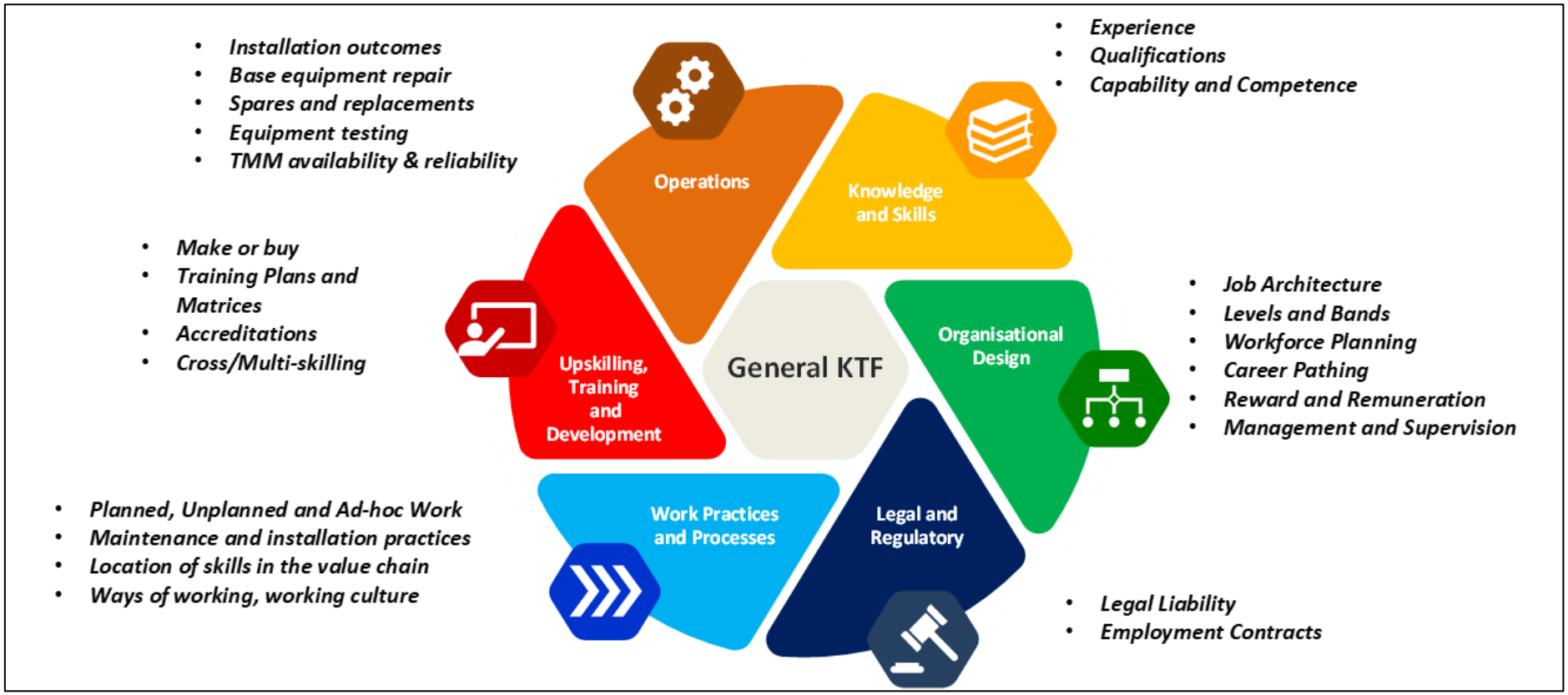


Figure 1: The Knowledge Transfer Framework

3. Approach

To understand and unpack the objectives put forward requires a data gathering approach that deep dives into the step-by step process of how a select group of mining houses implemented CPS in their operations. Therefore, this study conducted 1-to-1 interviews with three mining houses to understand their approach and explore their experience of IRM of CPS for TMM.

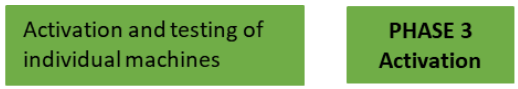
During the interview process the research team were presented with some valuable research reports that provided in-depth information related to the adoption of CPS for TMM. These reports detailed all aspects of the CPS for TMM adoption journey that included, but was not limited, to CPS IRM for TMM. While these papers included critical details related to aspects of IRM, they did not provide the level of detail required for the purposes of this study. As such, the information and findings presented below is based on the following:

- One-to-one interviews with Mining Houses
- Analysis of existing research related to the implementation of CPS for TMM
- Information gathered and tools developed during phase one of the study
- Desktop research

4. Case Study

4.1 Adopted process for CPS implementation

Figure 2 below summarizes the seven-phase approach that was adopted by an Underground Chrome Mine from October 2015 to February 2017. A detailed understanding of this process is clearly explained in a white paper written by the University of Pretoria in June 2018. The aim of this section is to provide an overview of the activities related to each phase of CPS implementation with a particular focus on skills readiness for IRM. It further aims to unpack alignment or misalignment to the Knowledge Transfer Framework.



Phase	PHASE 1 Pre-Installation	PHASE 2 Installation	PHASE 4 Cold Commissioning	PHASE 5 Partial Commissioning	PHASE 5 Partial Commissioning	PHASE 5 Partial Commissioning	PHASE 5 Partial Commissioning	PHASE 6 Hot Commissioning	PHASE 7 Maintenance & Improvement
Description	All work necessary off-site. Logical design.	Physical installation of software and hardware	Capability readiness established on all machines	Activation live in low volume working sections				Activation live on all mining machines on site	Preventive and update maintenance ongoing
Date	2015/10/21 – 2015/12/18	2015/12/18 – 2016/04/15	2016/04/11 – 2016/06/01	2016/06/01 – 2016/11/01				2016/11/01 – 2017/02/28	2017/02/28 - Onwards
Timeline	2 months	4 months	1.5 months	5 months				4 months	Ongoing

Figure 2: Seven-phase approach that was adopted by an Underground

Phase 1: Pre-Installation

The work conducted during this phase included a thorough understanding of the TMM fleet and to design the system within the context of the TMM requirements. In terms of IRM this phase included the "onboarding and training of dedicated installation personnel." The installation team is

outsourced to the OTM. It is important to note that in this case as well as other operations that have implemented CPS, all installation is done by the OTM and not by the mining house.

Phase 2: Installation

The main aim of this phase was to conduct the physical installation of the CPS on the TMM, which was done in a manner that firstly was in-line with mine safety requirements but also to ensure that production was least impacted. Therefore, installation occurred during work holidays or weekends. Other relevant activities that occurred during this phase were:

- Compilation of installation method statement and installation instructions
- Expert training for installation auto-electricians of the data and communications hub for the CPS
- Establishing a strong working relationship between installation team and relevant mine personnel

Phase 3: Activation

While this phase was about activation and testing it was also importantly about Change Management. Establishing buy-in and the adoption of the right behaviour required the following activities:

- Providing mine personnel with a thorough understanding of the system
- Daily meetings to reinforce the expected behaviour of the machines
- Ensuring production teams were involved as early as possible
- Creating change champions to ensure leaders are actively promoting the system, creating motivation, and creating the right communication and culture (“avoid the blame game – it’s a team effort”)

Phase 4: Cold Commissioning

This was the first stage of the activation where the key focus here was to gather and evaluate data in order to understand interactions and traffic management to therefore reduce interactions, revise plans, refine zoning and identify exclusion areas. This phase also included a strong focus on training and creating awareness.

Phase 5: Partial Commissioning

Partial activation was initiated in **low tonnage profile areas**. Here, various challenges were identified such as:

- The need to revise exclusion areas
- Traffic management
- The understanding of the behaviour of the system by mine personnel
- General behaviour challenges around the system

IRM related behaviours that occurred during this time were:

- Technicians were initially stationed where machines were operating, however, this posed challenges later when activation was rolled out to other sections.
- Reporting of CPS faults were incorrect as the faults were mostly unrelated to CPS.

As more TMM were activated during this stage further challenges were identified, particularly:

- Poor discipline related to traffic management,
- The need for dynamic zoning and
- Escalated down-time due to the continued incorrect reporting of faults.

To overcome these traffic management behavioural challenges TMM operators were empowered to reprimand mine personnel who do not adhere to traffic management rules.

In order to overcome the fault-finding challenges it was agreed that the OTM technicians would accompany the Mechanical Artisans to attend to breakdowns irrespective of the status of the machine.

Phase 6: Hot Commissioning

During the hot commissioning phase all TMM were activated for entire shifts, the lessons learnt from the previous phases were implemented and modifications or improvements were made where relevant such as the layout of the CPS interface and changes to the zone detection rules.

Phase 7: Maintenance and Improvement

Due to the extent of the various modifications and improvements as well as the adverse conditions of the mine's operations, continuous maintenance was necessitated. This was ensured by a 24-hour presence by OTM personnel who worked closely with OEM contractors and mine personnel. The system allows for real-time precise and accurate feedback that enables efficient maintenance that reduces the stress on the machines. This data is constantly assessed to allow for improvements to be made to the hardware, firmware and software.

4.2 Key Lessons

The following are critical lessons learnt during the implementation of CPS, particularly as it relates to IRM. These lessons are related to one or more mining operations that have undergone CPS implementation and will be a critical component that informs the skills transfer process detailed in section 5:

Key Lesson	Relevant KTF Dimension
All key components needed for effective IRM must be established and ready prior to the commencement of a CPS implementation project. This includes but not necessarily limited to the required IRM processes, IRM personnel which may include in-house recruitment or establishment of a maintenance SLA with the relevant suppliers, and the implementation of a stock spares management process.	Work Practices and Processes Operations
Stock spares management is a critical component as the unavailability of stock will contribute to downtime of a machine and a loss of productivity. In the case where different CPS are implemented on one operation this opens the risk of using an incorrect component on the system which may impact its functionality.	Operations
IRM technicians that have met the required criteria to perform IRM on CPS in each operation must be allocated with the required exclusion tags to ensure they are able to perform their roles without unnecessary delays.	Work Practices and Processes
Many CPS systems provide real-time data that should be understood and analysed by relevant mine personnel involved in IRM to effectively enhance decision making and drive continuous improvement of people and processes.	Knowledge and Skills
Strong teamwork is crucial to the effective functioning of CPS and therefore a vital skill that needs to be developed amongst the personnel involved in IRM. Mine operations have often encountered a culture of "blame" related to TMM downtime where no party takes accountability. There is then inaccurate reporting of faults and as a result significant down-time.	Knowledge and Skills Work Practices and Processes

The adoption of change by mine personnel has been reported as one of the most significant challenges faced in the implementation of CPS. Effective change management is driven by leaders and other TMM personnel – they need to consistently communicate the importance of mine safety, the functionality of CPS and general traffic management rules and regulations. If mine personnel exhibit the required discipline related to CPS and traffic management there would be less use of the CPS which would enhance productivity, increase safety and reduce costs related to the impact of the CPS on the braking systems. – "success of this type of project is only 20% based on engineering functionality: awareness, technology, installation, and maintenance. The remaining 80% of success is based on the mine operational adjustments such as traffic management, roadway conditions, employee acceptance to change/participation and implementing and maintaining discipline. The technology alone does not present a "silver bullet" solution. It must be combined with careful adjustments to operational environment and continuous training and coaching of the mining personnel, in order to achieve a successful and effective Collision Avoidance (Prevention) System"	Knowledge and Skills Work Practices and Processes
The CPS should be fully activated well in advance of operation so that, if it runs a self-diagnostic just prior to operation, this could identify faults that need to be addressed and therefore impact productivity.	Operations
CPS must be wired and installed as per the specific wiring requirements of the TMM, therefore it is important that the technician understands the unique requirements of the TMM as this may impact on functionality and fault-finding.	Operations
Supplier relationship must be strong as they bear a reputational risk associated with their products. Therefore, the issues around legal liability and assurance of suitable internal IRM capability must be established.	Legal and regulatory
On-the-job training was shown to be the most effective approach. Therefore, an effective skills transfer approach must include an on-the-job mentoring or coaching relationship between mine artisans and CPS technicians. However, it is important that such a training approach is suitably structured in a manner that ensures for full knowledge transfer and the adoption of full accountability for these duties.	Knowledge and Skills
It is reported that the quality of maintenance is generally of a higher standard when performed by outsourced CPS technicians rather than mine artisans. The possible reasons suggested for this are, the CPS technician is likely to have more experience. Also, internal employees are more impacted by pressures of production and therefore will focus mainly on getting the TMM operating as soon as possible.	Work Practices and Processes
The transfer of skill is impacted by a lack of accountability – it is easier to defer the responsibility to an external party than risk the impact of safety or production. A clear process of skills transfer must be in place and executed to enforce accountability by the maintenance team.	Work Practices and Processes

4.3 Minimum Requirements for effective CPS IRM of TMM

The table below summarizes the minimum requirements for effective CPS IRM of TMM as per mining houses that have already completed a CPS implementation project.

Relevant to	Element	Output
CPS Technician (see Appendix A for more detail regarding the key requirements for a CPS technician).	Qualifications	• N4 electrical engineering qualification with trade test
	Experience	• 2 - 3 years mining experience
	Training	• CPS specific training provided by relevant OTM • On-the-job coaching from an OTM CPS technician
Mine Management	Maintenance Schedule	• Daily inspections and tests • Daily safe declaration • Weekly routine maintenance
	Technicians per mine	• 5 total artisans per production section – 1 artisan available per 12-hour shift which rotates across 4 shift every 48 hours (1 relief artisan available to cover for sick leave.

4.4 Upskilling Approach

Required training

Artisans or instrument technicians responsible for the IRM of CPS for TMM would likely be responsible for maintenance across various components of a machine and perhaps have other core responsibilities - IRM of CPS is generally a component of their broader role (e.g., hydraulics, electric motors). For them to fulfil the specific IRM of CPS function they would be required to attend CPS training provided by the CPS manufacturer. While there are many similarities between CPS developed by different manufactures, there are core functional differences that require training which must be specific to the implemented CPS. This training is provided by the manufacturers. However, one of the mining houses has brought elements of the training in-house through train the trainer programs and the implementation of simulators into their training centres.

As per the case presented herein, technicians would need to attend training aligned to the following phases:

1. Mine specific training – this is role agnostic
2. Product specific training
3. Practical training
4. Ongoing coaching or on-the-job training

Learning objectives

The key learning objectives for CPS IRM for TMM training are the following:

1. To ensure technicians have a thorough theoretical understanding and competence of all the components of the Collision Prevention System and how they work together to enable optimal system functionality.
2. To provide practical competence in the installation, repair and maintenance of the Collision Prevention System on all Trackless Mobile Machines that have and will be fitted with the system, especially within the context of the mining operation in which the technician will perform their duties.
3. To perform data analytics that can be used to enhance the effectiveness of Collision Prevention Systems within the context of the mines operations.
4. To understand the role of CPS IRM within the broader context of the mine's operations, processes and requirements, which include but are not limited to safety protocols and regulations, traffic management, spares management and TMM maintenance.
5. To enable future fit IRM of CPS competence through ongoing training and support.

Curriculum

Figure 3 outlines the curriculum covered as part of the training required for Artisans who perform IRM of CPS for TMM. Company Specific Training is provided largely in-house, whereas Product Specific Training, Practical Training and Ongoing training is provided by the OTMs. It is worth noting that training curriculums are largely consistent across the training providers who have been willing to share their training information as part of this study. However, many training curriculums may vary depending on the OTM. In addition, components of the technical CPS training have been brought in-house in a few situations.

Company Specific Training	Product Specific Training	Practical Training	Ongoing
Risk Propensity Assessment and Training	System Introduction	Diagnostics	Annual / Bi-Annual Refreshers
The MHSA	Component Overview	System Checks	Competency Assessments
Health & Safety system	Installation & Configuration	Lamp Room Checks	Technical Reviews
Policies & Procedures	Operation	Fault Finding	Product Specialist Meetings
Codes of Practice	Geofences & Zone Adjustments	Replacement	
Standard Operating Procedures	Exclusion Zones	Software Uploads	
	Security Features	Data Downloads and Analysis	
	Maintenance		
	Troubleshooting		
	Technical Specifications		

Figure 3: Curriculum covered as part of the training required for Artisans who perform IRM of CPS for TMM

Duration

Training duration appears to vary between OTMs, however, in this case the duration of training phases is broken down as follows:

1. Product Specific Training – 1 day
2. Practical Training – 1 day
3. On-the-job Training – Ongoing

License renewal

CPS training is renewed as follows:

- Mandatory refresher every 2 and a half years, OR
- as required

On-the-job training

Maintenance Service Level Agreements (SLAs) are in place once CPS is installed on an operation's TMM, which lasts until IRM is fully insourced. The SLA ensures the CPS field technicians are available to perform the required IRM. In this case it also requires that the CPS field technicians provide ongoing training or coaching of in-house artisans with the intention of building up the required skill level for the artisans to conduct all IRM independently.

Accreditations

CPS training conducted by the OTMs is not accredited training and therefore, artisans do not receive any formal accreditation from the OTM or the Mining House as qualified CPS technicians. In some cases, competency certificates are issued to Artisans who attend and complete CPS training, however, this is a certificate of training attendance and not a formal declaration of competence.

5. Skills Readiness Plan

The above case explained a 16-month implementation process and the IRM related lessons learnt from that experience. The skills readiness plan below provides a practical guideline to not only implement a robust IRM function but to also overcome the expected challenges associated with the implementation of CPS. By implementing the phases outlined below and therefore, effectively managing the various challenges described above, it is our expectation that the time associated with the effective knowledge transfer of IRM duties as well as the broader CPS implementation process will reduce significantly and as such have a positive impact on cost, safety, and productivity.

To show how the below aligns to the Knowledge Transfer Framework (see Figure 1) the various activities have been colour coded accordingly. The relevant KTF dimensions are also listed next to each phase for ease of reference. In addition, "potential outcomes and key tools" have been referenced for each phase. These tools form part of the Skills Readiness Plan toolbox that users may find useful to aid in their execution of the plan. These are generic tools and Member firms are welcome to edit these to be more suitable within their own context. Alternatively, they may have their own versions of the below tools or, perhaps, even additional tools which they are encouraged to use and if possible, share with the broader MCSA community.

Phase	***Description***	***Potential outcomes and key tools***	***Parallel IRM Related Activities***	***KTF Dimension***
Steering & Tender Committee Appointed	***Committee to include:*** • Engineering Executive/Manager • Finance Executive/Manager • Health and Safety Executive/Manager • Chief Operating Officer/Mining Manager • HR Director/Manager	• Steering and Tender Committee Terms of Reference	***Ensure inclusion of:*** • **Engineering Executive/Manager** to oversee technical considerations • **HR Director/Manager** to oversee resourcing and development considerations	***Upskilling, training and development*** ***Organisational Design*** ***Operations*** ***Work Practices and Processes***

	• External Independent Technical Consultants			***Knowledge and Skills***
As-Is Analysis	***TMM*** • Current TMM Inventory (Per Operation, Per TMM, Per OEM, Per Geographic Region) • Current CPS Inventory (Per Operation, Per TMM, Per OEM, Per Geographic Region) • Current CPS shortfall (Per Operation, Per TMM, Per OEM, Per Geographic Region) ***Personnel*** • Current FTE of Artisans with required minimum qualification and experience • Required FTE of Artisans	• Analysis data sheet • Capacity model	**Key analysis outputs:** • Identify the required full-time equivalent (FTE) of artisans needed to perform IRM duties given the context of the operation – number of TMM, size of operation, length of shifts, likely relief support. • Identify the number of Artisans in-house that can be upskilled vs. the number of new recruits.	**Operations** **Organisational Design**

Supplier Selection and Contracting	• Draft and Issue Tenders
	• Tender Shortlist and Selection
	• Supplier Contracting incl.:
	  ○ Product Specifications
	  ○ Liabilities
	  ○ Rights to Upgrades
	  ○ Implementation Plan and Timelines
	  ○ Implementation Responsibilities
	  ○ Handover Criteria
	  ○ Knowledge Transfer
	  ○ IRM Training
	  ○ IRM schedule requirements and standards
		• Tender evaluation guidelines	***Ensure inclusion of:***
			• Required IRM Job Profiles
			• Knowledge Transfer Commitments
			• Knowledge Transfer Signoff
			• Supplier vs Customer Training Responsibilities (Pre and Post-Handover)
			• Recommended IRM Procedures and Standards
			• Potential transfer of IRM Personnel from supplier to customer (§197)
			• Ongoing IRM support
				Legal and Liability

Implementation Team appointed	Implementation team to include: • Programme Manager • Project Administrator • Project Management Tool • OTM Representatives • OEM Representatives • Engineering Executive (plus Engineering Managers per Operation) • Technical Training Manager • Change Manager and Change Champions	• Implementation Team Terms of Reference • Appointment letters and Scopes of Work • Reporting lines, formats and frequencies	***Ensure inclusion of:*** • **HR Representatives** covering IRM related Recruitment, Job Profiling, Training, etc. • **Engineering (Electrical) representatives** covering Operating Procedures, Job Descriptions, Technical Training and Onboarding • **Change Management** covering Communication and	***Knowledge and Skills*** ***Organisational Design*** ***Work Processes and Practices*** ***Operations***

			Socialisation of new ways of work	***Upskilling, training and development***

Implementation Plans agreed and committed to by suppliers and steering committee	Plans include:
	• Programme Charter
	• Project Plan
	• Risk Management Plan
	• Work Processes and Procedures
	• Logistics Support Plan
	• Project Resourcing Plan (incl. Change Management and Communications skills)
	• Contracted:
	  ○ Implementation Time
	  ○ Testing and Calibration
	  ○ IRM Technician involvement and on the job training
	• IRM Resourcing and Training Plan
	• Change Management Plans
		• Programme Charter
		• Project Plan
		• Risk Management Plan
		• Work Processes and Procedures
		• Logistics Support Plan
		• Project Resourcing Plan
		• IRM Resourcing and Training Plan
		• Change Management Plans
			Thorough IRM HR Plan covering:
			• Finalisation of Job Descriptions
			• IRM Personnel requirements based on Supplier Contracted Estimates
			• Labour Sourcing Plan with timings (Internal/External/Supplier)
			• Upskilling and training plan
			• Train the trainer plan
			• Onboarding including involvement in Installation and Commissioning
			• Handover and signoff of IRM handover plan by supplier
			Thorough Logistics Plan covering:
			• Parts supply
			• Processes
			Change Management Plan covering:
				Work Processes and Practices
				Operations
				Upskilling, training and development

			• Communication • Feedback Mechanisms • etc.	

Post Installation Planning	• IRM Resourcing schedule per operation
	• Central vs Operation support analysis
	• Training Schedule
	• Career Pathing
	• Operating Procedures
	• Spares stock management
	• Analytics and Diagnostics
	• Maintenance Agreements
	• Maintenance Planning & Schedules
	• Risk Planning and Risk Analysis
		• IRM resourcing schedule
		• Training schedule
		• Career path template
		• Maintenance plan
		• Maintenance schedule
		• Risk plan
		• Bowtie analysis
			Supplier and Customer Joint Task Team:
			• Monitoring of all IRM activities
			• Proactive adjustments to
			  ○ *Staff Mix*
			  ○ *Training*
			  ○ *Procedures*
				Work Processes and Practices
				
				Operations
				
				Upskilling, training and development
				
				Organisational Design
				
				Legal and Liability

IRM Implementation	• Artisan recruitment • Onboarding • Artisan technical upskilling • Non-technical skills training • On-the-job training • Supervisory and leadership training • Competency assessments	• Implementation and Onboarding guidelines and procedures		***Knowledge and Skills***

6. Conclusion

The case detailed above provides a practical approach to the transfer of skill to the mining houses as it relates to the IRM of CPS for TMM, specifically by drawing on the practical lessons learnt by mining operations that have already undergone substantial CPS implementation. These lessons emphasize the importance of a holistic approach to knowledge transfer, touching on all the key components of the Knowledge Transfer Framework (see *figure 1*).

These important lessons when overlaid with the holistic approach of the Knowledge Transfer Framework provide the mining houses with a practical step-by-step plan to ensure sufficient readiness of IRM skills. By implementing each of these steps a mining operation will ensure the operational, legal, technical and skill requirements are sufficiently covered to enable the effective performance of IRM duties. However, this study provides a clear case for the importance of the development of non-technical skills – namely, change management, leadership, accountability, teamwork and discipline. A lack of these critical non-technical skills poses a significant challenge to mining houses in not only the transfer of IRM skills but also across the entire CPS implementation process.

As the Mine Health and Safety Council Board has approved the end of December 2023 as the date for the lifting of the suspended Trackless Mobile Machinery (TMM) Regulations (see Appendix B) it is crucial that mining houses begin the implementation of this guide as a matter of urgency. This report previously stated that IRM processes and resources should be in place prior to the installation phase as this will ensure a positive impact on safety, cost and productivity.

7. Appendices

7.1. Appendix A – job description and other job requirements

Job Description

Job Title
Collision Protection System (CPS) technician
Job Purpose
To Install, Repair and Maintain (IRM) Collision Prevention Systems (CPS) on Trackless Mobile Machinery (TMM)
Generic Equivalent
• Trade-tested Artisan – Electrician / Auto Electrician/Instrument Mechanician. • Patterson Band – C1/C2
Minimum Technical Skills
• Product Knowledge • Basic computer knowledge • Basic TMM machine knowledge • Basic IT and Electronics (Hardware, Software and Networks) • Hand tools

Required Experience
• Supervised experience in the IRM of the relevant technologie(s) as guided by the OTM training guidelines • Control Instrumentation background / RF experience beneficial • 3-4 years' experience with installations / maintenance of control & instrumentation systems.
Key Responsibilities
5. Inspect CPS equipment at intervals determined by the site specific maintenance agreement or maintenance schedule as determined by the Task Based Risk Assessment specific to the machinery on which the CPS devices are installed and the mining conditions peculiar to the mining operation in question. 6. Repair and/or replace, as required, any devices, or device components that fail afore-mentioned inspection,. 7. Upload program upgrades within a period of time agreed between the device manufacturer (OTM) the operation to which the CPS Technician is assigned 8. Download diagnostic data as required by the operation to assess traffic and risk patterns
Organisational Interfaces
• Supervisor: Taking instructions and amended instructions, Reporting back IRM schedules and anomalies, Reporting of schedule interference. • TMM Operators: Communication of schedules and amended schedules, delays. Understanding operational priorities. Stop and Fix instructions. • Shift Bosses and Supervisors: Coordination of IRM activities, Stop and Fix instructions. • H&S Representative: Coordination of IRM schedules, anomalies, Stop and Fix instructions.

Figure 5

Functional Related Key Performance Indicators

Key Performance Areas	Cluster	Key Performance Indicators	Competencies
Safe and effective installation, repair, and maintenance of devices	Solving Problems	• Resolve problems that occur during the shift • Resolve problems picked up during maintenance	• Knowledge of job • Technical knowledge • Knowledge of relevant SOP's/COP's • Quality adherence • Planning skills • Organising skills • Controlling skills • Assertiveness • Conscientiousness • Problem solving skills
	Adaptability	• Ensure availability of material, tools and equipment	
	Delivering Results	• Output achieved within given guidelines • Comply with set standards and practices of the job • Time frames are adhered to • Check the Accuracy of the completion of Log books, permits and other documents	
Comply with provided systems, practices, methods, standards, and procedures of the work	Delivering Results	• Comply with standards, methods and procedures of the job • Attend to breakdowns promptly to minimise down time • Repair equipment and machinery promptly to ensure production targets are met • Conduct fault finding and repair installations according to schedule and company specific standards	• Job knowledge • Technical skills • Risk Assessment skills • Knowledge of standards, methods and procedures of the job • Ability to apply knowledge of standards, methods and procedures • Ability to apply fitting knowledge and skills • Inspection skills • Diagnostic skills • Communication skills

Figure 6

Safety Related Key Performance Indicators

Key Performance Areas	Cluster	Key Performance Indicators	Competencies

Safe and effective installation, repair, and maintenance of devices	Delivering Results	• Comply with electrical and mechanical standards, standard procedures and codes of practice to achieve zero harm
		• Comply with mine health & safety management systems & standards
		• Follow basic health and safety practices
		• Ensure compliance with gas safety rules / guidelines.
		• Ensure that PPE is used in accordance with standards and procedures
		• Submit accident/incident report in writing when required
		• Follow safety protocols when detecting unsafe working conditions
		• Comply with health & safety campaigns
		• Apply first aid as and when required
		• Ensure good housekeeping in area of responsibility
			• Knowledge of health & safety systems & standards
			• Understanding of "right to withdraw" procedure
			• Attentiveness
			• Mine health and safety awareness
			• Communication skills
			• Set example
			• Basic legal understanding
			• Risk management skills
			• Hazard identification skills
			• Problem solving skills
			• Literacy and numeracy skills
			• Writing skills
			• adaptability
			• Knowledge of the mines health and safety policies
			• Knowledge of safety campaigns
			  • First aid skills
			  • Housekeeping skills

	Influencing People	• Report unsafe behaviour, acts and conditions immediately • Lead by example and walk the talk; Be your brother's keeper.	

Figure 7

Behavioural Framework

Figure 8 illustrates a behavioural competency profile for a generic CPS technician. The competencies described below is based on the Saville Behavioural Competency Model.

The categorisation of the competencies into essential, important, and less important is based on a generic understanding of the role. However, the categorisation may take a different form depending on the context in which it is applied.

Cluster	Dimension			Cluster	Dimension		
Solving Problems	Examining Information	Developing Expertise	Generating Ideas	Adapting Approaches	Conveying Self Confidence	Thinking Positively	Understanding People
	Documenting Facts	Adopting Practical Approaches	Exploring Possibilities		Showing Composure	Embracing Change	Team Working
	Interpreting Data	Providing Insights	Developing Strategies		Resolving Conflict	Inviting Feedback	Valuing Individuals
Influencing People	Interacting with People	Convincing People	Making Decisions	Delivering Results	Meeting Timescales	Managing Tasks	Taking Action
	Establishing Rapport	Articulating Information	Directing People		Checking Things	Upholding Standards	Seizing Opportunities
	Impressing People	Challenging Ideas	Empowering Individuals		Following Procedures	Producing Output	Pursuing Goals

Key

- **Essential**
- **Important**
- **Less Important**

Figure 8

Typical working conditions that a CPS Technician needs to be accustomed to

Environmental	Physical	Emotional	Mental	General

• Underground/Surface
• High risk
• Dusty
• Noisy
• Heat
• Radiation
• Low illumination
• Working at heights
• Uneven/slippery surfaces
• Travelling ways
• Material ways
• Back and abandoned areas
• Occasionally exposed to fumes
	• Endurance
	• Walking
	• Standing
	• Sitting
	• Operating Equipment
	• Physical Strength
	• Climbing ladders
	• Finger dexterity
	• Hearing and visual acuity
		• Stressful
		• Consequences can be severe
		• Time constraint: High to Severe
		• Emotionally Stable
			• Moderately cognitive
			• Moderately complex
			• Thinking
			• Reasoning
			• Awareness
			• A wide range of choices and decisions within predefined scope
			• Discretion
			• Basic Analytical Skills
				• Knowledge of the requirements of:
				  • The MHSA
				  • Health & Safety system
				  • Policies & Procedures
				  • Codes of Practice
				  • Standard Operating Procedures
				• Able to perform routine work
				• Available for Standby/Call Outs & Unplanned Overtime

Figure 9

7.2. Appendix B – Mine Health and Safety Act, 1996 (Act No 29 Of 1996) Regulations Relating to Machinery and Equipment (Amendment of Chapter 8 Of the Regulations)

TMM regulations were promulgated under notice N.R. 125 in the Government Gazette, on the 27th of February 2015. The TMM Regulations form part of chapter 8 of the regulations made under the MHSA. The regulations came into operation three (3) months after the date of publication in the Government Gazette, with the exception of sub-regulations 8.10.1.2 (b) and 8.10.2.1 (b), which deal with the slowing down and stopping of diesel-powered TMM.

The amendments to Chapter 8 of the MHSA 1996 require all mining operations to take "*reasonably practicable measures*" to prevent accidents involving mobile machinery within their operations.

Accidents are defined as being between:

- Trackless vehicles and people (pedestrians) (for underground)
- Trackless vehicles and other trackless vehicles (for surface)
- Trackless vehicles and rail-bound vehicles
-

Solutions to prevent accidents in this regard have to be compliant in terms of these amendments, and requires three components:

- A proximity detection device identifying the existence of people or other vehicles in the vicinity
- A mechanism to alert the machine operator and the nearby people / vehicles of each other's presence
- An automated system to slow the vehicle to a safe speed without human intervention if no corrective action is taken to prevent an eminent collision