Keynote address: Scraper Winch Systems

President AMRE - Fritz van Zyl

Scraper winch systems: Background and History

2025[1]

Significant advancement in winch scraper safety controls and/or elimination of winches **implementation of semi-automated** winch scraper operations

2018

Worker tracking and **proximity detection** using RFID tags and UHF systems

2003

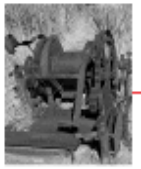
The double chain configuration was abandoned due to wear of chains, flights and rollers. Single chain scrapers were introduced which utilised quarter ton scraping buckets attached to a single drive chain to move ore (Rupprecht, 2003)

1991

Continuous double chain scraper adopted in 1991 which was derived from armored face conveyors used in coal mines. Ore was moved by flights that are attached to chains at two points

1932

South Africa endeavors to mechanise rock handling operations. By 1946 **mechanised rock handling** was prominent (Biccard Jeppe)



1919

The **scraper gained popularity** around 1919 in the Mesabi Iron Range, USA

1890

The **earliest application of the scraper** was in Kellogg, Idaho, USA where the slip scraper was used to develop tunnels in 1898

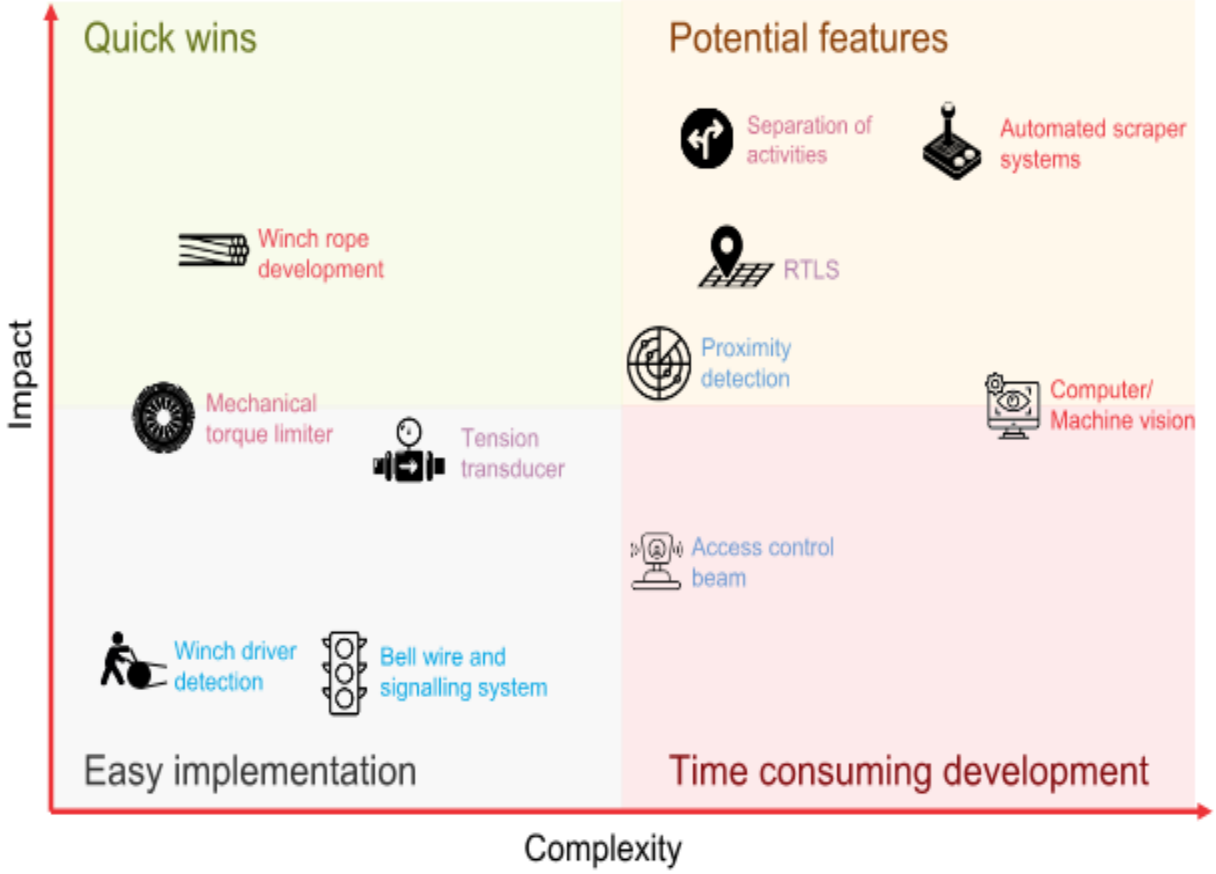
- The use of scraper winch systems date back to the 19th century and are **still common practice in modern conventional breast stoping mines** to clean the Stoping Face as well as Advanced Strike Gullies and Centre Gullies.
- **Tremendous amounts of energy are embedded** in scraper winch systems which has caused countless injuries over the decades of use of these systems.
- Industry has noted the safety risks of using scraper winch systems and **various engineering controls have been implemented** to enhance safety, however, these controls remain **non exhaustive**.
- It is essential to **refine** existing controls, **develop** future concepts and **influence** the associated behaviors underground to ensure an intrinsically safe operation and pave the way to **zero harm**.

[1] Testing & pilots underway in modernised operations

HARMONY

Commercial — Concept

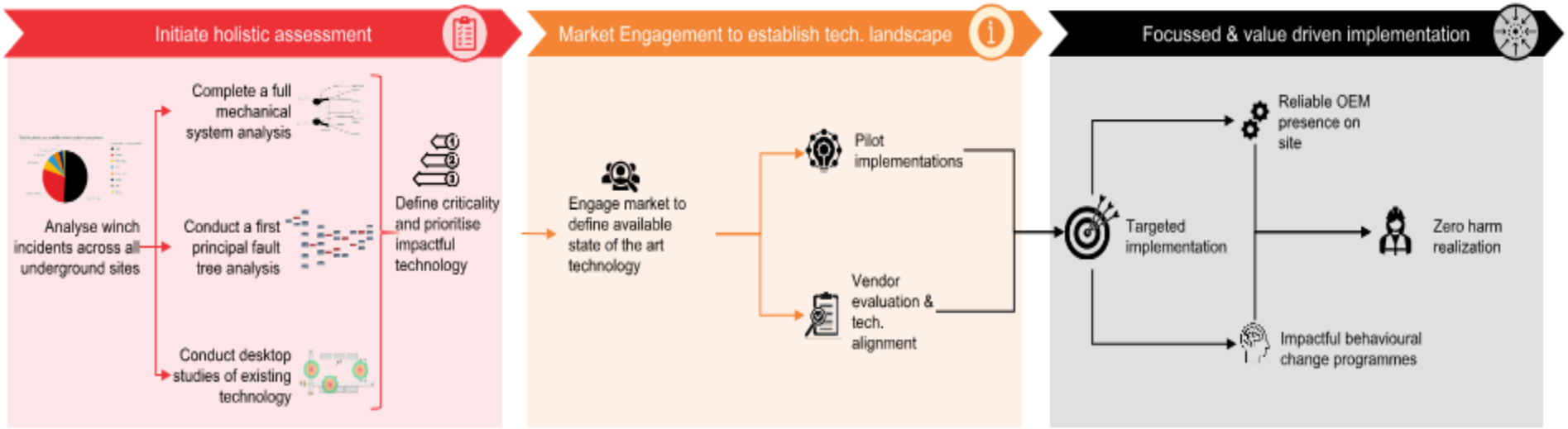
High level view of state-of-the-art



- There are a **wide variety** of engineering controls that can be implemented to mitigate or eliminate scraper winch incidents in underground mining environments.
- The effectiveness of these control **are site specific**, and each control **introduces an intrinsic complexity** to the total system that should be understood before implementation.
- It is clear that no “silver bullet” currently exists and a **combination of controls** and behavioral changes could be required on the pathway to zero harm.

HARMONY

Harmony's approach to improving winch systems



Description

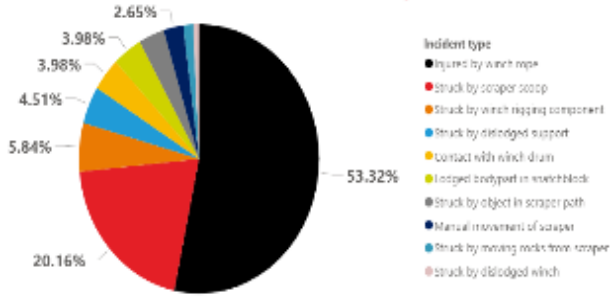
Harmony has initiated a process to analyse the **root cause** of incidents across the 9 underground sites. The analysis includes a fault tree, mechanical analysis and analysis of existing technology. The outcome is to **focus efforts on impactful and cost-effective solutions.**

Market engagement is essential to **evaluate state-of-the-art technology** and assist in development of new concepts and novel solutions. Harmony follows a **structured approach** to incorporate all relevant market sectors to paint a comprehensive picture available controls and technology.

To ensure success it is essential that identified engineering controls are **implemented swiftly** with utmost **precision**. User adoption strategies are often overlooked; however, **adequate training and behavioural change is crucial** for rollout success.

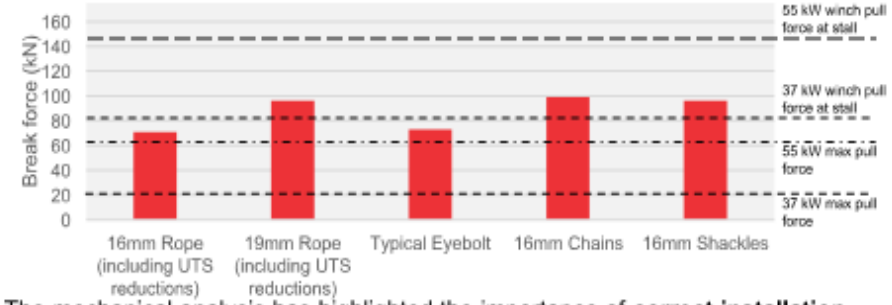
Harmony's key findings

Incident analysis



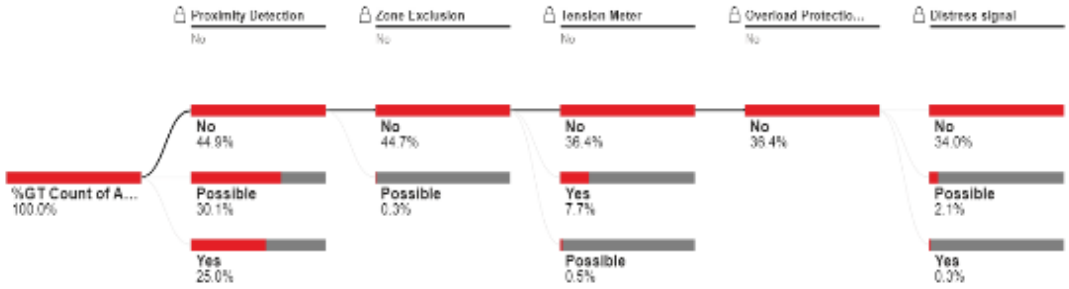
Harmony has identified the **winch rope, scraper scoop and winch rigging** components as the 3 main **components to cause injury**. Controls **aimed to mitigate these components** will result in the highest safety enhancement impact.

Mechanical analysis



The mechanical analysis has highlighted the importance of **correct installation** and **component selection**, and the **consequences** of the **energy associated** with winch systems (importance of torque limiters).

Control analysis



- Harmony has **modelled common controls** (proximity detection, winch driver detection [zone exclusion], Tension transducer, overload protection, worker distress signal) to past incidents **to analyse the impact on the result**.
- It is clear that **a "silver bullet" does not exist** presently, but rather a **combination of controls is required** to eliminate all incidents. It is critical to note incidents will occur for which no control is implemented. It is the **responsibility of industry** to act on such incidents and **develop future pathways** to ensure worker safety.

How do we transition to a zero-harm strategy?

5.2%

of all fatalities at Harmony are caused by Scraper winch systems (FY11 – FY22)…

of these fatalities could be eliminated by implementing a large combination of currently available state-of-the-art controls…

How does the pathway look to eliminate the remaining

14%

Utilise Connectivity

Underground connectivity unlocks a host of safety opportunities including short interval control, real time monitoring and RTLS.

Utilise Data Analytics

Modern mines have access to advanced data analytics and modelling tools to prevent future accidents based on past experience.

Develop partnerships

Safety driven partnerships between mining houses, OEMs and technology companies can revolutionise the underground activities.

Further develop technologies

Advancements in autonomous and semi-autonomous scraping will pave the way to a future safe mine.

Thank you!

Any questions?