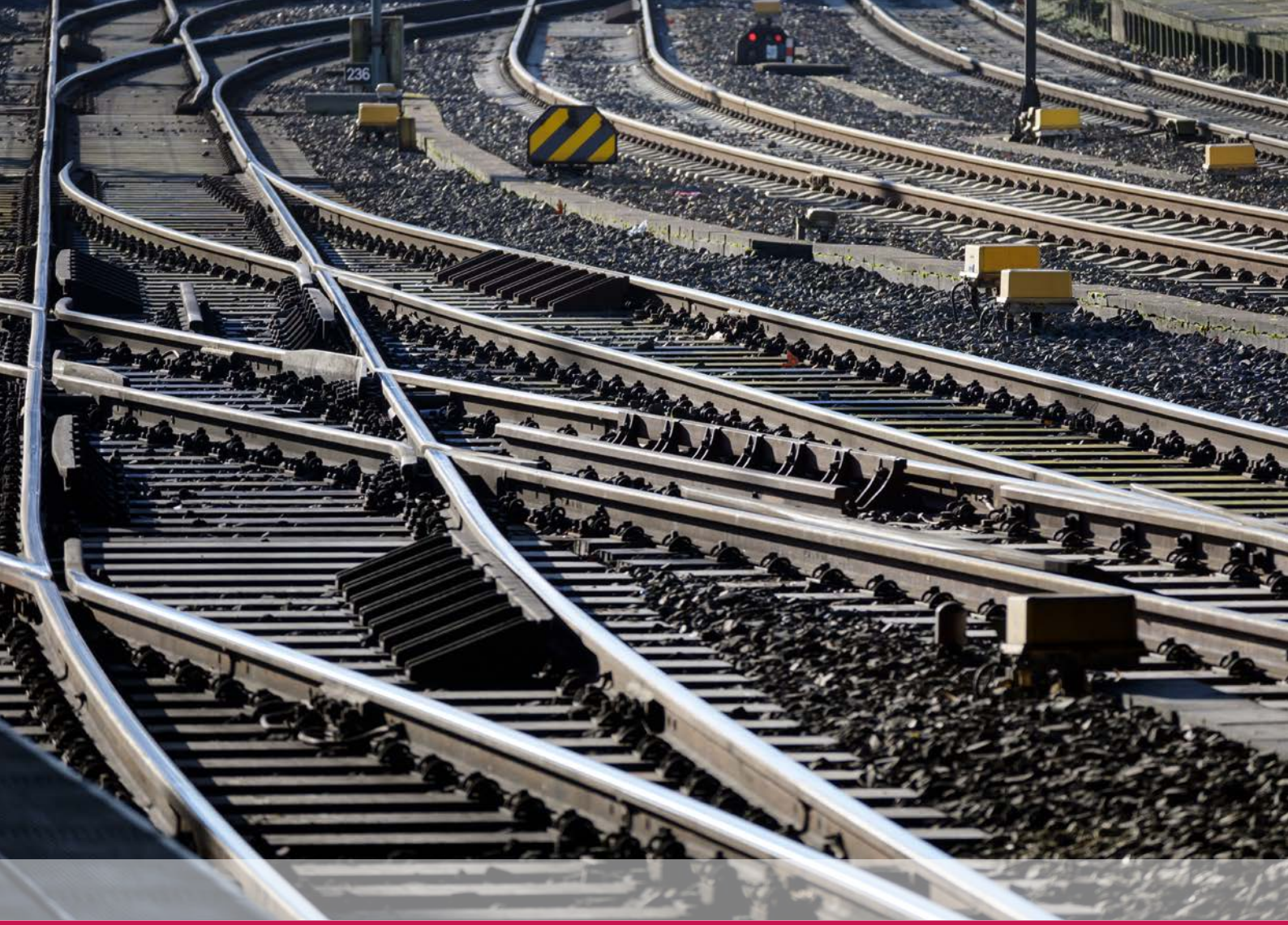

UIC SECURITY PLATFORM

Metal Theft on the Railways
Revised Edition

December 2024

INTERNATIONAL UNION
OF RAILWAYS

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Preface

This document is an updated version of the original UIC publication Metal Theft on the Railways, published in 2013. Over the past 11 years, despite significant technological advancements and dynamic railway development, the problem of metal theft continues to persist and, in some regions, has escalated, increasingly impacting railway operations and causing substantial operational losses.

This is why the UIC Security Platform Sabotage, Intrusion & Attacks Working Group (SIA WG), led by DB A.G., chose to revisit and reevaluate the problem. This update is based on the exchange of experiences and sharing of innovative solutions during SIA WG meetings and responses to a Network of Quick Responders questionnaire.

Executive Summary

Metal theft in the railways causes significant disruptions and impacts the whole operational chain. This updated metal theft brochure aims to provide UIC members with guidance on how to address this issue.

The document begins by expanding on the issue of metal theft, outlining the key aspects of the problem, including its scale, the economic and social drivers, and its consequences for railway services. It also presents the scale of the operational losses reported by UIC Members in the workshop of SIA WG which tackled this problem in April 2024.

It then transitions into a discussion on metal theft management, presenting a structured and risk-based approach, as well as real-life security measures implemented by UIC Members. It further provides a look into possible future security solutions.

It concludes by highlighting the importance of a sector-wide and even cross-sector approach to address the issue of metal theft.

1. Introduction

1.1. What is metal theft?

Definition

Metal theft is the illegal removal of items for their constituent metals with the intention of selling them for profit.[1] The metals most commonly stolen are copper, aluminum, brass, zinc, nickel, platinum and bronze. Metal theft is prevalent across various types of industries, such as warehousing, retail, construction, energy, transportation and manufacturing. Criminals may also target buildings for their metal roofs or gutters, as well as places of faith and cultural sites (e.g., sculptures).

Sale

The stolen items hold little value for the thief in and of themselves, which is why they sell them to scrapyards or dealerships that are involved in the process of recycling metal scrap for further use. The scrap metal industry plays a vital role in the green economy through the collection, processing, exportation, and recycling of scrap metals. However, it also provides a low-risk disposal route for stolen metals, often paying cash with few questions asked regarding the identity of the seller or the ownership of the materials. The receiver of stolen metal, in this case the scrap metal industry, forms a chain where the metal is moved from dealership to dealership until it reaches a small number of operators equipped to process and refine the material. Once stolen metal enters this chain, it becomes extremely difficult, if not impossible, to identify its origin.

Criminalisation

Metal theft can be perceived either as a petty crime or as a serious criminal offense, depending on the scale and impact of the theft.

It is commonly believed that the vast majority of stolen metal from petty theft is sold to local scrap metal recycling industries, rather than being exported out of the country of origin.

Organised crime groups also engage in metal theft and are most likely exporting the stolen metals. Indeed, the 2014 CER Position Paper on Metal Theft highlighted that organized crime groups targeting the railways are operating internationally. The EUROPOL SOCTA Review from 2021 suggests that these criminal groups often travel long distances, making it difficult to detect their activities, especially as they cross open borders. Crossing borders allows them to evade increasingly strict resale regulations and other collaborative mitigation efforts currently put in place.

Motivation

The issue of metal theft is linked to, but not dependent on, socio-economic factors such as the commodity market prices of metals, global industrialization and level of employment. Copper, a commonly targeted metal for theft, has a wide range of uses, making it an important article of trade. It can be forged into equipment, construction materials, and infrastructure components, making it a highly versatile commodity.

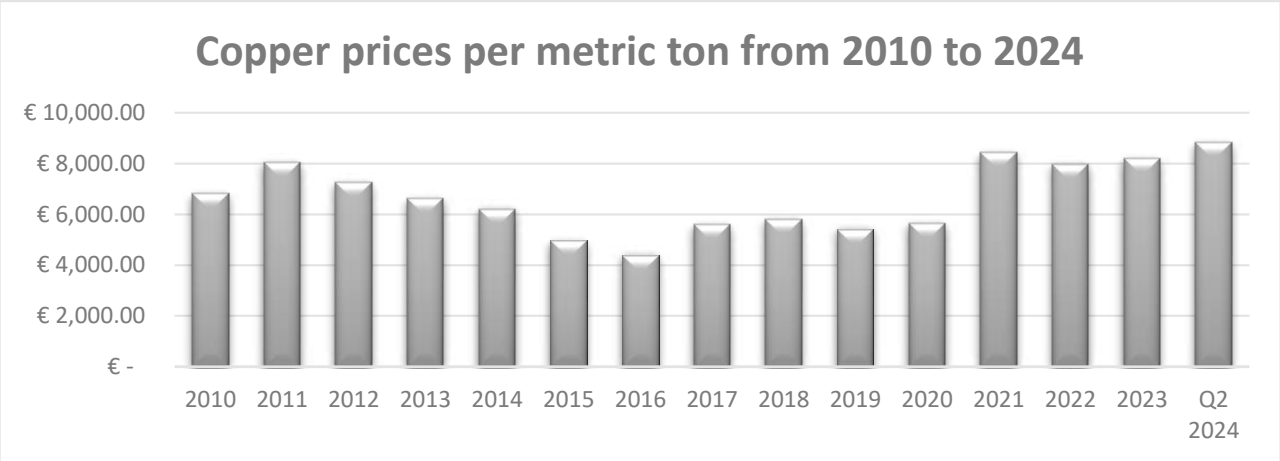
As a result, the price of copper is directly tied to its global demand and consumption. As noticed in the UIC paper on metal theft from 2013, the price of copper spiked significantly in 2006, rising from EUR 3,000 to EUR 6,000 per metric ton, driven by the rapid development of Asian and Australasian countries, which increased demand.

[1] Posick, C., Rocque, M., Whiteacre, K., & Mazeika, D. (2012). *Examining metal theft in context: An opportunity theory approach*. Justice Research and Policy, 14(2), 79–102.

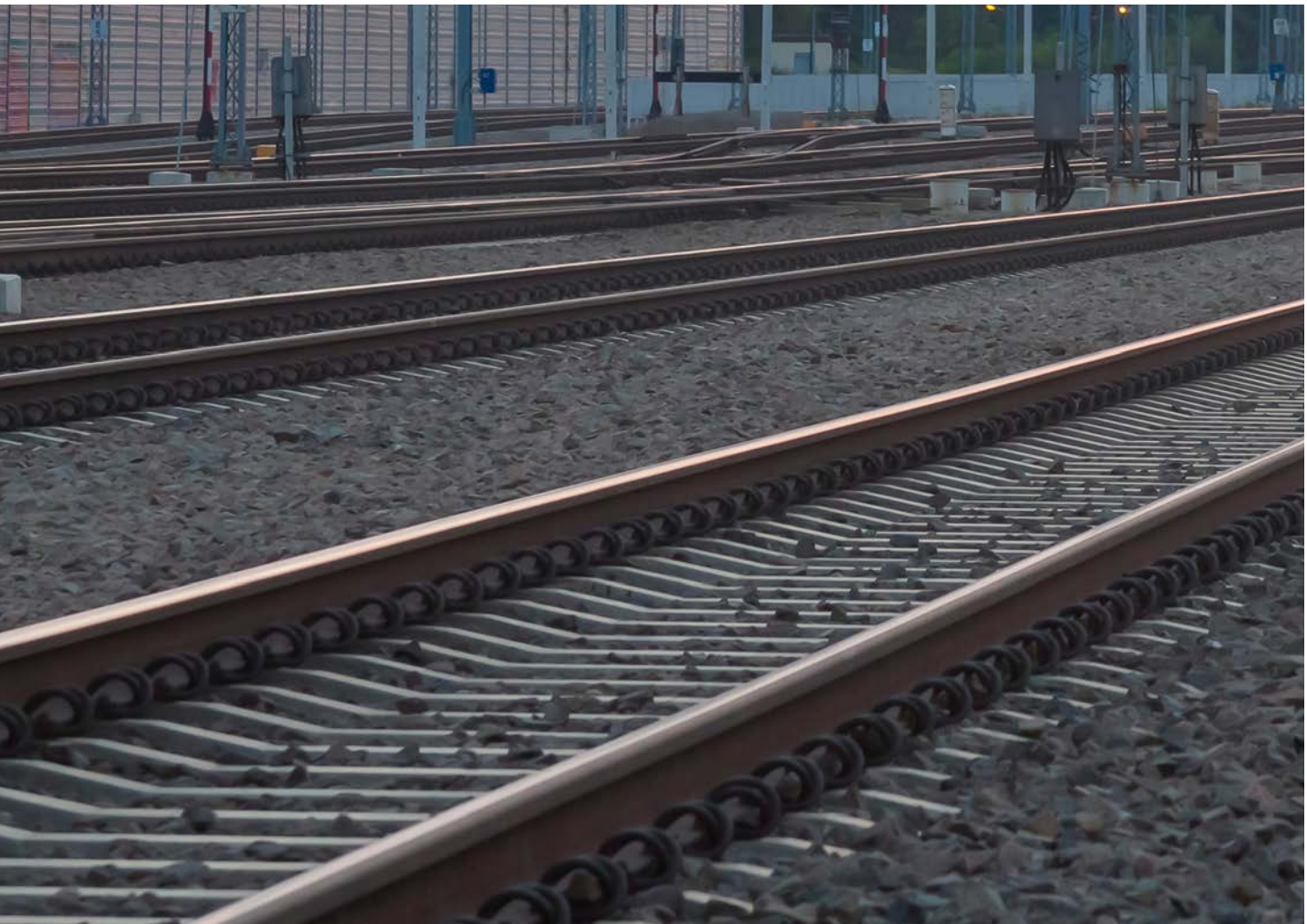
Since then, prices have fluctuated based on market dynamics, particularly influenced by major copper consumers like China, which accounted for 8.7 million metric tons in 2022. In the second quarter 2024, the average price for the copper surged to EUR 8,825 per metric ton due to soft demand and rising inflows in Asian warehouses. An estimation of copper prices from 2010 to 2024 is shown in Figure 1.

The steady and high demand for metal on the international market, coupled with the significant rise in metal prices, has made it a particularly attractive and lucrative enterprise for thieves. However, while there may be instances where rising prices correlate with increased thefts, it is essential to approach this relationship with caution, as the trends can vary significantly across different regions and contexts.

Figure 1. Copper prices per metric ton from 2010 to 2024



Source: combined data from London Metal Exchange, World Bank and Statista



1.2. Metal theft in the rail sector

Railways as an attractive target

When it comes to metal theft in the railway industry, any component containing copper or other valuable metal may be targeted by thieves. Indeed, the diversity of metal products used by railways is immense (e.g., in telecommunication systems, signaling, traction energy). The most common targets are copper components used in the long-distance railway networks, such as power and signaling cables. Additionally, rail warehouses and construction sites may also be targeted, as the stored equipment (e.g., heavy machinery parts or cables to be laid) can also be a subject for scrap resale. This results in considerable disruptions, and the costs associated with replacing and repairing the damage often, if not always, far exceed the value of the stolen metal.

From an outsider's perspective, railways are often perceived as primary targets for metal theft due to several factors:

- **Low sense of risk** – many long-distance railway networks, particularly in remote or rural areas, are not fully supervised or covered by surveillance. The vast and open nature of railway infrastructure adds to the difficulty of providing comprehensive monitoring, making it easier for criminals to operate undetected. Additionally, metal theft does not require sophisticated tools to perform the extraction, as the necessary equipment is often commercially available. Because of this, thieves often perceive these locations as "low risk, high reward" spots, as the chances of detection and on-site apprehension may be low.
- **Weak traceability** – once stolen, copper and other metals may be difficult to track, especially when sold to scrap metal dealers with limited regulatory oversight. Weak regulations around the sale and resale of scrap metal provide a convenient loophole for criminals to exploit.
- **Abundance of metals** – the diversity of metal used by the railways is immense. Such diversity and quantity are attractive to thieves, as they present a multitude of targets to strike.
- **Normative challenges** – depending on the state, specific regulations in the scrap metal industry (e.g., different requirements for sellers to prove the origin of the metals, absence of ID checks or the ability to pay in cash) may contribute to the enabling of metal theft.

In summary, the combination of economic incentives, characteristics of the railways and gaps in legal systems attract both organized and opportunistic thieves.

Impacts

Metal theft has far-reaching consequences on the railways, as presented in the (non-exhaustive) table below. Furthermore, such incidents may create a ripple effect that can be observed throughout the whole railway network, adversely straining financial resources while negatively impacting performance and reputation.

Additionally, thieves endanger themselves by tampering with live electrical cables, infrastructure, rolling stock, and equipment, which can result in severe injury or death (e.g., electrocution).

Table 1. Potential risk and consequences matrix of metal theft for rail companies

RISKS AND CONSEQUENCES	RAIL SERVICES AND ASSETS		
	PASSENGER OPERATIONS	**FREIGHT OPERATIONS**	**RAILWAY INFRASTRUCTURE**
OPERATIONAL LOSSES	■ Journey delays ■ Service disruptions	■ Delays in delivery ■ Additional delays due to possible passenger train prioritization	■ Service disruption ■ Danger to the integrity of the infrastructure
FINANCIAL LOSSES	■ Loss of revenue due to unsatisfied passengers ■ Compensation costs	■ Performance penalties ■ Increased costs due to delays in distribution	■ Costs associated with replacement of infrastructure
REPUTATIONAL DAMAGES	■ Decreased customer satisfaction and loss of trust in reliability of operations by the client ■ Negative media coverage of incidents		
SECURITY CONCERNS	■ Increased need for surveillance and additional security measures in high-risk areas (e.g., near towns or stations)	■ Risk of cargo theft in parallel with metal theft (e.g., halted train on sidetracks)	■ Increased need for surveillance of line or point infrastructure vulnerable for metal theft
SAFETY CONCERNS	■ Passenger accidents[2]	■ Staff accidents	■ Risk to public safety if failsafe mechanisms are compromised

[2] Although safety systems are designed to fail-safe—turning signals red to stop trains in the event of disruption—there are still potential risks. For instance, if a train stops unexpectedly, passengers may attempt to exit the train in unsafe conditions, increasing the risk of accidents.

Scale of the problem

Even though it has been more than a decade since the first issue of this brochure, the scale of metal theft in railways remains problematic. According to the 50th UIC Network of Quick Responders survey that was conducted in April 2024, UIC Members are still reporting worrying figures with regard to delays, as well as operational and financial losses caused by metal theft.

Total of EUR 32,339,189 in damages reported for the year 2023

86 days of delays reported by two members

2,524 cases of metal theft in 2023, reported by 8 respondents

Seven out of ten respondents reported an increase in metal theft incidents

Three out of ten members reported decreases

Key takeaways from the survey suggest that the problem of metal theft causes significant financial and operational damages to the whole railway system. The consequences are usually counted in millions of Euros and in days of delay. It is important to note that some of the figures reported by UIC Members do not account for additional financial burdens caused by operational delays, material damage or passenger reimbursements, and are rough estimates. Therefore, the actual total loss is likely higher, further emphasizing the criticality of the issue.

2. Metal Theft Management

Managing the consequences of metal theft has become a critical focus of railway security. The scale and frequency of these incidents demand sustainable, long-term solutions, highlighting the desirability of a structured and coordinated approach.

2.1. Understanding the problem

Risk Management

To effectively combat and manage metal theft in the railways, it is essential to begin with a thorough, ground-up risk assessment. The following risk assessment plan is inspired by the European Commission Directorate-General Mobility and Transport (DG MOVE) Expert Group on Land Transport Security (LANDSEC) study on metal theft in rail transport, carried out by UIC in 2015:

1. STAKEHOLDERS

Due to the complexity of the railway system and the implications of metal theft, multiple stakeholders are often involved in the aftermath of an incident. While each has a distinct role and set of responsibilities, they must also work in coordination. The main stakeholders include:

- **Railway operator** – directly responsible for security, service disruptions, transportation safety concerns and financial losses due to operational delays, both in freight and passenger transport.
- **Infrastructure manager** – tasked with maintaining and repairing (or replacing) the damaged components. They are often first to assess the extent of the damage and are burdened with the repair costs.
- **Law enforcement agencies** – responsible for investigating and apprehending offenders.
- **Scrap metal dealers** – may be the recipient of stolen metals. While dealers are expected to comply with regulations that require them to verify the origin of the metals they purchase, failure to do so can further push the market for stolen goods.
- **Governmental agencies** – may play a pivotal role in developing policies concerning scrap metal vendors and the prosecution of metal thieves. With stronger legal frameworks, they facilitate the ability to prosecute thieves effectively.

2. OFFENDERS

Identifying the perpetrators and analyzing their motivations and methods can help in developing more effective preventative measures. Such offenders usually fall into two categories:

- **Opportunistic thieves** – individuals who exploit the vulnerability of the railway system spontaneously, usually targeting easily accessible metal components.
- **Organized crime groups** – well-coordinated and often operating across borders, these groups engage in large-scale theft and are equipped to transport and sell stolen metals through established criminal networks.

3. TYPES OF INCIDENTS

Metal theft incidents vary depending on the nature of the railway network, but they can generally be classified into the following categories:

- **Cable theft** – the most common form of metal theft in the railways, the targets are overhead power lines, signal cables and grounding wires.
- **Removal of other infrastructure components** – the targets are usually smaller infrastructure components such as rail clips or fasteners.
- **Theft from facilities** – thieves may also steal from railway premises (e.g., depots, warehouses, maintenance stations).

4. TARGETS, LOCATIONS, TIMES

The following questions should be answered after each incident:

- **What was stolen?** (e.g., copper cable)
- **Where did it occur?** (e.g., line number, geolocation, type of facility)
- **When did it occur?** (e.g., exact time, during the night, weekends or holidays, when monitoring may be reduced)
- **At what time was it detected?** – allows to measure how long it took to intervene.

5. SEVERITY OF THE THEFT

Severity of the theft is critical to understanding its impact on operations and the broader rail system and it should consider:

- **Equipment losses** – direct financial cost of replacing stolen equipment, such as cables or infrastructure components.
- **Delay in time** – the length of time required to repair the damage and restore passenger or freight services, which directly affects customer satisfaction and the railway's reputation.

Considering the global diversity of railway systems, the proposed framework should be adjusted to meet the specific needs of each railway company.

Incident Database

Properly assessing metal theft incidents in railway operations allows for better tracking and recording of incidents. This information can then be transposed into a structured database that manages and effectively helps railways to mitigate the impacts of such crimes. Creating metal theft incident database facilitates:

- Systematic recording, tracking, and analysis of each metal theft occurrence;
- Identification of trends, hotspots, and potential vulnerabilities within the railway network;
- Monitoring of metal theft patterns over time.

2.2. Responding to the problem

Once the risk assessment framework has been carried out, the next step is to develop a **comprehensive response plan that should include solutions on detection, protection, and mitigation.** This chapter outlines a range of measures for:

- **Detection** – Measures aimed at identifying theft attempts early and monitoring vulnerable areas.
- **Protection** – Strategies focused on preventing theft through physical and technological means.
- **Mitigation** – Actions designed to minimize the operational and financial impact once a theft has occurred.

The collection of measures presented here is non-exhaustive and informal, drawing on the shared experiences of security experts within the UIC Security Platform and the relevant working groups. It is important to note that the effectiveness of these security measures can vary depending on the specific circumstances in different countries or regions. Additionally, the benefits and limitations of each measure are listed for general reference. These measures are not ranked by priority, effectiveness, or importance, as their applicability will depend on the explicit challenges faced by different railway companies.

Detection measure 1: CCTV systems

DESCRIPTION	**CCTV systems** are used for surveillance and when combined with video analysis, can be used to detect abnormal behaviours.  *Source: Adobe Stock*
BENEFITS	■ Real-time surveillance allows operators to spot incidents of metal theft as they happen, reducing the time it takes to mobilize a response team. ■ May serve as a visual deterrent. ■ Can be combined with other systems, such as alarms or sensors, creating a layered surveillance network. ■ Recorded footage may be used as evidence in investigation, aiding law. ■ Relatively cost-effective overwatch method for depots or storage yards. ■ When integrated with modern technologies, CCTV systems can automatically trigger alerts when suspicious activity is detected, allowing for quicker response times.
LIMITATIONS	■ Given the vastness of many railway networks, it is often impractical or cost-prohibitive to cover the entire system with CCTV surveillance. ■ Cameras have a fixed field of vision, meaning they may miss crucial parts of an incident if the theft occurs outside the camera's range. ■ The stationary nature of most CCTV cameras makes it difficult to track thieves who quickly move in and out of the area. ■ While some systems use AI to enhance detection, many CCTV setups still rely on human operators for monitoring. ■ Camera systems can be cut off by the thieves, giving them time to steal the railway components or break into the site.
EXAMPLE OF OPERATIONAL EXPERIENCE	As an example of a solution to combat metal theft, Deutsche Bahn AG uses a **mobile CCTV observation tower** without external power supply, that can be autonomically operative for 60 days. This CCTV system has equipment with detection techniques depending on application requirements, e.g., thermal sensors, ground sensors, early fire detection and video analysis. The system is used to detect unauthorized persons within a monitored area. It can be installed in the area with the need of increased surveillance against metal theft (e.g., construction equipment storages or hotspots).  *Source: DB*

Detection measure 2: Drones

DESCRIPTION	**Drones**, or unmanned aerial vehicles (UAVs), are increasingly being used in railway operations to monitor infrastructure and detect metal theft. Equipped with high-resolution cameras, thermal imaging, and other advanced sensors, drones provide a mobile and flexible surveillance solution. Unlike stationary CCTV cameras, drones can cover broad areas, including remote or difficult-to-access locations, making them particularly useful for patrolling vast railway networks. They may also serve as on-site guards (e.g., storage depots) and be integrated with other detection systems, to improve the surveillance and detection capabilities of break-ins and ongoing thefts.  *Source: Adobe Stock*
BENEFITS	■ Wide coverage of large and remote areas that are difficult to monitor using fixed systems like CCTV. ■ Advanced detection technologies like thermal and infrared cameras enhance monitoring in low-light conditions. ■ Cost-effective compared to installing fixed surveillance systems across the entire network. ■ There is little to no possibility of damaging or cutting off the drone's connection by the perpetrator.
LIMITATIONS	■ Limited battery life, restricting how long they can stay in the air without needing to recharge. ■ Drones are weather-dependent and may not function effectively in poor weather, such as heavy rain, snow, low temperatures or high winds. ■ Many regulatory challenges remain. Compliance with airspace, artificial intelligence (AI) and privacy laws may limit where and when drones can be deployed. ■ Drones are not a "grab and go" measure. They require operational complexity, skilled operators, proper maintenance and logistical coordination. They are also less scalable financially in comparison to CCTV systems.

Detection measure 3: Patrols

DESCRIPTION	Physical patrols involve security personnel regularly inspecting railway infrastructure to detect and deter metal theft. Patrols can be conducted on foot, by vehicle, or even using trained animals like K9 dogs. Patrols can be regular or irregular (e.g., on unused lines, where thieves may have false sense of security). Patrols can also be conducted jointly with law enforcement agencies and other stakeholders to enhance overall security and response capabilities.  *Source: Adobe Stock*
BENEFITS	▪ Regular patrols can provide a visible deterrent to potential thieves, particularly in high-risk or remote areas. ▪ With proper training, patrolling security personnel can quickly assess and respond to a range of situations, providing a flexible detection method for metal theft. ▪ Unpredictable schedules make it harder for thieves to anticipate security patterns, thereby increasing the chances of early detection and immediate intervention. ▪ Localized knowledge of guards and their familiarity with the rail layout can be utilized to track down perpetrators. ▪ Unlike automated systems or algorithms, on-site patrols can detect a wide range of issues related to metal theft, such as tampering, suspicious activity or other damages (e.g., cut fences) that might go unnoticed by technology.
LIMITATIONS	▪ Requires a significant number of personnel and vehicles, making it costly and difficult to scale across vast networks. ▪ Patrols can only cover certain areas at any given time, leaving other parts of the network vulnerable.
EXAMPLE OF OPERATIONAL EXPERIENCE	**Polish-German campaign on cross-border metal theft in 2014 called "Campaign Days East"** was a joint patrol operation involving companies from affected industries, such as railways and telecom, and also law enforcement authorities from both countries. Patrols were supported by several measures such as drones, DNA markings and educational work at scrap metal dealerships.

Detection measure 4: Intrusion detection systems

DESCRIPTION	Intrusion detection systems consist of sensors installed along railway infrastructure to detect unauthorized access or tampering. These systems often use vibration, motion, or pressure sensors to alert security personnel when someone attempts to access restricted areas or tamper with cables, signalling systems, or other critical components. As an example of such technology, optical fibres may be tuned to detect human footsteps. GPS trackers may also be installed in the valuable equipment to detect relocation and therefore theft attempt. Sensors are often interconnected with different technologies, such as CCTV systems, wireless communication networks, etc. in order to provide precise and quick visual feedback on metal theft incidents.  *Source: Adobe Stock*
BENEFITS	▪ Intrusion detection systems provide real-time alerts when unauthorized access is detected, allowing for rapid response. ▪ These systems operate 24/7, ensuring protection even when patrols or other surveillance methods are not active. ▪ Can be integrated with other security systems, such as alarms, lights, or drones, to automatically respond to detected breaches. ▪ In case of cut catenary lines, the detection of the cut location is precise, and it helps in reducing the time of intervention and delays caused by the disruption.
LIMITATIONS	▪ Environmental factors like wind, animals, or other disturbances can trigger false alarms, requiring constant monitoring and calibration. ▪ These systems can be expensive to install across large networks and require regular maintenance. ▪ Limited effectiveness in extremely remote or isolated areas without a rapid response mechanism. ▪ Costly to implement and maintain.

Protection measure 1: Barriers

DESCRIPTION	Although the general purpose of physical barriers, such as fences, gates, and enclosures, is to restrict access to sensitive areas of railway infrastructure for safety reasons, they also serve as protective measures against metal thieves. These barriers are often installed around critical components like signalling systems, overhead power lines, and storage facilities to prevent unauthorized access.  *Source: Adobe Stock*
BENEFITS	■ Barriers make it harder for thieves to access valuable materials, increasing the effort and time required. ■ Barriers may provide more time for security operators to detect and intervene. ■ Basic physical barriers are often less expensive to implement than high-tech solutions. ■ Can be combined with other security systems like alarms and CCTV for added protection.
LIMITATIONS	■ Skilled or well-equipped criminals may find ways to bypass or breach barriers. ■ Barriers can degrade over time and may need repairs or replacements, especially in remote areas. ■ Thieves may specifically target areas not protected by physical barriers.

Protection measures 2: Marking systems

DESCRIPTION	Marking systems involve labelling or tagging metal components, such as cables and power lines, with unique identifiers (e.g., chemical markers, barcodes, or artificial DNA printed onto the cable isolation), proving ownership.  *Source: Adobe Stock*
BENEFITS	▪ Stolen metal marked with unique identifiers can be traced back to its source, aiding in recovery and prosecution. ▪ The presence of markings during the resale makes it more difficult for thieves to offload it without getting caught.
LIMITATIONS	▪ Only marked components benefit from this system, leaving other materials vulnerable. ▪ It is not viable to implement this across a wide network, as it can be labour-intensive and time-consuming. ▪ Scrap dealers and law enforcement need to be aware of and trained to detect the markings for the system to be effective. ▪ Caducity of markings on devices situated in the active tracks exposed to external factors may degrade, making them unreadable. ▪ Thieves may be unaware of such technologies, which ultimately may lead to insignificant decreases in metal theft incidents.
EXAMPLE OF OPERATIONAL EXPERIENCE	In the West Midlands, Network Rail has marked trackside cables with **a forensic liquid** that contains over a billion unique chemical code combinations, making it virtually impossible to remove. This allows law enforcement to link stolen cables back to specific locations. Infrabel has implemented a UV detection system that is applied directly onto the copper part of a cable. Upon exposure to UV light, it reveals the name of the company, thus making it easier to identify upon inspection by scrap dealers or law enforcement.

Protection measure 3: Anti-theft signage

DESCRIPTION

Anti-theft signage involves placing visible signs around railway infrastructure, warning potential thieves that the area is monitored and that harsh penalties apply for metal theft. These signs often indicate the presence of surveillance cameras, drones or marking systems and may include information about legal consequences of metal theft or other criminal activity.

Source: Adobe Stock

BENEFITS

- Can deter opportunistic thieves by increasing the perceived risk of being caught or prosecuted.
- Signage is relatively inexpensive and easy to implement, compared to other measures.

LIMITATIONS

- Organized crime groups or experienced thieves may not be dissuaded by the warnings and signs alone.
- They provide no protection to the railway infrastructure itself.

Protection measure 4: Cable burying

DESCRIPTION	Cable burying involves installing metal cables, particularly those used for signaling and power, underground to make them harder to access by thieves. This is an alternative to leaving cables hanged or exposed and therefore exposed for criminals to tamper with or steal.  *Source: Adobe Stock*
BENEFITS	▪ Reduced ease of access for thieves. ▪ Cables buried underground are also protected from external factors like environmental damage and sun wear, which expands their lifespan. ▪ They are less visible for thieves, making them harder to spot and target.
LIMITATIONS	▪ Requires investment in excavation, installation, and potential rerouting of existing infrastructure. ▪ May affect the maintenance and repair times. ▪ They are not feasible everywhere due to terrain or already existing infrastructure.
EXAMPLE OF OPERATIONAL EXPERIENCE	The cable burying measure can be further enhanced by additional security solutions. For example, SNCF has introduced **protective foam** that fills the empty spaces of the cable canal, preventing easy access to the cables.  *Source: SNCF*

Protection measure 5: Enforcing metal components with anti-theft devices

DESCRIPTION	This measure involves reinforcing critical metal components, such as cables or overhead lines, with specialized anti-theft devices. These devices can include protective sheathing, locks or tamper-proof fastenings.  *Source: Adobe Stock*
BENEFITS	▪ Once installed, these devices offer long-term protection with relatively low maintenance. ▪ Anti-theft devices make it more difficult for thieves to access or remove metal components.
LIMITATIONS	▪ Installing anti-theft devices on all vulnerable components across a large network can be expensive. ▪ If thieves attempt to bypass the anti-theft devices, they may cause collateral damage to the infrastructure. ▪ While effective against opportunistic thieves, organized criminals may still find ways to bypass these devices. ▪ While individual devices, such as anti-theft clips, are inexpensive, the quantity needed may prove prohibitively expensive.
EXAMPLE OF OPERATIONAL EXPERIENCE	Several anti-theft solutions are available on the market, such as fastening systems, clips, and sleepers. These systems typically function by installing an anti-theft device on top of the component, which is then sealed. Access to the component requires a specialized tool that is not commercially available, making theft more difficult.

Mitigation measure 1: Replacement of metal components

DESCRIPTION	This mitigation measure involves replacing traditional metal components with alternative materials that have little or no scrap value. For instance, concrete sleepers can be used in place of metal ones, and aluminium or other materials may replace copper cables in non-critical areas. This mitigation method may be used during the infrastructure replacement or renovation works, replacing old components at the end of their lifecycle.  *Source: Trafikverket presentation from 2024 SIA WG thematic workshop on metal theft*
BENEFITS	▪ Due to low resale value, the incentive for metal theft is reduced. ▪ Materials like concrete may reduce the maintenance cost of components over time and also extend their lifecycle. ▪ Reduction of metal theft incidents and long-term durability may offset the initial investment.
LIMITATIONS	▪ Significant initial investments, especially over vast railway networks. ▪ In some cases, alternatives to metal may not offer the same performance as traditional metals. ▪ Not all metals can be replaced.

Mitigation measure 2: Memorandum of Understanding (MoU)

DESCRIPTION	An MoU is a formal agreement between railway operators and other stakeholders, such as law enforcement, government bodies and scrap dealers. Such documents outline roles, responsibilities and procedures for preventing and responding to metal theft incidents. MoUs help to establish cooperation and streamline response processes.  *Source: Adobe Stock*
BENEFITS	■ MoUs foster collaboration between key stakeholders, improving communication and coordination during metal theft incidents. ■ An MoU defines the actions each party should take in the event of metal theft, ensuring swift and efficient responses.
LIMITATIONS	■ MoUs may be time consuming to develop when multiple stakeholders are involved. ■ MoUs may require legal review and approval. ■ MoUs rely heavily on the commitment and active participation of all parties involved. ■ Depending on the structure of the agreement, an MoU may not carry the legal weight of a contract, potentially limiting its enforceability.

Mitigation measure 3: Secure contractor management

DESCRIPTION	Secure contractor management involves implementing strict security protocols when working with third-party contractors on railway infrastructure. This includes restricted access to sensitive areas and secure on-site monitoring of valuable assets to ensure contractors do not create a favourable environment.  *Source: Adobe Stock*
BENEFITS	▪ By properly instructing contractors and limiting their access, railway operators can reduce the risk of metal theft caused either by a lack of attention or from insider threat. ▪ A secure contractor management system ensures that contractors follow security procedures and can be contractually held accountable for any breaches. ▪ Monitoring and audits of contractor activities help maintain security standards in railway operations. ▪ Secure contractor management ensures high level of accountability and compliance.
LIMITATIONS	▪ Implementing a secure contractor management system requires additional resources for monitoring and auditing. ▪ Extra security measures may slow down operations and project timelines, particularly if there are delays in contractor approvals. ▪ Managing multiple contractors and ensuring compliance across all operations can be challenging, especially on large-scale projects. ▪ If the rail company does not have a good relationship with the contractor, the contractor may be less inclined to report on-site irregularities. This reluctance can increase the risk of theft (e.g., components, equipment or metal), particularly on contracted worksites, where oversight might be less stringent due to a false sense of security. ▪ Contractors hired for maintenance or construction under tight deadlines may neglect security measures due to time pressure.

2.3. Summary of measures

The measures described above combine three approaches to combating metal theft:

- **Detecting the crime;**
- **Reinforcing operational resilience;**
- **Mitigating future attempts by perpetrators.**

These strategies are interconnected and can be adapted based on the needs of the railway company. For instance, patrols can be supported with additional drone surveillance, while contractor operations (e.g., for construction on railway sites) can be further safeguarded with appropriate anti-theft signage, DNA markings on the components, additional fencing or alarms.

It is important to note that, no matter how robust and effective a measure may be, it is impossible to fully predict where the next metal theft strike will occur and detection systems may occasionally fail to alert surveilling operators. However, by conducting thorough assessments of each measure's efficacy, lessons can be drawn from real-world experience. Over time, these measures can be continuously improved through post-incident evaluations.

Source: West Midlands Police

2.4. Looking forward: the potential of new technologies

Emerging, advanced technologies could greatly contribute to mitigating the impacts of metal theft or improving the prevention of the crime. Some examples include:

- **AI-powered mounted cameras** on the front of trains may be able to detect anomalies and theft-related incidents in real time. These systems may use artificial intelligence to log suspicious activities along the route, feeding operators with alerts in real-time.
- **Automated drones**, triggered upon anomaly detection, would be able to patrol large sections of the railway infrastructure without the need for human operators.
- **Open Source Intelligence (OSINT) tools** may be able to predict potential thefts and identify **hotspots** where metal theft is more likely to occur.

While promising, the cost of development, implementation and integration of such emerging security measures can be significant, particularly for large networks. Additionally, issues related to regulatory compliance, such as adherence to privacy laws, and the ethical concerns surrounding the use of AI and autonomous technologies, must be carefully addressed.

3. Conclusion

Despite efforts to reduce these incidents, the impact of metal theft continues to be widespread, affecting not only the financial stability of railway companies but also the security, safety and satisfaction of passengers and freight customers. As highlighted in recent reports by UIC members, the financial damage caused by metal theft is measured in millions of Euros, with delays and service disruptions affecting both passenger and freight operations.

While the problem of metal theft is one that every railway company must address individually, adopting a broader, sector-wide approach and working with the different stakeholders described in this document is key. **Railway associations/organisations, such as UIC,** can provide the tools necessary for knowledge sharing and awareness raising and be a guiding force, increasing the resilience of the railways to this threat.

Looking beyond the rail sector, exchanges with other industries facing similar challenges, such as construction or telecommunications, could potentially further our collective efforts to combat the phenomenon of metal theft.

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