Tampere University

Md Riad Arefin Himel

STREAMLINING RISK ASSESSMENT FOR ENHANCED SAFETY DOCUMENTATION FOR PROPRIETARY EQUIPMENT

Master of Science Thesis
Faculty of Management and Business
Jouni Kivistö-Rahnasto
Maria Lindholm
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ABSTRACT

Md Riad Arefin Himel: Streamlining risk assessment for enhanced safety documentation for proprietary equipment
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Risk Assessment is essential in ensuring machinery safety by identifying potential hazards, evaluating risks and implementing mitigation measures throughout the lifecycle (from design to scrapping) of the machine. However, current risk assessment practices that use risk assessment software often experience challenges related to software limitations, inconsistencies in risk assessment documentation and difficulties in communication among stakeholders. This thesis studies these challenges within a case company that uses Safexpert as its primary risk assessment tool. The study aims to increase the efficiency of the risk assessment process and enhance the quality of risk assessment report to create Installation, Operation, Maintenance, and Spares (IOMS) manuals more efficiently.

The research adopts a qualitative case study approach which involves interviews, document analysis and participation in live risk assessment sessions to gather insights from the stakeholders (facilitators, product team, technical writers, etc.). The findings from the study reveal critical issues in software usability, risk assessment report clarity and collaboration between stakeholders. To address these issues, a streamlined workflow was developed for facilitators including a work instruction document, a library of appendices, a communication channel and additionally a list of recommendations was created for the software manufacturer to resolve the software related issues.

The proposed and implemented solutions significantly reduced inconsistencies in Safexpert generated reports and facilitated a smoother transfer of information into IOMS manuals. These improvements not only improved compliance with international safety standards, but also strengthened the company's overall risk assessment and safety documentation framework. This study contributes to the field by providing a practical framework for integrating risk assessment tools with technical documentation, offering insights that are usable across industries experiencing similar challenges.

Keywords: IOMS Manuals, ISO 12100, Machinery Directive, Machinery Safety, Risk Assessment, Safexpert, Technical Documentation.

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PREFACE

This thesis represents the final phase of my Master's degree, wrapping up an incredible journey at Tampere University. Looking back on this, I'm amazed how quickly the time has flown during my studies and life in Finland. I owe the completion of this work to the amazing people around me; I couldn't have completed this without the incredible support and encouragement from them.

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I'm deeply grateful to my friends, who helped me survive and thrive here by offering much needed escape from the stress of studies. Special thanks to Jere Kaikkonen for introducing me to Finnish wilderness and inspiring my passion for hiking. I'm grateful to my friend Anni Honkonen, for her support and suggestions in every aspect, from studies to career and adapting to life here.

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Tampere, 22 November 2024

Md Riad Arefin Himel

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LIST OF SYMBOLS AND ABBREVIATIONS

ANSI	American National Standards Institute
AS	Australian Standard
ATEX	Atmosphères Explosibles, Explosive Atmospheres
CCOHS	Canadian Centre for Occupational Health and Safety
CE	Conformité Européenne, European Conformity
CSA	Canadian Standards Association
EFTA	European Free Trade Association
EHSR	Essential Health and Safety Requirements
EMC	Electromagnetic Compatibility
EU	European Union
FMECA	Failure Mode Effects and Criticality Analysis
FTA	Fault Tree Analysis
HAZOP	Hazard and Operability
IOMS	Installation, Operation, Maintenance, and Spares
ISO	International Organization for Standardization
KPI	Key Performance Indicators
LVD	Low Voltage Directive
OSHA	Occupational Safety and Health Act
PED	Pressure Equipment Directive
PRA	Preliminary Risk Analysis
QEHS	Quality, Environment, Health, and Safety
ROHS	Restriction of Hazardous Substances
SE	Safexpert
SMEs	Subject Matter Experts
TÜV	Technischer Überwachungsverein, Technical Inspection Association
WHS	Work Health and Safety

1. INTRODUCTION

1.1 Importance of Risk Assessment for Machinery Manufacturing Industries

In 2021, machinery-related accidents account for approximately 25.7% of all industrial injuries in Europe, highlighting the critical need for effective risk assessment practices in the machinery manufacturing industry (Eurostat, 2023). Such incidents not only endanger workers but also disrupt production, leading to significant economic losses. Evaluating the risks posed by machinery is essential to ensuring worker safety (Del Giudice et al., 2024). Risk assessment requires gathering information about both the intended and unintended use of the machine, including its structure, functions, environment, and users. A systematic approach to defining the machine's limits, its functions, and the context of its use helps design teams identify potential hazards and accident scenarios to avoid, while also evaluating the effectiveness of existing safety measures (Kivistö-Rahnasto, 2000). The process involves not only hazard identification but also risk estimation and control, aimed at reducing risks to an acceptable level throughout the lifecycle of the machinery (Vasara, 2019; Standard ISO 12100, 2010).

According to Gauthier et al. (2021), manufacturers are at the forefront of machinery safety, implementing essential safety measures from the very start of the design phase. This proactive approach ensures that safety is embedded in the machine design, rather than being addressed reactively after accidents occur. Additionally, Kivistö-Rahnasto (2000), highlights that the safety team's collaboration enhances the quality of safety measures by involving more designers, allowing them to better assess the pros and cons of the proposed safety solutions. When multiple stakeholders contribute to the risk assessment, it results in a more comprehensive understanding of potential hazards, leading to better-informed safety decisions.

Existing literature provides valuable insights into the application of risk assessment techniques in diverse industrial settings, particularly in the context of machinery safety, offering organizations a comprehensive framework for identifying potential hazards and implementing effective control measures to mitigate risks (Willquist and Örtengren, 2005). The absence of proper risk assessment has often been linked to machinery-related accidents, highlighting its critical role in preventing incidents (Chinniah, 2015).

1.2 Product Safety Obligations in Europe and Worldwide

In Europe, the Machinery Directive 2006/42/EC provides the foundational legal framework that governs the safety of machinery. This directive sets out essential health and safety requirements that machinery must comply with, ensuring that products meet stringent safety standards before being introduced to the market. It promotes the free movement of compliant machinery within the European Union (EU) and aims to harmonize safety requirements across member states (Directive 2006/42/EC, 2006).

Alongside the Machinery Directive, ISO 12100:2010 (Safety of machinery — General principles for design — Risk assessment and risk reduction) serves as the key reference standard for conducting risk assessments of machinery across various industrial sectors (Compare et al., 2018). ISO 12100:2010 defines key terms, principles, and methods. It serves as a foundation for risk assessment and risk reduction, offering designers essential guidelines to achieve safety objectives (Del Giudice et al., 2024; Standard ISO 12100, 2010). This standard emphasizes the need for a structured approach to identifying hazards and applying appropriate risk-reduction measures, thereby ensuring machinery is safe to use throughout its lifecycle (Tiusanen, 2014; Standard ISO 12100, 2010).

Globally, other regions have developed similar regulatory frameworks to ensure machinery safety. For example, the United States follows the Occupational Safety and Health Act (OSHA) of 1970 and standards from the American National Standards Institute (ANSI) to set safety requirements for machinery. Canada and Australia also have established frameworks that incorporate ISO standards alongside local regulations to align safety practices with international norms. These regulations collectively contribute to a global network of safety frameworks aimed at minimizing risks associated with machinery operation (ANSI, 2015; CCOHS, 2024; OSHA, 1970; Safe Work Australia, 2024; Vasara, 2019).

1.3 Specific Needs of Metso and Research Focus

Metso, a company specializing in sustainable technology and services for the aggregates, minerals processing, and metals refining industries, requires a robust risk assessment process to ensure the safety and compliance of its machinery (Metso, 2023; Metso, 2024a). The company's diverse product portfolio and range of applications pose unique challenges in implementing effective risk assessment and product safety strategies. To meet these challenges, the company places significant emphasis on Quality, Environment, Health, and Safety (QEHS) policies, which are central to its sustainability goals and "zero-harm" culture (Metso QEHS Policy, 2024).

The existing Safexpert risk assessment process plays a crucial role for the company in adhering to international standards such as the Machinery Directive 2006/42/EC and ISO 12100, ensuring machinery safety throughout its lifecycle (Metso, 2023). However, several issues impact the effectiveness of this process, including software limitations, inconsistencies in risk assessment documentation, and difficulties in translating Safexpert (SE) reports into clear and user-friendly Installation, Operation, Maintenance, and Spares (IOMS) manuals. These challenges require improvements to ensure that risk assessments are consistent, accurate, and efficient.

To address these issues, the aim of this research is to streamline the Safexpert risk assessment process to enhance safety documentation for proprietary equipment at the case company. The study seeks to overcome the current challenges by improving the consistency of Safexpert reports and providing clearer inputs for technical writers in the creation of IOMS manuals. The research focuses on identifying key issues hindering the smooth risk assessment process and affecting the quality of risk assessment reports. Guided by these objectives, the research seeks to answer the following questions:

1. What are the existing problems during risk assessment (using Safexpert) from the facilitator's perspective, and how do these issues impact the quality of the outcome report?
2. What challenges are associated with using Safexpert risk assessment reports to create IOMS manuals from the technical writers' perspective?
3. How can the risk assessment process be streamlined from the perspectives of facilitators and technical writers?
4. What will be the process of adapting risk assessment reports into IOMS manual creation after streamlining the risk assessment process?

By addressing these questions, the research aims to develop practical solutions to enhance the Safexpert risk assessment process, streamline documentation workflows, and ensure that the case organization maintains high standards of safety and compliance across its global operations.

Finally, this study will contribute to the field by developing practical solutions that advance current risk assessment practices, addressing limitations in Safexpert and improving documentation workflows. It will provide a framework that can be adapted to other industries facing similar challenges in risk management and safety documentation. By refining risk assessment processes and streamlining the creation of user-friendly safety manuals, the research will help bridge gaps in existing methodologies and enhance compliance with international safety standards.

2. BACKGROUND AND THEORETICAL FRAME-WORK

2.1 Legal Frameworks for Machinery Safety

Machinery safety is governed by a robust set of international laws and standards designed to ensure that products meet stringent safety requirements before being introduced to the market or put into operation. Since the early 2000s, numerous international standards for machinery safety have been published, offering a structured approach to addressing machinery-related hazards (Tiusanen, 2014).

The International Labour Organization (ILO) provides a global outlook with its code of practice on the safe use of machinery. This code emphasizes risk reduction through the entire machinery lifecycle, promoting a systematic approach for the manufacturers to identifying and mitigating hazards. This code of practice has key elements including risk assessment frameworks, guarding requirements, and comprehensive worker training (ILO, 2013).

In 1989, Europe established a foundational legal framework to define the relationship between machinery design and safe operation. This was achieved through two key regulations: the Occupational Health and Safety (OHS) Directive (89/391/EEC) and the Machinery Directive (89/392/EEC), which paved the way for future machinery safety regulations. Today, regulations such as the European Machinery Directive (2006/42/EC), along with internationally recognized standards like ISO 12100, serve as the core legal and technical frameworks guiding machinery safety worldwide (Jocelyn et al., 2016).

In the United States, machinery safety is primarily governed by the Occupational Safety and Health Act (OSHA) of 1970, which ensures safe working conditions by enforcing standards and providing training, outreach, and education. OSHA works alongside the American National Standards Institute (ANSI), which publishes voluntary national consensus standards like ANSI B11 that focus on the safety of machinery and equipment (OSHA 1970; ANSI, 2015). These U.S. standards, together with regulations from Europe and other countries, form a global network of safety frameworks aimed at minimizing risks associated with machinery operation (Vasara, 2019).

Canada also has a well-established legal framework for machinery safety through the Canadian Centre for Occupational Health and Safety (CCOHS), which collaborates with provincial and territorial safety regulators to ensure consistent standards across the country. Canadian regulations align with ISO standards and also reference Canadian-specific standards such as CSA Z432, which provides guidelines for safeguarding machinery (CCOHS, 2024; Del Giudice et al., 2024).

Similarly, in Australia, machinery safety is regulated through Safe Work Australia, which develops national policies on work health and safety. Australia's framework includes Work Health and Safety (WHS) regulations, which incorporate ISO standards as well as the Australian/New Zealand Standard AS 4024.1 for safeguarding machinery. These frameworks are designed to protect workers from hazards associated with the use of machinery and ensure compliance with both local and international safety requirements. (Safe Work Australia, 2024)

The EU regulations are widely recognized internationally. The EU has established mutual recognition agreements with countries like Australia, Canada, Japan, New Zealand, the United States, and Switzerland, specifying each nation’s criteria for acceptable conformity assessments based on the EU’s designated conformity bodies. In addition, the EU maintains free trade agreements with countries such as South Korea, India, China, various South American nations, Argentina, and Canada. Moreover, EU has Customs union agreement with Turkey, Andorra and San Marino. CE markings are also accepted in certain African and South American countries that have historical ties to France and the United Kingdom. However, some regions, including China and the Eurasian countries, have distinct regulatory requirements that manufacturers must adhere to before supplying machinery to those markets (European Union, 2021; Vasara, 2019).

The following subsections outline the essential elements of these frameworks.

2.1.1 Machinery Directive 2006/42/EC (Europe)

The Machinery Directive (2006/42/EC), introduced in 2006 and completely adopted in 2009, is a cornerstone of machinery safety in Europe. It is designed to ensure that machinery operates safely while facilitating the free movement of machines within the European Union (EU) and European Free Trade Association (EFTA) countries (Directive 2006/42/EC, 2006; Kivistö-Rahnasto, 2009). This directive lays out essential health and safety requirements that manufacturers must meet, covering the entire lifecycle of a machine from design to scrapping (Directive 2006/42/EC, 2006).

One of the key features of the Machinery Directive is its broad definition of machinery, encompassing various types of equipment, including industrial, construction, and agricultural machinery. It mandates that machinery must be designed and constructed to reduce or eliminate risks associated with its use, taking into account all phases of the machine’s lifecycle, including transportation, installation, use, and maintenance (Directive 2006/42/EC, 2006).

The directive not only promotes the design of inherently safe machinery but also encourages manufacturers to implement the highest possible safety solutions. These solutions must comply with essential health and safety requirements to protect operators and ensure the machinery's safe use in different environments (Tiusanen, 2014). The implementation of these requirements allows for the free circulation of compliant machinery across the EU while ensuring that safety remains a top priority (Jespen, 2016). However, Regulation (EU) 2023/1230 will replace the current Machinery Directive 2006/42/EC on January 14, 2027, by introducing direct applicability across the EU, expanding coverage to include new technologies like AI and IoT, updating definitions and obligations, and enhancing safety requirements for high-risk machinery and cybersecurity. (Regulation (EU) 2023/1230, 2023).

2.1.2 ISO Standards for Machinery Safety

ISO standards are essential for aligning machinery safety practices across industries, ensuring consistent safety measures and compliance with international regulations. They provide a structured approach to risk assessment and risk reduction, minimizing hazards in machinery design and operation. Among these, ISO 12100 is one of the most critical standards for machinery safety, serving as the foundation for many other specialized safety standards (Main, 2009). Specific harmonized standards, such as ISO 13849-1, ISO 13849-2 and EN 62061, complement ISO 12100 by offering more detailed procedures for validating machinery safety. Together, these standards ensure comprehensive risk assessment and risk reduction strategies. The continuous development and updating of ISO standards ensure they remain relevant in an evolving technical landscape (Koo et al., 2018).

Apart from these above-mentioned ISO standards, there are several other standards that play a crucial role in ensuring machinery safety, such as ISO 10218 (robot safety), ISO 7010 (safety signs), and ISO 14118 (prevention of unexpected startup), among others (Del Giudice et al., 2024). While many of these standards contribute to specific areas of machinery safety, a broad overview of ISO 12100 will be highlighted here, as the Safexpert Risk Assessment process is based on this foundational standard. This focus underscores ISO 12100’s significance in shaping comprehensive safety strategies across various machinery applications.

ISO 12100:2010:

ISO 12100 sets out general principles for risk assessment and risk reduction in machinery design. It is considered a type-A standard, meaning it provides fundamental safety concepts that apply to all machinery types, rather than focusing on specific types of equipment (Standard ISO 12100 2010). The primary objective of ISO 12100 is to ensure that machinery is designed to prevent hazards and reduce risks to an acceptable level throughout its entire lifecycle, from design and installation to operation, maintenance, and eventual decommissioning (Jespen, 2016).

This standard offers guidance on identifying hazards, assessing risks, and applying appropriate risk-reduction measures. It categorizes hazards into different types, such as mechanical, electrical, thermal, and chemical, to help safety engineers recognize and address risks effectively (Koo et al., 2018; Standard ISO 12100, 2010). ISO 12100 also emphasizes the importance of eliminating hazards at the design stage whenever possible, and if not feasible, implementing safeguards and protective measures to mitigate risks (Tiusanen, 2014).

Furthermore, ISO 12100 is harmonized with the European Machinery Directive (2006/42/EC), ensuring that machinery designed according to this standard complies with essential health and safety requirements within the European Union (Directive 2006/42/EC, 2006). By adhering to ISO 12100, manufacturers can streamline compliance with international safety regulations, enhance the safety of their machinery, and reduce the risks posed to users and operators across different industries (Main, 2009).

2.1.3 Legislations in Finland for Machinery Safety

In Finland, machinery safety is governed by both national legislation and European Union (EU) directives, forming a robust framework designed to protect workers and ensure the safe operation of machinery across various industries (Tuominen, 2017). One of the key pieces of EU legislation is the Machinery Directive 2006/42/EC, which sets essential health and safety requirements for the design, manufacture, and maintenance of machinery (Directive 2006/42/EC, 2006). This directive is implemented at the national level through specific legislative acts that ensure machinery meets safety standards before entering the workplace (Government Decree 12.6.2008/400, 2008; Vasara, 2019; Tukes, 2024c).

At the heart of Finland’s workplace safety regulations is the Occupational Safety and Health Act (738/2002). This law places broad obligations on employers to maintain a safe working environment, particularly in relation to machinery use and maintenance (Act

738/2002, 2002; Nenonen, 2012). Employers are required to carry out regular risk assessments, ensure machinery is safe, and provide adequate training to workers on machinery operation. Additionally, the act mandates that employers minimize any risks related to machinery use (Act 738/2002, 2002; Nenonen, 2012).

The Government Decree on the Safety of Machinery 400/2008 transposes the Machinery Directive into Finnish law, setting essential safety standards for machinery design, construction, and compliance verification. These standards apply to both newly manufactured machines and those assembled using existing parts, ensuring that all safety procedures and documentation align with the decree's requirements (Government Decree 12.6.2008/400, 2008; Tiusanen, 2014; Tukes, 2024c; Tuominen, 2017).

Complementing the Occupational Safety and Health Act, the Government Decree on the Safe Use and Inspection of Work Equipment (403/2008) requires regular inspections and maintenance checks of all workplace machinery. This decree stipulates that machinery must be inspected upon installation and periodically throughout its operational life to ensure continued compliance with safety standards. If any machinery presents a hazard, employers must act immediately to eliminate the risk, primarily through technical measures like safety devices or barriers. If these measures are inadequate, employers are to ensure safe use through warnings, guidance, or personal protective equipment (Government Decree 403/2008 2021; Tiusanen 2014).

Another crucial piece of Finnish legislation is the Act on the Conformity of Certain Technical Devices to Relevant Requirements (1016/2004), which ensures that machinery and technical devices conform to national and EU safety standards. This act requires that machinery meet stringent design and construction requirements before being approved for use in Finland, aligning with the ISO 12100 standard on risk reduction throughout a machine's lifecycle (Act 2004/1016, 2004; Tuominen, 2017). It applies to new machines, machinery assemblies, and modifications that change the intended use of machinery (Act 2004/1016, 2004).

Finnish machinery safety regulations are also influenced by other EU directives that apply based on a manufacturer’s risk assessment. Examples include the Low Voltage Directive (LVD) 2014/35/EU, the Outdoor Noise Directive 2000/14/EC, and the Pressure Equipment Directive (PED) 2014/68/EU. Other relevant directives include the EMC (Electromagnetic Compatibility) Directive 2014/30/EU, the ROHS (Restriction of Hazardous Substances) Directive 2011/65/EU, the Gas Appliances Regulation (EU) 2016/426, and the Seveso III Directive 2012/18/EU (Tukes, 2024b; Tuominen, 2017).

The enforcement of these safety regulations is overseen by both the Finnish Safety and Chemicals Agency (Tukes) and the Finnish Occupational Safety and Health Administration. Tukes is responsible for ensuring the safety of consumer-use machinery, while occupational safety authorities monitor machinery intended for professional use, ensuring compliance with both national and EU directives (Tukes, 2024a; Tyosuojelu, 2022). Figure 1 below represents the machinery safety legislation framework in Finland, illustrating the legal requirements and standards for ensuring machinery safety.

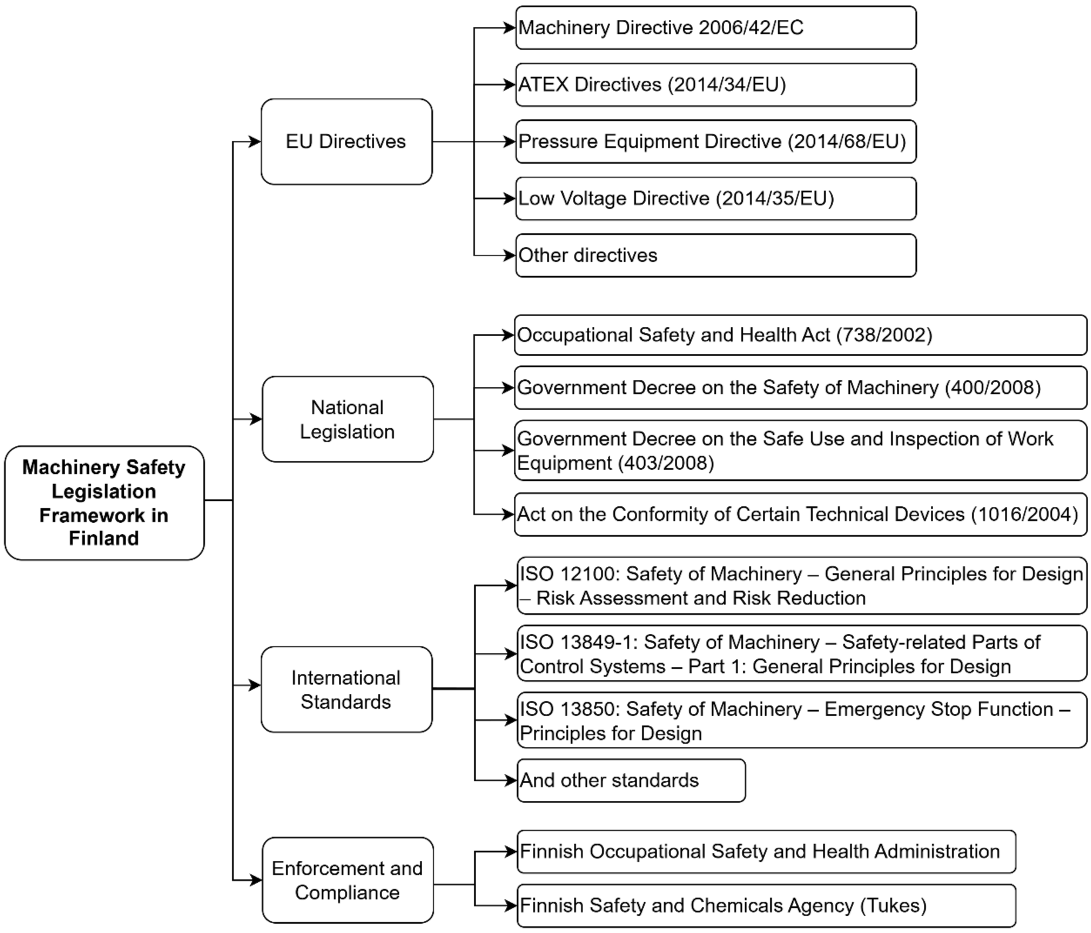

Figure 1. *Machinery Safety Legislation Framework in Finland (Source: Tukes, 2024a; Tyosuojelu, 2022)*

2.2 Existing Research on Risk Assessment in Machinery Safety

Risk assessment is a key process aimed at identifying significant risks that may impact the chosen feature of a machine or system. The true value of risk assessment lies not only in identifying these risks but also in using the findings to guide decision-making and determine appropriate risk responses based on specific identified risks (Hopkin, 2017). Risk assessments are crucial in establishing milestones and action plans while also identifying key performance indicators (KPIs) to monitor the impact of changes on hazard management (UNIDO, 2019).

The literature on risk identification and estimation tools in machinery safety, along with risk management methods from other fields such as engineering, medicine, and finance, provides valuable insights into improving safety practices across industries (Jocelyn et al., 2016). The goal of risk assessment in machinery safety is to generate insights about machine hazards that can inform and update safety design specifications (Kivistö-Rahnasto, 2000).

2.2.1 What is Risk Assessment from an Engineering Perspective?

In engineering, risk refers to the probability of a specific unwanted event occurring within a given time frame, along with the associated consequences of that event (Raafat, 1989). More broadly, risk encompasses the unpredictability of any activity that can influence outcomes either positively or negatively (Cox, 2021). The primary purpose of conducting a risk assessment is to mitigate potential risks (Main, 2009).

The risk assessment process generally follows three key stages: (1) identifying all potential hazards associated with work activities, (2) evaluating the risks linked to these hazards, and (3) implementing mitigation measures when risks are deemed intolerable (Comberti and Demichela, 2022). This systematic process helps to model and quantify risks, addressing key questions such as: What could go wrong?, How likely is it to happen?, and What would be the consequences? (Ayyub, 2003).

The basic equation for risk assessment combines two key factors: the severity of anticipated harm and the likelihood of its occurrence (Raafat, 1989). According to the ISO 12100 standard, risk in engineering is defined as the combination of the likelihood of a hazardous event and the severity of its consequences (ISO 12100, 2010).

2.2.2 Risk Assessment in Machinery Safety

In the field of machinery safety, risk assessment consists of two main phases: risk analysis and risk evaluation (Chinniah, 2015). During the risk analysis phase, three steps are crucial: (i) determining the operational limits of the machinery, (ii) identifying possible hazards, and (iii) assessing the associated risks (Del Giudice et al., 2024). By thoroughly assessing the risks, a comprehensive understanding of the machine's safety requirements is gained, along with the pros and cons of various design alternatives (Kivistö-Rahnasto, 2000).

i. Hazard Identification

Hazard identification is considered the most crucial step in any risk assessment process (Jespen, 2016). The key aspects of hazard identification include determining who may be harmed by the hazard and analyzing the potential severity of injury (Hopkin, 2017). Common techniques used for hazard identification in machinery safety include Preliminary Risk Analysis (PRA), Failure Mode Effects and Criticality Analysis (FMECA), Hazard and Operability (HAZOP) Analysis, Fault Tree Analysis (FTA), and Bow Tie Analysis (Jocelyn et al., 2016). Figure 2 details various hazard identification methods employed in Risk assessment, highlighting their applications.

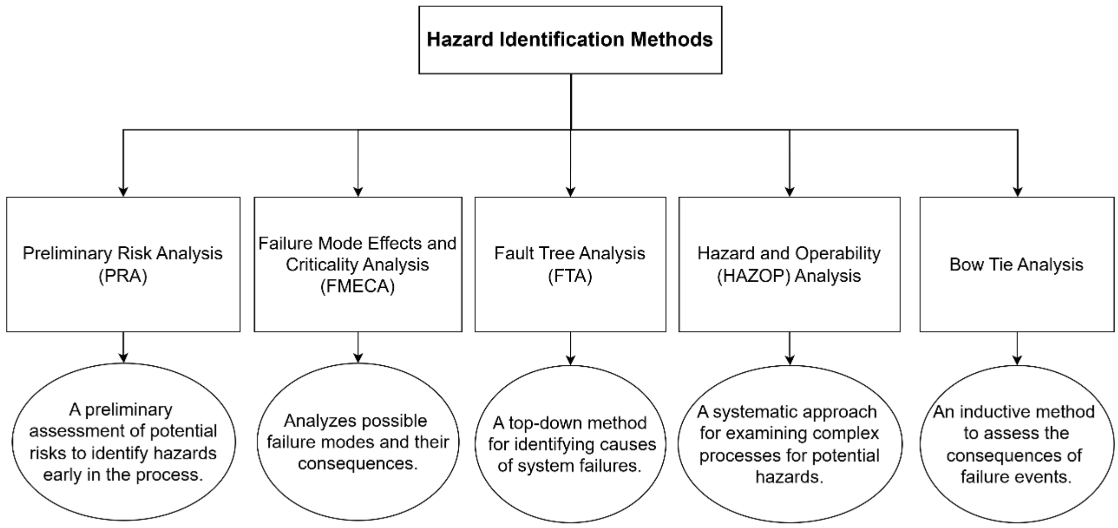

Figure 2. *Hazard Identification Methods (Source: Jocelyn et al., 2016)*

The goal of hazard identification is to systematically detect both predictable hazards and those that may arise unexpectedly throughout the entire lifecycle of the machine (Tiusanen, 2014). A comprehensive list of relevant hazards, hazardous situations, and their potential impacts should be produced (Jespen, 2016).

ii. Risk Estimation and Evaluation

After identifying hazards, the next phase is risk estimation, where every identified hazard is analyzed for the potential severity of harm and the likelihood of its occurrence. This estimation is crucial for prioritizing risk-reduction measures (Del Giudice et al., 2024). The outcomes of this process are often compared against a predetermined risk matrix to determine whether the risk falls within acceptable limits (Compare et al., 2018). Figure 3 shows a risk matrix to evaluate and categorize risks for different risk scenarios.

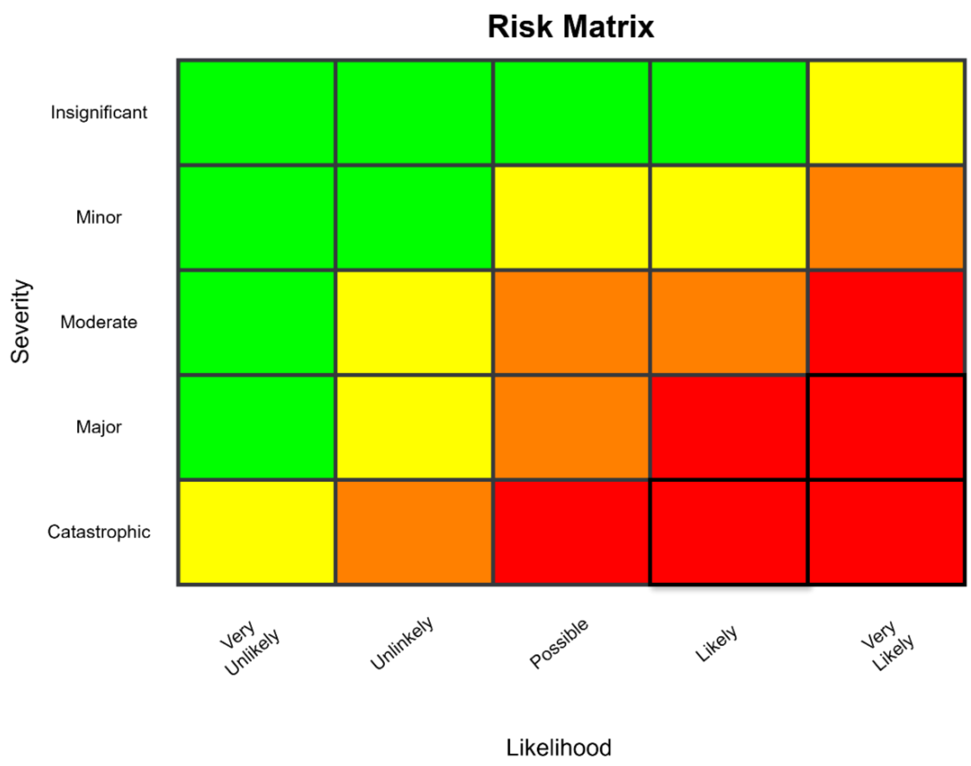

Figure 3. *Risk Matrix (Source: Hopkin, 2017; Pačaiová et al., 2021; Standard ISO 45002, 2023)*

Table 1 provides a decision for determining appropriate risk mitigation measures based on different levels of risk for the above illustrated risk matrix.

Table 1. Decision Table for Risk Levels and Measures (Source: Hopkin, 2017; Pačaiová et al., 2021; Standard ISO 45002, 2023)

Risk Level	Description	Required Action	Example of Measures
Low (Green)	Acceptable risk; no significant consequences.	Continuous monitoring; no immediate action required	Training, safety sign, user manual
Medium (Yellow)	Tolerable risk	Reduce risk to acceptable level and continuous monitoring	Safeguarding (interlocks, guards)
High (Orange)	Unacceptable risk; poses significant threat	Unacceptable risk; reduce risk to tolerable level	Safeguarding (interlocks, guards), redesign
Very High (Red)	Critical risk; almost certain	Immediate action; reduce risk to tolerable level	Redesign to eliminate the hazard

However, the risk matrix doesn’t always represent the exact risk scenario. According to Chinniah (2015), Risk estimation often relies on qualitative tools from various standards and guides related to machinery safety. However, despite the broad range of available tools, their effectiveness in accurately estimating risks remains uncertain. Additionally, Jespen (2016), points out that each identified hazard must be assessed for worst-case scenarios and evaluated against the Essential Health and Safety Requirements (EHSR).

Risk evaluation is the process that follows risk analysis, where the estimated level of risk associated with a specific hazard is compared against predefined criteria to assess its acceptability or tolerability (Pačaiová et al., 2021). If the risk exceeds acceptable levels, protective measures are then identified and implemented to reduce the risk to a level that is considered safe (Jespen, 2016).

iii. Risk Control and Mitigation

Once risks are identified and evaluated, the next step involves implementing risk control measures. The most effective controls in machinery safety often involve designing systems or machinery that inherently reduce or eliminate risks (Kivistö-Rahnasto, 2000).

Preventive controls aim to reduce the likelihood of a hazardous event occurring, while corrective controls address undesirable conditions to reduce exposure to risks (Hopkin, 2017). To ensure ongoing safety, the effectiveness of protective measures should be continually evaluated by repeating the risk assessment process (Compare et al., 2018).

In machinery safety, risk-reduction measures are categorized into three levels, from most to least effective: (1) inherently safe design, (2) safeguarding measures such as guards and protective devices, and (3) providing information for safe use, such as visual signals and instructions. The goal is to design machinery that not only meets safety requirements but also reduces risks to an acceptable level (Chinniah, 2015; Jocelyn et al., 2016; Standard ISO 12100, 2010). Here, figure 4 displays the hierarchy of risk controls and mitigation strategies, from most effective to least effective measures.

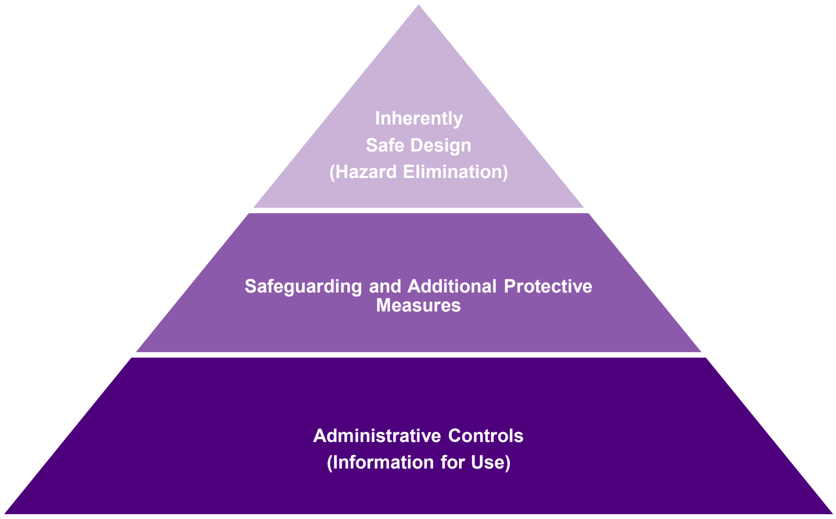

Figure 4. *Hierarchy of Risk Control and Mitigation (Chinniah, 2015; Jocelyn et al., 2016; Standard ISO 12100, 2010)*

2.2.3 What is Product / Machinery Safety?

Machinery safety and product safety are essential aspects of industrial operations, as they aim to protect workers, end-users, and the general public from potential hazards associated with the use of machinery and equipment. Ensuring a high level of safety requires a thorough understanding of the risks involved and the implementation of effective control measures (Chinniah et al., 2019).

Safety refers to a machine's capability to carry out its intended function without causing harm or posing risks to health (Kivistö-Rahnasto, 2000). Product safety, on the other hand, is primarily concerned with the safety of consumers using the final product, while machinery safety focuses on the safety of workers operating or maintaining machinery. This distinction emphasizes the different safety considerations for consumers and industrial workers, each requiring targeted safety measures (CDC, 2024).

In the design and development of both consumer and commercial products, product safety plays a crucial role. Product safety management, however, often differs from the more mature and understood activity of workplace safety management. These differences highlight the need for specific safety protocols depending on whether the focus is on the product's end-users or on workers interacting with industrial machinery (Sibley et al., 2012).

To guide machinery safety, standards such as ISO 12100 have been developed. This is a fundamental safety standard that applies to a broad array of machinery, ensuring that general safety principles are followed. Additionally, specific industry consensus standards exist for particular types of equipment, including power presses, robots, and packaging machinery. These standards provide a framework to ensure machinery is designed and operated in ways that minimize risks (Main, 2009). Figure 5 provides a schematic representation of the risk reduction process based on ISO 12100 standard, demonstrating steps from hazard identification to risk mitigation.

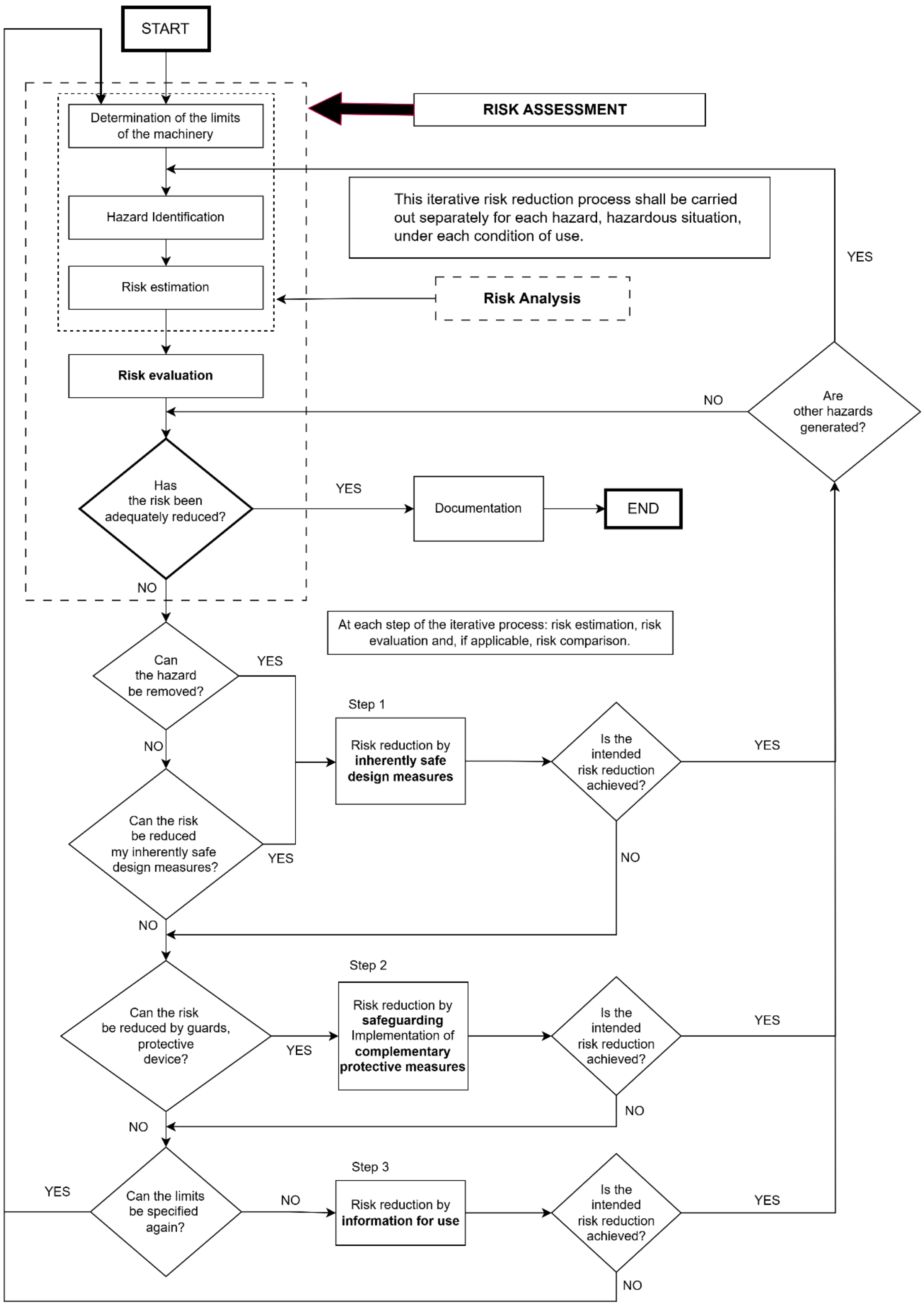

Figure 5. *Schematic Representation of Risk Reduction Process (Source: ISO 12100)*

During the process of risk assessment, it is important to provide background information about the machines and processes being used. This information enhances the understanding of production objectives, and the safety measures required to achieve those objectives (Koo et al., 2018). Furthermore, understanding product risks is crucial, as these risks consist of product hazards, potential sources of harm and the probability of those harms occurring. Manufacturers must first identify all possible hazards associated with the product throughout its lifecycle. Ideally, these hazards should be eliminated. However, when elimination is not feasible, the risks must be mitigated through various safety barriers and functions (Vasara, 2019).

2.2.4 Safexpert and Its Role in Risk Assessment for Machinery/ Product Safety

In modern engineering, digital tools play a crucial role in streamlining the risk assessment process. These tools allow engineers to automate hazard identification, risk analysis, and ensure compliance with safety standards, significantly improving the efficiency and accuracy of risk assessments (Kaplan, 2024). While basic methods like using spreadsheets to document risk assessments exist, various commercial software systems are available to aid safety experts. These software tools focus on documenting hazards, evaluating risks, and providing solutions for risk reduction (Pantano et al., 2022). One of the most prominent software tools is Safexpert, which offers comprehensive support for the risk assessment process (Huck et al., 2021).

Safexpert is a TÜV-certified, modular software designed to facilitate the risk assessment process for machinery by providing a structured approach to hazard identification, risk evaluation, and risk reduction. The software is built to ensure compliance with key international safety regulations, including ISO 12100 and the Machinery Directive 2006/42/EC (IBF Solutions, 2024b). Risk assessment software like Safexpert typically includes customizable checklists, real-time data collection, and automated report generation, helping to save time, minimize human error, and maintain uniformity across departments or facilities (Kaplan, 2024). These features make Safexpert a preferred tool among safety engineers, with 72% of surveyed safety experts indicating they use Safexpert in their risk assessments (Huck et al., 2021).

The risk assessment process using Safexpert follows a structured workflow. The first step is creating a new project by defining the machine’s limits, including dimensions and operational boundaries (IBF Solutions, 2024a). Once this is done, Safexpert guides users through hazard identification, offering a hazard list based on ISO 12100, which helps users assess potential risks at different stages of the machine’s life (IBF Solutions, 2024a; IBF Solutions, 2024c). For example, hazards like "Crushing" can be associated with specific operational phases (IBF Solutions, 2024a). This streamlined identification of hazards simplifies the task for engineers and safety experts alike, allowing them to efficiently address each potential risk (IBF Solutions, 2024b). Figure 6 shows the Safexpert risk assessment workflow for a new project from initiation to completion.

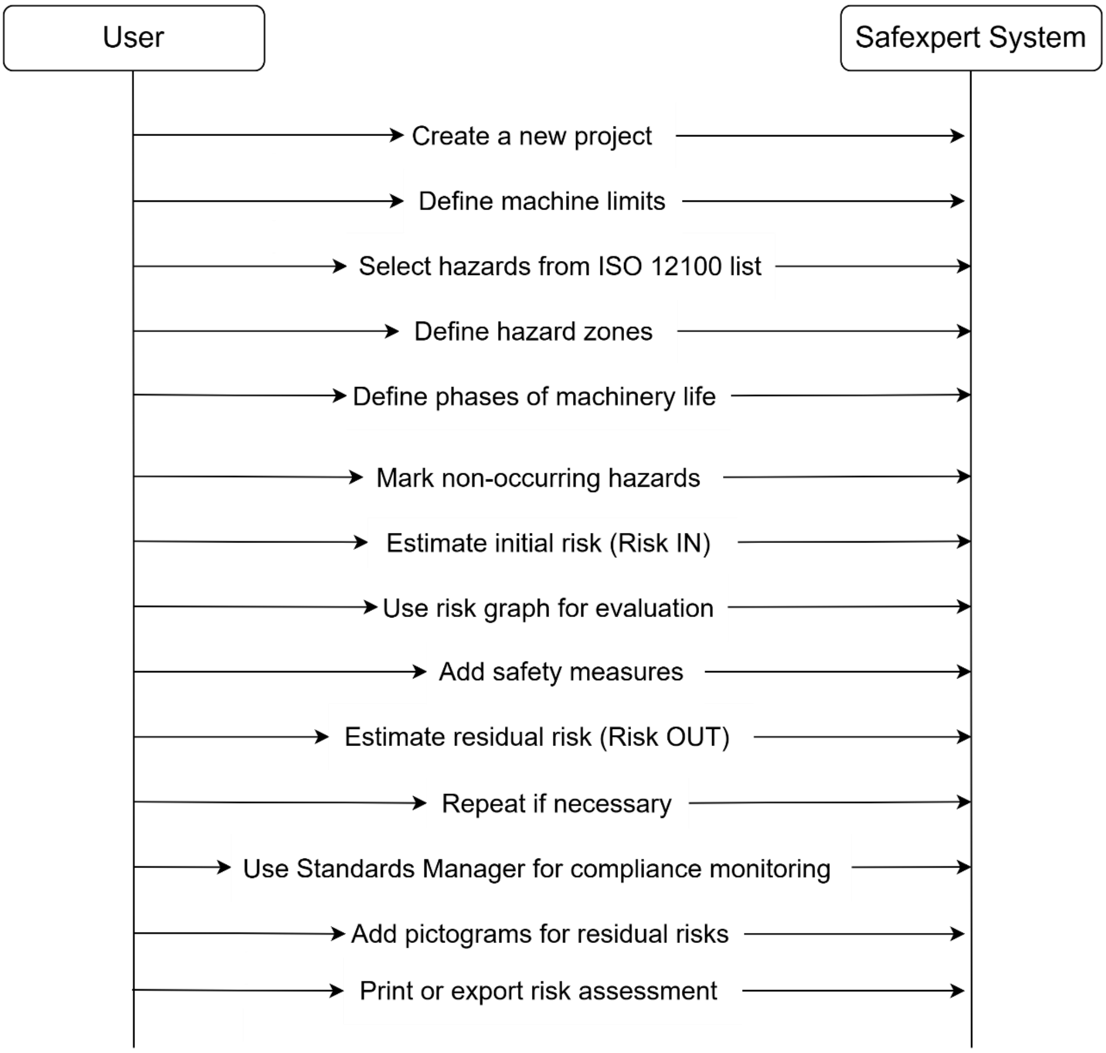

Figure 6. *Safexpert Risk Assessment Workflow (Source: IBF Solutions, 2024a)*

Next, Safexpert enables users to estimate and evaluate risks before implementing any mitigation measures. The software guides users in estimating risk levels (Risk IN) and determining which safety measures need to be implemented (IBF Solutions, 2024a). Once these measures, such as guard doors or other safety mechanisms, are in place, Safexpert allows for a secondary risk evaluation (Risk OUT) to assess if the implemented measures have sufficiently reduced the risk (IBF Solutions, 2024a).

One of Safexpert's strengths lies in its ability to manage ongoing project documentation and compliance with EU regulations, such as the Machinery Directive and Low Voltage Directive. The software assists in generating thorough and legally compliant documentation, ensuring all necessary safety steps are completed before signing a declaration of conformity (IBF Solutions, 2024c). Furthermore, it allows for seamless long-term project management by maintaining a library of safety solutions and keeping track of relevant standards and updates over time (IBF Solutions, 2024c).

In summary, Safexpert offers users a systematic, efficient way to manage risk assessments while ensuring compliance with international safety standards. By automating key processes, it not only reduces engineering workloads but also minimizes human error and enhances the accuracy of risk evaluations, making it an invaluable tool for both machinery and product safety engineers. However, despite positive aspects, users face certain challenges while using Safexpert for risk assessment.

2.2.5 Metso’s Risk Assessment for Product Safety and Use of Safexpert

At Metso, Risk Assessment for machinery is a vital and structured process that ensures compliance with essential health and safety regulations. These assessments are mandatory for all machinery, including partly completed machinery, and they play a key role in identifying and mitigating risks related to machinery operation. The aim is to provide detailed information about potential hazards and ensure that the necessary safety design measures are in place throughout the machinery’s lifecycle (Metso, 2023).

The risk assessment process begins with defining the boundaries of the product, including its intended and unintended uses, as well as its structure, functions, and the environment in which it operates (Kivistö-Rahnasto, 2000). Once these limits are set, potential hazards are identified systematically, and the risks are estimated based on the severity of harm and the likelihood of its occurrence. Safexpert, case organization’s primary risk assessment tool, facilitates this process by providing a structured approach to identifying, evaluating, and mitigating risks across the machinery’s lifecycle, from design to disposal (Metso, 2023). Safexpert also helps standardize the risk assessment process globally, ensuring compliance with international safety regulations, such as the Machinery Directive 2006/42/EC and ISO standards like ISO 12100 and ISO 13849-1 (Metso, 2023).

The process at case company is repetitive, meaning ongoing assessments and adjustments are made to ensure that risks are minimized throughout the machinery's lifecycle. This includes designing, operating, and dismantling the equipment in a way that is both safe and cost-efficient. The case organization’s broader Product Safety Management framework reinforces this by ensuring that essential health and safety requirements, as outlined by both European and international directives, are consistently met (Metso, 2023). Figure 7 illustrates the Safexpert risk assessment workflow at the case company, showing the sequence of activities from initiation to documentation.

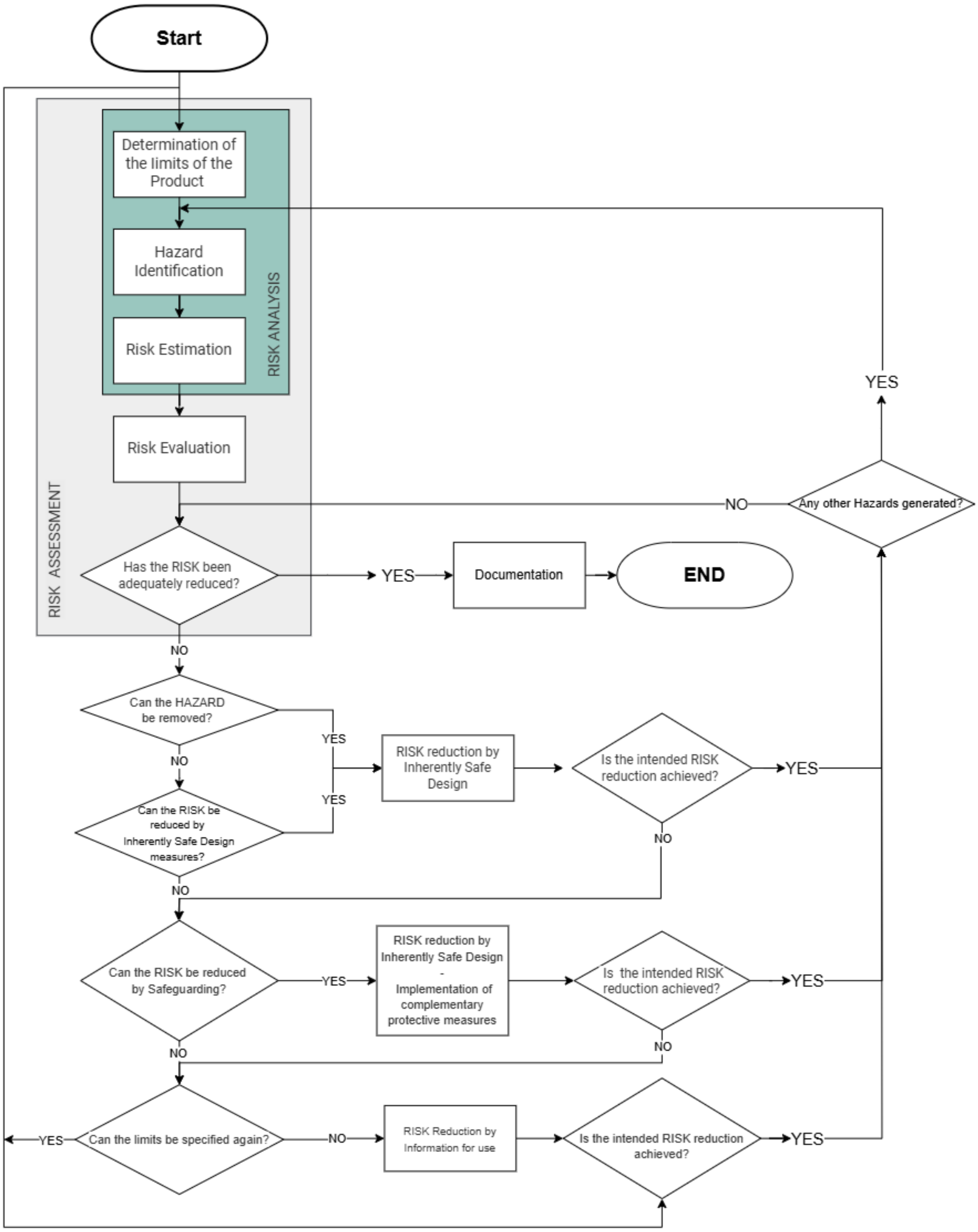

Figure 7. *Risk Assessment Process at Metso (Source: Metso, 2023)*

The Risk Assessment Team

Risk assessment at the company is a collaborative process, involving a multidisciplinary team to address all aspects of safety and compliance. The team typically consists of the following key members (Metso, 2023):

The risk assessment team is composed of several key roles, each playing a crucial part in the process. The **Safexpert Facilitator** oversees the risk assessment, ensuring the effective use of Safexpert to guide the team in a structured and systematic manner, facilitating the identification of hazards, risk evaluation, and the implementation of risk reduction strategies. The **Project Leader** coordinates team activities, making sure the risk assessment aligns with the overall project objectives and managing the availability of required resources. **Design Leads and other designers** (mechanical and/or EIA) contribute technical expertise, initiating risk assessments specific to the project and integrating safety measures into the machinery's design (Metso, 2023).

Application Engineers, when involved, provide specialized knowledge of the machinery's intended application to ensure its design and functionality meet usage requirements. A **team member** knowledgeable in maintenance, service, operation, or installation brings practical experience to identify risks that may not be apparent during the design phase. The **Product Manager** ensures compliance with relevant standards and regulations, applying product-specific knowledge to meet both customer expectations and regulatory requirements. Finally, the **Technical Writer** who prepares the Installation, Operation, Maintenance, and Spares (IOMS) manual, ensuring that all safety-related information and instructions are thoroughly documented during the risk assessment session to support regulatory compliance (Metso, 2023).

This diverse team ensures that all technical, operational, and practical perspectives are considered, allowing for a comprehensive evaluation of risks and their mitigation (Standard ISO 31000, 2018). According to Chinniah (2015), it is important that the team evaluates multiple risk reduction options, selecting the one that best mitigates risks, is acceptable to workers, and complies with regulatory requirements.

Tools and Methods

The case company utilizes Safexpert to standardize the risk assessment process across its global operations, ensuring that all proprietary equipment is compliant with international safety regulations. Safexpert enables the clear definition of product limits, application of relevant directives, and the identification of hazards at various stages of the product lifecycle, including design, installation, operation, maintenance, and disposal. By using Safexpert, the case organization ensures that appropriate risk reduction measures are applied, either eliminating hazards or reducing risks to acceptable levels (Metso, 2023).

This risk assessment process aligns with ISO Standard 31000, which emphasizes that risk assessments should be conducted in a structured, repetitive, and collaborative manner, incorporating the perspectives of all relevant stakeholders. By involving multiple viewpoints, the organization enhances the thoroughness of its risk assessments, reducing the likelihood of accidents and operational disruptions (Metso Business Overview, 2023; Standard ISO 31000, 2018).

2.2.6 Challenges and Limitations in Risk Assessment Implementation

Risk assessment methodologies have become essential tools for enhancing machinery safety in industrial environments. Extensive research has explored diverse approaches, ranging from traditional hazard identification techniques to more dynamic and advanced models that aim to capture complex risk scenarios (Petruni et al., 2017; Lee et al., 2021).

Despite these advances, the practical application of risk assessment remains challenging in complex industrial settings, where specific limitations hinder its effectiveness. One key challenge in current risk assessment methodologies is their tendency to treat potential hazards as isolated events, often overlooking the interdependencies that exist between various hazards. This approach can result in an incomplete understanding of the overall risk profile, as the cumulative impact of multiple, interconnected hazards may not be fully captured. Without accounting for these interdependencies, the assessment may underestimate or overlook critical risk factors, leading to potential gaps in safety protocols. Additionally, conventional methods frequently fall short in evaluating the severity of potential outcomes in a comprehensive manner, addressing risks primarily in terms of their probability rather than the varied consequences they may produce, which could include loss of working days, serious injuries, or even fatalities (Cinar and Çebi, 2020).

Furthermore, many risk assessment frameworks remain narrowly focused on physical and technical factors, while largely disregarding other important dimensions that influence machinery safety. Factors such as psychological, organizational, cultural, and systemic elements can significantly impact the safe operation of machinery, yet they are often not integrated into conventional risk assessment practices. This gap creates a limited safety perspective, where root causes of risk may go unaddressed, thereby limiting the effectiveness of safety interventions (Lee et al., 2021).

In the case company, Safexpert, a prominent risk assessment tool, is employed to facilitate risk assessments and ensure compliance with relevant standards. However, despite its structured workflows and compliance support, several challenges prevent Safexpert from achieving its full potential in facilitating seamless safety assessments. Facilitators have frequently reported software-related issues, such as the application freezing unexpectedly, which disrupts the assessment process and causes delays. Additionally, Safexpert lacks change-tracking and multi-user editing capabilities, limiting collaborative updates and making it difficult to document changes accurately. These challenges collectively highlight the need for process improvements and highlight the rationale behind this thesis, which seeks to address these limitations and propose more effective solutions.

In summary, while risk assessment remains an invaluable tool for enhancing machinery safety, its implementation faces considerable challenges both in methodological rigor and practical application. These limitations point to a pressing need for improved processes, integrated approaches, and adaptable tools capable of addressing the complex realities of industrial environments.

2.3 Technical Documentation and Its Role in Machinery Safety

Technical documentation plays a critical role in ensuring machinery safety by providing clear and comprehensive information about product design, construction, and safe operation. One of the key goals in the process of product specification is documenting the constraints involved, ensuring that the design is compliant with safety requirements (Kivistö-Rahnasto, 2000). The manufacturer is required to conduct research and testing on components, fittings, or the entire machine to verify that its design and construction allow for safe assembly and operation. These findings must then be documented in the technical file (Directive 2006/42/EC, 2006).

The main objective of technical documentation is to present complex information in a way that is clear, concise, and easy to understand (Kopacz, 2024). This not only supports user comprehension but also serves to ensure the correct installation, operation, and maintenance of machinery, thereby minimizing the risk of errors or accidents (Sibley et al., 2012).

2.3.1 What is Technical Documentation?

Technical documentation refers to a collection of information specifically provided to the user (Puchleitner, 2013). It aims to enhance understanding and facilitate the correct use of an application, product, or service. These documents include a range of materials such as user manuals, product guides, policies, procedures, and product catalogs, often supplemented with visuals like diagrams and schematics to assist in comprehension

(Zinck, 2023). It conveys essential instructions for the safe operation of machinery using text, symbols, and diagrams, either individually or in combination (Compare et al., 2018).

Technical documentation also serves as a vital link between complex systems and the individuals who operate or interact with them. It clarifies the functionality, usage, and internal workings of machinery and is typically created by technical writers in collaboration with subject matter experts (SMEs). Its formats vary depending on the needs of the user, but it always aims to communicate essential information effectively (Harsh, 2024).

A key component of technical documentation is its role in risk assessment. According to ISO 12100, technical documentation must include information on identified hazards, risk reduction strategies, and operational limits to help minimize accidents throughout the lifecycle of the machinery (Standard ISO 12100, 2010).

2.3.2 Why is Technical Documentation Important in Machinery Manufacturing and Machine Safety?

In machinery manufacturing, technical documentation fulfills multiple functions. It not only guides users on the safe operation of machinery but also supports collaboration, training, and onboarding processes for new employees (Kopacz, 2024). The technical file demonstrates that the machinery complies with the relevant health and safety requirements, covering its design, manufacture, and operation (Directive 2006/42/EC, 2006). Figure 8 illustrates the technical documentation process in machinery safety by addressing the steps involved in creating technical files.

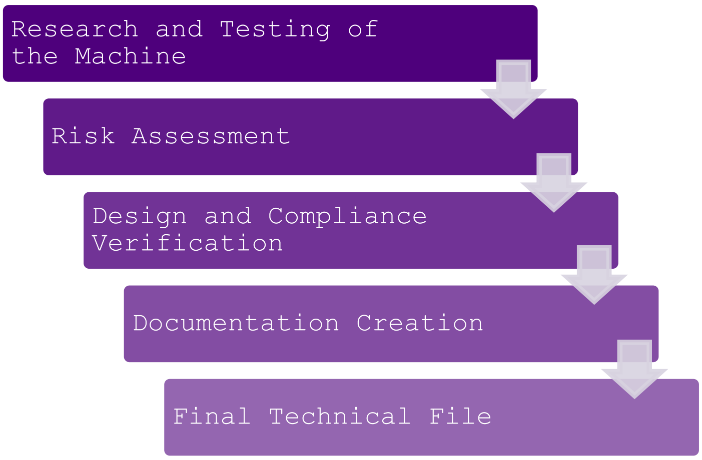

Figure 8. *Technical Documentation Process in Machinery Safety (Source: Standard ISO 12100, 2010 – modified and simplified)*

The documentation must include a risk assessment, which outlines the safety procedures followed. This includes a list of the applicable essential health and safety requirements, the protective measures taken to eliminate hazards, and, if necessary, an indication of any residual risks associated with the machinery. Such detailed documentation is critical, as failure to present it upon request by competent national authorities could raise doubts about the machinery's compliance with safety standards (Directive 2006/42/EC, 2006).

Moreover, the technical documentation must be retained for at least ten years after the last unit of a product is produced, ensuring that this information is available for inspection when required (Regulation (EU) 2023/1230, 2023). Adequate and high-quality documentation significantly enhances the overall user experience, providing stakeholders with the necessary information about the product’s functionality and usage (Harsh, 2024).

Before placing machinery or a related product on the market or putting it into service, manufacturers must prepare the relevant technical documentation (Regulation (EU) 2023/1230, 2023). This documentation should also explain the rationale behind design decisions and provide a record of the safety requirements and the conditions under which they apply (Tiusanen, 2014).

Finally, the risk assessment documentation, as required by Annex VII, Part A of the Machinery Directive, plays a crucial role in demonstrating compliance. This may involve a checklist of essential health and safety requirements and corresponding protective measures, though it is advisable that all relevant technical file requirements linked to the risk assessment process be included (Jespen, 2016). Properly prepared technical documentation is, therefore, a key step in achieving CE marking, a certification that indicates machinery complies with European safety regulations (Directive 2006/42/EC, 2006; Koo et al., 2018).

2.3.3 How Metso Develops Technical Documentation Based on Risk Assessment?

Metso’s approach to technical documentation is deeply integrated with its comprehensive risk assessment process, ensuring that safety measures are embedded into the design, operation, and maintenance of machinery. As discussed in the section “2.2.5” risk assessments at the company are conducted using the Safexpert tool, which provides a structured framework for identifying hazards, evaluating risks, and implementing risk-reduction measures throughout the product lifecycle (Metso, 2023).

Once the risk assessment is completed using Safexpert, a risk assessment report is generated, capturing all inputs related to potential hazards, risk evaluations, and safety measures. This report is then forwarded by the facilitator to the product team for a final review. After receiving confirmation and approval from the product team, ensuring that all safety concerns and design aspects are adequately addressed, the facilitator submits the report to the technical writers (Metso, 2023).

The technical writers then use the Safexpert report as an input to create the final Installation, Operation, Maintenance, and Spares (IOMS) manual, ensuring that all safety information is clearly communicated to the end user. The IOMS manual serves as the primary source of technical documentation, providing detailed instructions for the safe operation, maintenance, and troubleshooting of the machinery. This ensures that the machinery's safety features and operational limits, as derived from the risk assessment, are easily understood and accessible to users (Metso, 2023). Figure 9 illustrates how the case company transforms the risk assessment outcomes as technical documents.

Figure 9. *Metso's Technical Documentation Creation Process from Risk Assessment*

This process highlights the collaborative nature of the organization's documentation efforts. The involvement of the facilitators, product team, project team, and technical writers at various stages ensures that the documentation is not only compliant with safety regulations like the Machinery Directive 2006/42/EC but also user-friendly and effective in minimizing operational risks (Directive 2006/42/EC, 2006). By embedding the results of the risk assessment into the IOMS manual, the company provides comprehensive safety guidance, reducing the potential for user error and enhancing overall operational efficiency (Metso, 2023; Vasara, 2019).

The company's technical documentation is a direct outcome of its through risk assessment process. The Safexpert-generated reports are transformed into clear, concise, and regulatory-compliant user manuals, ensuring that all stakeholders, from engineers to end users, are well-equipped to safely and effectively operate the machinery. This end-to-end process, from risk identification to documentation, ensures that the company consistently meets both safety standards and user expectations.

2.3.4 Challenges in Creating Technical Documentation

Creating effective technical documentation presents a range of challenges that can impact clarity, usability, and consistency, particularly in complex industrial contexts. One significant issue is the rapid pace of technological change, which often results in outdated information that fails to meet evolving user needs (Smith et al., 2020).

The complexity of technical subjects further complicates documentation efforts, as technical writers must balance detailed technical accuracy with accessibility. Achieving this balance is particularly challenging; technical documentation can easily become overly complex or, conversely, too simplified, with either approach risking reduced usability (Jones, 2020).

Collaboration among diverse teams can also introduce inconsistencies in style, tone, and terminology, which complicates the documentation process further. When multiple contributors with varying backgrounds and writing styles work on a single document, discrepancies in language and format often arise. This issue underscores the importance of standardization and strong editorial oversight to maintain coherence across documentation (Brown et al., 2022).

Technical documentation serves as the backbone of successful projects, providing essential information for users, developers, and stakeholders. Creating such documentation requires a delicate balance of technical accuracy, user-friendly language, and comprehensive coverage (Hind et al., 2020). Maintaining this balance is crucial to bridging the gap between technical expertise and user comprehension. Documentation that is too technical can alienate general users, while overly simplified content may fail to support those with advanced knowledge (Perryman, 1985).

However, technical writers at the case company sometimes encounter unique challenges when using Safexpert reports to create IOMS manuals. The wording style used in Safexpert reports often does not align with the language standards required for user-friendly IOMS documentation, requiring substantial rewriting to achieve clarity and accessibility. Additionally, communication delays between technical writers and safety experts slow down the documentation process, as clarification on specific terms or instructions is frequently needed but not readily available. These challenges emphasize the necessity for this thesis to investigate and address ways to streamline documentation processes, ensuring both accuracy and efficiency in the conversion of technical safety assessments into end-user documentation.

3. CASE COMPANY AND RESEARCH STEPS

3.1 Overview of the Case Company: Metso

3.1.1 Metso as a Company

Metso is a global company specializing in providing sustainable solutions and services for the aggregates, minerals processing, and metals refining industries. The company is recognized for its innovative technologies, offering equipment and services that enhance efficiency and safety while minimizing environmental impacts. Headquartered in Espoo, Finland, the company operates in more than 50 countries and employs approximately 17,000 professionals worldwide (Metso, 2024a).

The company prioritizes sustainability by supporting customers in improving resource efficiency and minimizing environmental impact. It plays a significant role in driving global industries toward more sustainable practices by offering technologies that reduce water consumption, minimize waste, and improve energy efficiency. A key initiative reflecting this approach is the company's Planet Positive strategy, which focuses on creating technologies that supports customers' sustainability goals and address global environmental challenges (Metso GRI Supplement, 2023).

The company's product portfolio is extensive, providing a wide range of solutions primarily for industries such as minerals, metals processing, and aggregates. The company's advanced automation and control systems are used across various sectors to improve operational efficiency and safety. The company provides a service network designed to enhance equipment performance, extend operational lifetimes, and minimize downtime (Metso Business Overview, 2023).

From a financial standpoint, the company reported sales of EUR 5.4 billion, with 27% of these sales coming from its Planet Positive offerings, which represent environmentally friendly technologies. Its global operations support industries aiming to achieve both operational efficiency and environmental objectives (Metso Financial Review, 2023).

3.1.2 Environment, Quality, Health, and Safety (QEHS) Management at Metso

The company prioritizes maintaining high standards in Quality, Environment, Health, and Safety (QEHS) throughout its operations as part of the sustainability objectives. Its QEHS policies are focused on minimizing risks, ensuring employee well-being, and promoting environmental responsibility. The quality management system is designed to meet legal and regulatory requirements while addressing customer needs. Efforts are supported by ongoing improvements to ensure that processes, products, and services follow safety and efficiency standards (H. and S. Metso, 2024b; Metso Business Overview, 2023; Metso QEHS Policy, 2024).

The case company’s environmental management practices are designed to reduce its ecological footprint. The company actively works to conserve natural resources, lower emissions, and ensure responsible waste and water management throughout its value chain. Through comprehensive pollution control measures and efforts to protect biodiversity, the company addresses both immediate and long-term environmental challenges (Metso Business Overview, 2023).

Health and safety are integral to the company’s operations, with a focus on accident prevention and the creation of safe working environments. By systematically identifying workplace hazards and implementing risk mitigation strategies, the company ensures the safety of its employees, contractors, and customers (Metso QEHS Policy, 2024).

A cornerstone of the company’s approach to health and safety is the promotion of a "zero-harm" culture. The company prioritizes compliance with both local and international safety regulations and continuously works to reduce incidents that could lead to injuries. Regular health and safety training ensures that all employees are aware of the risks associated with their roles and understand the preventive measures in place. By fostering a proactive approach to health, safety, and environmental policies, the company maintains high operational standards while promoting a culture of sustainability and responsibility (H. and S. Metso, 2024b; Metso QEHS Policy, 2024).

3.1.3 Product Safety at Metso

Product safety is an important aspect of the case company’s focus on quality and efficient operations. The company's Product Safety Management framework ensures that all products comply with international and regional safety standards, such as the European Machinery Directive 2006/42/EC and ISO 12100, which outline risk assessment and risk reduction for machinery (Metso, 2023). Company's compliance to these standards ensures that its machinery and equipment are safe to operate, minimizing potential hazards for both operators and the environment (Metso Business Overview, 2023).

Central to the company’s product safety strategy is a comprehensive risk assessment process (Metso, 2023). This process ensures that risks and opportunities are consistently identified and managed, with operations and product development conducted in a way that prevents and minimizes defects, pollution, and accidents (Metso QEHS Policy, 2024). The company uses tools such as Safexpert to systematically assess potential risks associated with machinery across its lifecycle—from design to disposal. This structured methodology facilitates the identification of hazards, the estimation of risk levels, and the selection of appropriate measures to mitigate those risks. By employing such tools, the company ensures that all risks are effectively managed, and products meet stringent safety requirements (Metso, 2023). Figure 10 illustrates the case company's comprehensive approach to product safety.

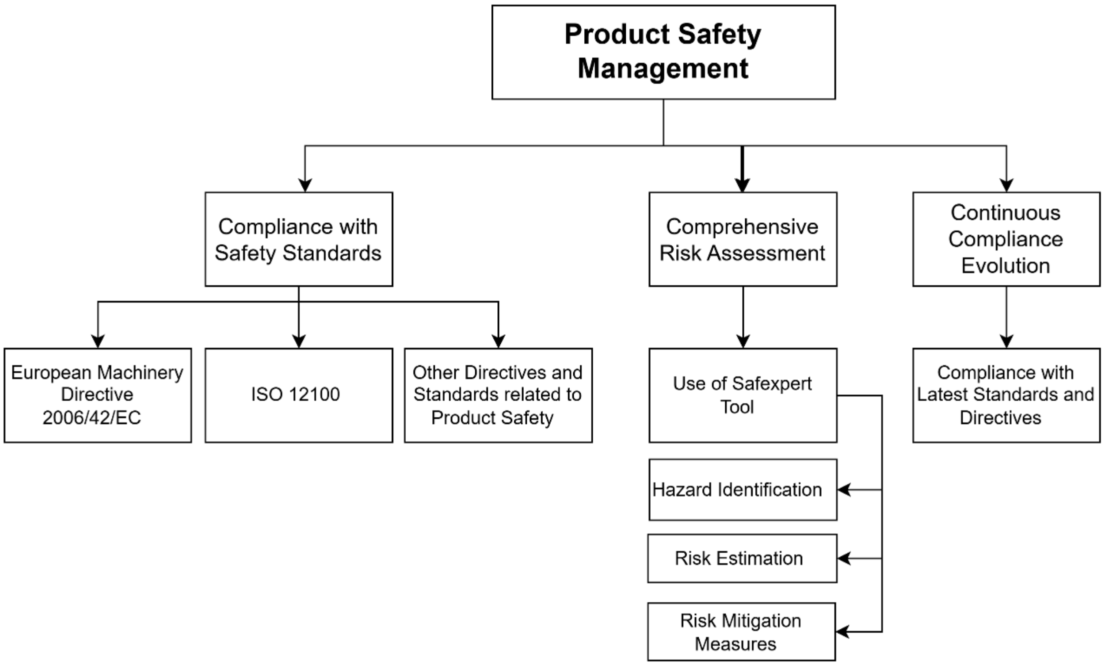

Figure 10. *Product Safety at Metso (Source: Metso, 2023)*

Moreover, the company's code of conduct highlights company's focus on developing, designing, and delivering solutions, equipment, and services that not only comply with relevant legislative and regulatory product safety requirements but also meet or exceed customer and industry expectations (Metso Code of Conduct, 2024).

Metso's product safety initiatives continue to evolve to meet the challenges posed by new technologies and complex machinery. By maintaining compliance with the latest standards and directives, the company has successfully avoided any fines or penalties related to non-compliance with laws, regulations, or voluntary codes concerning product use in 2023 (Metso GRI Supplement, 2023).

3.2 Research Methodology

3.2.1 Research Design

A qualitative case study approach was chosen for this research, as it allows for an in-depth exploration of complex, real-life processes. Case studies are particularly useful in situations where the boundaries between the phenomenon and its context are unclear, making them well-suited for understanding the intricacies of the case organization's risk assessment and documentation challenges (Noble and Heale, 2019; Yin, 2014).

This study engaged multiple stakeholders, including facilitators, technical writers, and product managers, to gather comprehensive insights. As Creswell (2017) notes, qualitative research is essential for capturing the perspectives and experiences of participants, making it the ideal approach for uncovering the subjective challenges faced in this context.

In order to enhance the credibility of the findings, a triangulation strategy was employed. This involved gathering data from diverse sources, such as semi-structured interviews, document analysis, software evaluations, and direct observation of live risk assessment sessions. According to Noble and Heale (2019), triangulation strengthens the validity of qualitative research by cross verifying the findings from different perspectives.

3.2.2 Data Collection Methods

The data collection for this study was designed to capture a comprehensive view of the challenges related to the Safexpert risk assessment process and the creation of IOMS manuals. By employing a triangulated approach, the research leveraged multiple methods to provide a deeper understanding and cross-validation of findings from diverse perspectives. This section outlines the key methods used, including interviews, document analysis, software evaluation, and participant observation.

Interviews

Semi-structured interviews were a central part of the data collection process, offering the flexibility to explore both anticipated and emerging themes. Interviews were conducted with three key groups involved in the risk assessment and documentation process: facilitators, technical writers, engineers and product managers. According to Creswell (2017), his method allowed for in-depth insights into the bottlenecks and communication challenges that affect the overall efficiency of these processes.

Interviewees were selected based on their direct involvement in the Safexpert risk assessment process and the IOMS manual creation, ensuring that the data collected was relevant and representative of the key stakeholders. The semi-structured format allowed participants to share their experiences freely while ensuring that all essential topics were covered. This approach ensured both consistency across interviews and the flexibility to probe deeper into specific issues as they arose.

The interviews covered core topics such as:

a. The practical challenges in using the Safexpert software for risk assessments.
b. Difficulties in translating Safexpert-generated reports into IOMS manuals.
c. Collaboration challenges among facilitators, product manager / safety team / package engineer and technical writers.

The interviews ranged from 45 to 90 minutes in length and followed an interview guide designed around the research questions. Table 2 provides a summary of the interview participants and the primary focus areas for each group.

Table 2. Roles and Focus Areas of Interview Participants

Role	**Interview Focus**	**# Participants**
Facilitators	Challenges in Safexpert risk assessments	7
Technical Writers	Issues in creating IOMS manuals from Safexpert reports	4
Safety Team	Contributions to risk assessments and coordination challenges	1

The data from these interviews was invaluable in identifying both procedural and software-specific issues, forming a foundation for understanding how the risk assessment and documentation processes could be improved.

Document Analysis

To complement the interview data, document analysis was conducted on a range of internal materials. This included Safexpert risk assessment reports, IOMS manuals, risk assessment templates, and work instructions for both facilitators and technical writers. According to Bowen (2009), document analysis is a crucial method for corroborating interview data and providing additional context that may not emerge through interviews alone.

The analysis was structured around three main criteria:

Completeness: Ensuring all required information was present in the reports and manuals.

Clarity: Evaluating how clearly the risk assessment results were communicated.

***Consistency**:* Identifying any discrepancies or inconsistencies across documents.

The documents were instrumental in highlighting recurring issues, particularly in the conversion of technical risk assessment data into user-friendly IOMS manuals. Issues such as inconsistencies in formatting, terminology, and the application of safety standards were common. The insights from this analysis not only validated several points raised during the interviews but also added depth to the understanding of documentation challenges. Table 3 showcases the document analyzed during the thesis based on the types, providing insight into the details of materials reviewed.

Table 3. Documents Analyzed for Process Assessment

Document Type	Number
Safexpert Risk Assessment Reports	15
IOMS Manuals	16
Risk Assessment Templates	15
Work Instructions for Facilitators	2
Work Instructions for Technical Writers	2

Through this method, patterns of inconsistency were identified, particularly in how Safexpert data was translated into actionable content for IOMS manuals. Document analysis also supported the triangulation strategy by verifying the feedback from interviews and observations.

Software Evaluation

An independent assessment of the Safexpert software was conducted to gain a firsthand understanding of its technical and usability challenges. By directly engaging with the software, common issues mentioned by interviewees were observed, such as the complexity of the user interface, difficulties in generating reports, and challenges in data entry.

This evaluation provided important insights into how software-specific factors influence the overall efficiency of risk assessments. By actively using Safexpert, the study was able to cross-check facilitator feedback regarding software frustrations, adding another layer of validation to the qualitative findings. Creswell (2017) highlights the importance of direct observation in qualitative research, as it offers a deeper understanding of the practical challenges that stakeholders encounter.

Participant Observation

To further understand the real time dynamics of the Safexpert risk assessment process, participant observation was employed. Several live risk assessment sessions, each lasting between two and four hours, were attended. This method allowed for direct observation of how risks were identified, documented, and discussed among stakeholders, providing crucial insights into both group dynamics and software use.

Participant observation offered an opportunity to capture non-verbal cues and communication patterns that may not have been explicitly discussed in interviews. Additionally, the challenges faced by facilitators during live documentation were clearly evident, further corroborating the issues identified during the interviews.

By integrating findings from these observations with data gathered from interviews and document analysis, a more comprehensive understanding of the challenges within the Safexpert risk assessment process was developed, enhancing the overall triangulation approach.

3.2.3 Research Approach for Each Research Question

This section outlines the specific research approaches used to address each of the study's key research questions (RQ). By tailoring the methodology to the unique requirements of each question, the study ensured that relevant data was collected systematically and comprehensively. A combination of interviews, observations, document analysis, and brainstorming sessions was employed to provide a multi-dimensional understanding of the challenges faced by the case organization in using Safexpert for risk assessments and the creation of IOMS manuals.

Research Approach for RQ1: Facilitators' Perspective on Existing Problems in Risk Assessment

Research Question 1: What are the existing problems during risk assessment (using Safexpert) from the facilitator's perspective, and how do these issues impact the quality of the outcome report?

To investigate this question, the following steps were undertaken:

1. **Familiarization with Safexpert and Risk Assessment Reports:** The researcher reviewed the Safexpert software and relevant risk assessment reports to gain a foundational understanding of the system and how it is used within the case company.

2. **Participation in Live Risk Assessment Sessions:** Direct observation of live risk assessment sessions was conducted to capture real-time challenges faced by facilitators when using the Safexpert software. This provided valuable insights into both software usability and procedural inefficiencies.
3. **Interviews with Facilitators:** Semi-structured interviews were carried out with facilitators who had direct experience with the Safexpert risk assessment process. These interviews focused on identifying software-related and procedural difficulties that impact the quality and efficiency of risk assessments.
4. **Brainstorming Session with Stakeholders:** A collaborative brainstorming session was held with facilitators and other key stakeholders to explore potential solutions to the identified challenges.

Analysis: Data from the interviews, observations, and brainstorming session were combined to highlight recurring issues such as software usability, report generation difficulties, and procedural inefficiencies. These insights formed the basis for identifying how existing problems in the risk assessment process impact the quality of the reports generated.

Research Approach for RQ2: Technical Writers' Perspective on Challenges with IOMS Manual Creation

Research Question 2: What challenges are associated with using Safexpert risk assessment reports to create IOMS manuals from the technical writers' perspective?

The approach for this research question included the following steps:

1. **Familiarization with Risk Assessment Reports and IOMS Manuals**: The Safexpert risk assessment reports and the corresponding IOMS manuals were reviewed to understand how technical writers convert risk assessment data into manuals. This initial step helped identify the points at which difficulties might arise in this translation process.
2. **Interviews with Technical Writers**: Semi-structured interviews were conducted with technical writers to gather insights into the specific challenges they face when working with Safexpert-generated reports. These interviews explored issues related to report clarity, consistency, and the complexity of converting technical risk assessment data into user-friendly IOMS manuals.

3. **Brainstorming Session with Stakeholders**: A brainstorming session involving technical writers and other relevant stakeholders was conducted to identify potential solutions for overcoming the challenges encountered in the documentation process.

Analysis: Data from these interviews and the brainstorming session were combined to identify common problems, such as inconsistencies in the risk assessment reports and difficulties in aligning technical data with the IOMS format. These findings helped to develop strategies for improving the documentation process and enhancing the accuracy and usability of the IOMS manuals.

Research Approach for RQ3: Streamlining the Risk Assessment Process

Research Question 3: How can the risk assessment process be streamlined from the perspective of facilitators and technical writers?

To explore potential improvements in the risk assessment process, the following research approach was applied:

1. **Interviews with Facilitators and Technical Writers**: Semi-structured interviews were conducted to collect facilitators' suggestions for improving the Safexpert risk assessment process. These interviews focused on identifying areas where the software and procedures could be optimized for greater efficiency.
2. **Assessment of Safexpert Software**: The Safexpert software was independently assessed to identify technical challenges that may be slowing down the process. This evaluation examined the software's functionality, interface, and reporting features to uncover areas for potential enhancement.
3. **Brainstorming Session with Stakeholders**: A collaborative brainstorming session was held to generate and evaluate ideas for streamlining the risk assessment process. Facilitators and other stakeholders discussed potential solutions, focusing on software improvements and workflow optimizations.

Analysis: The data from interviews, software evaluation, and the brainstorming session were combined to identify practical, feasible solutions for improving the efficiency of the Safexpert risk assessment process. The recommendations included streamlining data entry procedures and optimizing software functionalities to reduce issues and difficulties.

Research Approach for RQ4: Adapting Risk Assessment Report into IOMS after Streamlining the Risk Assessment Process

Research Question 4: What will be the process of adapting risk assessment reports into IOMS manual creation after streamlining the risk assessment process?

To address this question, the following steps were taken:

1. **Interviews with Technical Writers**: Semi-structured interviews were conducted with technical writers to explore the challenges they face in adapting risk assessment reports during the IOMS manual creation process. These interviews sought to identify barriers and workflow inefficiencies that hinder effective adaptation of risk assessment reports.
2. **Familiarization with Risk Assessment Reports and IOMS Manuals**: A thorough review of the Safexpert risk assessment reports and corresponding IOMS manuals was carried out to identify critical points where changes are required for ensuring accurate and consistent documentation.
3. **Brainstorming Session with Stakeholders**: A brainstorming session involving facilitators, technical writers, and other relevant stakeholders was conducted to generate strategies for better adapting risk assessment report to create IOMS manuals more effectively. The session focused on communication tools, standardization of templates, and workflow improvements.

Analysis: Data from the interviews, document review, and brainstorming session were combined to highlight the key barriers to effective adaptation of risk assessment report into IOMS manual. Solutions such as improving communication channels, standardizing documentation formats, and developing clearer guidelines for using risk assessment data were discussed and refined during this process.

Table 4 outlines the research approach tailored to each specific research questions, detailing the methods and strategies employed to find the answer of each query effectively.

Table 4. Research Approach based on Research Questions

Research Question	Research Tasks
1	Familiarization with Safexpert and Risk Assessment Reports Participating in Live Risk Assessment Sessions Interviews with Facilitators Analysis of Collected Data (Interviews, Safexpert Application, Risk Assessment Session and Safexpert Report) Brainstorming Session with Stakeholders
2	Familiarization with Risk Assessment Reports and IOMS Manuals Interview with Technical Writers Analysis of Collected Data (Interviews, Safexpert Report and IOMS Manuals) Brainstorming Session with Stakeholders
3	Interviews with Facilitators and Technical Writers Assessment of Safexpert Software Analysis of Collected Data (Interviews, Safexpert Software Assessment Result) Brainstorming session with stakeholders
4	Interviews with Technical Writers Familiarization with Risk Assessment Reports and IOMS Manuals Analysis of Collected Data (Interviews, Safexpert Report and IOMS Manuals) Brainstorming Session with Stakeholders

3.2.4 Data Analysis

The data analysis process for this study was designed to ensure thorough examination and cross-verification of findings from multiple sources, enhancing the reliability and depth of the research outcomes. By employing a synthesis-based approach, data from interviews, document analysis, software evaluation, and participant observation were systematically reviewed to uncover key challenges in the Safexpert risk assessment process and the creation of IOMS manuals. This section outlines the key steps taken to organize, synthesize, and interpret the data, ensuring a comprehensive understanding of the issues under investigation.

Data Organization and Synthesis

A collaborative, synthesis-based approach was used to analyze the qualitative data. Information from all data collection methods: interviews, document analysis, software evaluations, and live session observations was consolidated into a central Excel file. This repository served as the primary tool for organizing and cross-referencing data, allowing for a systematic comparison of findings across different sources.

Key themes and recurring issues were identified through this process, focusing on challenges related to:

Safexpert software usability*:* Difficulties in navigating the software and generating reports efficiently.

***Stakeholder collaboration**:* Miscommunications and workflow inefficiencies between facilitators and technical writers.

***Technical documentation bottlenecks**:* Issues in translating technical risk assessment data into IOMS manuals.

By cross-referencing data from multiple sources, this synthesis approach ensured that recurring themes were validated and triangulated, adding robustness to the findings. For example, issues highlighted in interviews were often corroborated by document analysis, while live observations provided further real-world context to the challenges identified.

Stakeholder Collaboration and Issue Prioritization

After initial data synthesis, a brainstorming session was held with key stakeholders, including facilitators and technical writers, to collaboratively review the findings and prioritize the most critical issues. This participatory approach allowed the stakeholders, who were directly involved in the Safexpert process, to weigh in on the relevance and feasibility of addressing the identified challenges.

The collaborative session followed a structured format:

***Review of Key Findings**:* The synthesized data, including recurring themes and challenges, was presented to stakeholders for validation and feedback.

***Prioritization of Issues**:* Stakeholders were asked to choose the issues based on urgency and impact on the overall process. This collaborative prioritization ensured that the study focused on the most pressing challenges, as experienced by those directly involved in the risk assessment and documentation processes.

***Brainstorming of Solutions**:* The group discussed potential solutions for the prioritized issues, focusing on practical improvements that could be implemented within the Safexpert workflow and documentation processes.

This collaborative process ensured that the findings were not only data-driven but also grounded in the practical realities of the case company's operations, increasing the relevance and applicability of the proposed solutions. This aligns with the principles of participatory research, where stakeholder involvement is crucial for refining and validating research findings (Creswell, 2017).

Cross-Verification and Final Analysis

To enhance the reliability of the study’s findings, a triangulation approach was applied, where data from different sources were cross verified. This involved comparing interview data with the results from document analysis, software evaluation, and live session observations to ensure consistency and accuracy across different perspectives. For example:

> ***Interviews with facilitators*** often mentioned specific software usability challenges, which were validated through direct software evaluation.
>
> ***Document analysis*** revealed inconsistencies in the translation of Safexpert reports into IOMS manuals, which echoed concerns raised during interviews with technical writers.
>
> ***Live observations*** of risk assessment sessions provided further evidence of workflow inefficiencies, particularly in real-time documentation and interdepartmental communication.

This multi-source cross-verification added depth to the final analysis, ensuring that the findings were both comprehensive and well-supported by data. Additionally, this method helped mitigate potential researcher bias by corroborating insights through multiple data points, enhancing the overall validity of the study.

The final analysis highlighted several critical areas for improvement in both the Safexpert risk assessment process and the creation of IOMS manuals. These insights formed the foundation for the recommendations presented in subsequent chapters, aimed at streamlining processes, improving collaboration, and enhancing documentation quality.

Figure 11 below, highlights the research methodology workflow, outlining the step-by-step process utilized in the study for comprehensive data collection and analysis.

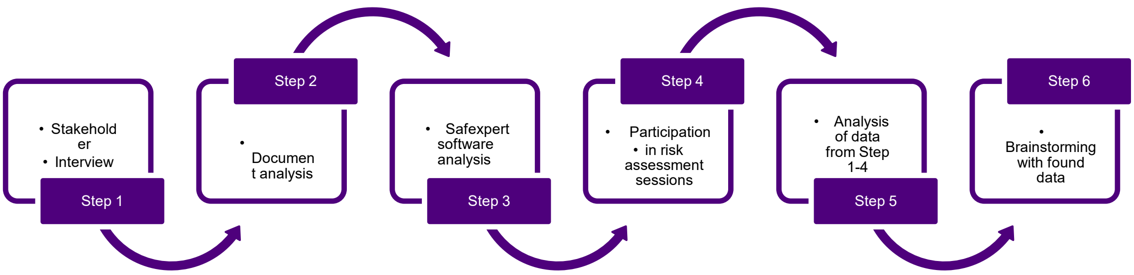

Figure 11. *Research Methodology Workflow*

3.2.5 Ethical Considerations

This study adhered strictly to ethical guidelines to ensure the integrity of the research process and the protection of all participants. Following the recommendations for conducting ethical qualitative research by Creswell (2017), several key measures were implemented to ensure that participants' rights were safeguarded, and data confidentiality was maintained throughout the study.

Informed Consent

All participants were provided with detailed information about the study's objectives, the role of their participation, and the methods through which their data would be collected and used. Each participant was given the opportunity to ask questions about the research, ensuring they had a clear understanding of their involvement before agreeing to participate.

Participants were explicitly informed that their participation was entirely voluntary, and they could withdraw from the study at any stage without consequence. This approach ensured that participants retained control over their involvement in the research process.

Confidentiality and Anonymity

To protect participants' privacy, strict confidentiality protocols were followed. All data collected through interviews, document analysis, software evaluations, and participant observation were anonymized. Pseudo names were used during the transcription of interviews and analysis to prevent the identification of individual participants or their specific roles within the case company.

In addition, all raw data such as interview transcripts, observational notes, and internal documents were securely stored in digital files accessible only to the researcher. No identifying information was shared with the case company or any other external parties, ensuring that the confidentiality of participants was fully protected.

Data Security

All digital data, including interview recordings, transcripts, and notes from observation sessions, were stored in private files. Only the researcher had access to these files, minimizing the risk of data breaches or unauthorized access. Upon completion of the study, all identifiable data will be securely destroyed in accordance with ethical research standards.

Mitigating Power Dynamics

Given that some participants held hierarchical roles within the case company, steps were taken to mitigate potential power imbalances that could influence responses during the interviews. Participants were assured that their responses would remain confidential and that their feedback would not be linked to their individual identities or positions within the organization. This ensured that participants felt comfortable providing honest and candid responses without concern for potential repercussions.

Ethical Approval

The research study was conducted in line with the ethical guidelines of the institution overseeing the project. Ethical approval was obtained before commencing the study, ensuring that all research activities met the necessary ethical standards for conducting human subjects' research. The study complied with ethical principles outlined by Yin (2014) and Creswell (2017), particularly regarding informed consent, confidentiality, and the minimization of harm to participants.

3.2.6 Limitations of the Study

While this study provides valuable insights into the challenges associated with the Safexpert risk assessment process and the creation of IOMS manuals at the case company, several limitations should be acknowledged. These limitations primarily relate to the scope of the research, the inherent nature of qualitative studies, and the potential for contextual bias. Understanding these limitations is important for interpreting the findings and their applicability to other contexts.

Scope and Generalizability

This research was conducted within a single organizational context (for a Business Line) at the case company and focused exclusively on the use of the Safexpert tool for risk assessments and documentation processes. As a result, the findings are highly specific to the case company's workflows, organizational culture, and technical tools. While case studies allow for an in-depth understanding of particular contexts (Yin, 2014), they do not always provide findings that are easily generalizable to other organizations or industries.

Although the methodologies and frameworks developed in this study, such as the Safexpert Best Practices Manual, could potentially be adapted to other contexts, their direct applicability may be limited for organizations that use different risk assessment tools or operate under different safety and documentation standards. Therefore, the transferability of the study's findings to broader industries or other risk assessment tools remains a limitation.

Subjectivity and Researcher Bias

As a qualitative case study, the findings of this research are shaped by the perspectives and experiences of both the participants and the researcher. Semi-structured interviews, while rich in detail, rely on participants' subjective views, which may vary based on their role, level of experience, and personal perceptions (Creswell, 2017). Although efforts were made to ensure objectivity through triangulation of data from multiple sources, the interpretation of qualitative data inevitably involves some degree of researcher bias.

Furthermore, the researcher's direct involvement in observing risk assessment sessions and interacting with participants could have influenced the data collection and analysis process. While participant observation provided critical insights into group dynamics and practical challenges, it also introduced potential for observer bias, as researcher's presence may have impacted how facilitators and technical writers behaved during sessions.

Time Constraints

The study was conducted over a finite period (06 months), meaning that the data collected reflects an image of the case company's risk assessment and documentation processes at a specific point in time. Changes in team dynamics, evolving safety standards, or updates to the Safexpert software could significantly impact the findings if the study were conducted over a longer time frame.

As Creswell (2017) notes, longitudinal studies often provide more comprehensive insights into the long-term effectiveness of safety management processes. Future research could expand on this study by examining the long-term outcomes of the recommendations proposed and their sustainability in an evolving operational environment.

Technological Focus

A key focus of this study was on the Safexpert tool, which served as the primary software for risk assessments at the case company. While this allowed for a detailed exploration of the specific challenges related to Safexpert, it also constrained the study's focus to a single technological solution. Other organizations may use alternative risk assessment tools with different functionality, and thus the findings related to software challenges and improvements may not fully apply in those contexts. Additionally, the software's limitations were evaluated based on the current version in use at the case company, and future updates or changes to the software could alter its functionality and usability.

Participant Selection

While the study included interviews with facilitators, technical writers, and product managers, the relatively small sample size (12 interviewees) may limit the breadth of perspectives captured. Although the sample was representative of key stakeholders directly involved in the Safexpert process, it may not fully reflect the views of all personnel who interact with the system, especially those in peripheral roles. A larger, more diverse participant group might reveal additional challenges or offer different insights into the risk assessment and documentation processes.

This chapter outlined the qualitative case study approach used to explore the challenges in the Safexpert risk assessment and IOMS manual creation at the case company. The methodology involved semi-structured interviews, document analysis, software evaluation, and participant observation to gather insights from facilitators, technical writers, and product managers. Triangulation was used to cross-verify data, enhancing the validity of the findings, while ethical standards ensured confidentiality.

Although limitations such as generalizability and researcher bias were noted, the methodology provided a strong basis for identifying key challenges at the case company. The findings offer practical recommendations for improving risk assessment and documentation. The next chapters will present actionable steps to streamline workflows, enhance departmental collaboration, and improve the quality of technical documentation, with potential applications in similar industries.

4. RESULTS

4.1 Identified Issues related to SE Risk Assessment Process

In the course of this research, 18 key problems were identified during the Safexpert risk assessment process, specifically from the facilitators' point of view. These issues not only caused troubles for a smooth performing of risk assessment process but also impacted the accuracy, consistency, and overall quality of the Safexpert reports, which in turn affected the creation of IOMS manuals. The problems were related to Safexpert software limitations, the way of working for the facilitators using Safexpert software and software improvement opportunities.

4.1.1 Identified Problems

1. Delays When Starting the Application

Facilitators reported that the Safexpert application experienced significant delays when starting, particularly when loading libraries such as pictograms and standards, as well as when saving changes. This issue was more pronounced with larger projects, causing unnecessary downtime and slowing down the entire risk assessment process.

Impact: The delays disrupted workflow, reduced efficiency, and extended the time required to complete risk assessments. This also led to frustration among facilitators, especially when working under tight deadlines.

2. No Auto-Save or Undo Option

The absence of an auto-save or undo feature in Safexpert increased the risk of data loss. Facilitators expressed concerns about losing data if the application crashed unexpectedly, as there was no option to automatically save progress or undo changes made during the assessment.

Impact: The lack of auto-save or undo functionality made the risk assessment process more error-prone, increasing the potential for data loss and requiring facilitators to manually re-enter lost information, which further delayed report completion.

3. Inability to Edit Text Created by Other Facilitators

Safexpert did not allow facilitators to edit text entries created by other users within the same project. This restriction limited collaboration and made it difficult for facilitators to make necessary corrections or updates to shared project reports.

Impact: This issue created bottlenecks in collaborative projects, as facilitators had to rely on the original creator to make edits, leading to delays in updating risk assessments and finalizing reports.

4. Inability to Use Two Monitors Simultaneously

The Safexpert application could not be displayed on two monitors at the same time, which limited facilitators' ability to manage multiple documents or tasks concurrently. This restriction was particularly problematic when facilitators needed to cross-reference information or work on several sections of the assessment simultaneously.

Impact: The lack of dual-monitor support hindered multitasking and made it more difficult for facilitators to work efficiently, leading to longer assessment times.

5. Difficulty Remembering Functions When Used Occasionally

Facilitators who used Safexpert infrequently found it challenging to remember all the available functions and features of the software. This issue was compounded by the lack of best practices manual / guide or reminder system to help occasional users navigate the application.

Impact: The steep learning curve for infrequent users reduced efficiency and increased the likelihood of errors. Facilitators often had to spend additional time reviewing how to use certain features, which delayed the assessment process.

6. Inability to Repeat Hazard Types Under the Same Zone and Phase

Safexpert did not allow facilitators to repeat the same hazard type under the same hazard zone and phase of machinery life when there were different cases of the same hazard. This limitation restricted facilitators’ ability to document all possible risk scenarios accurately.

Impact: The inability to document multiple instances of the same hazard compromised the thoroughness of the risk assessment, potentially leading to incomplete or inaccurate reports.

7. No Data or Information Bank for Best Practices

Facilitators indicated that there was no centralized storage within the case company exclusively for Facilitators for storing best practices or tips related to risk assessments. This absence made it difficult for facilitators to access reference materials or share knowledge across different projects.

Impact: The lack of a best practices repository limited the ability of the facilitators to easily access to available documents dedicated to Safexpert risk assessment process that hinders the standardize risk assessments across projects, resulting in inconsistencies in the quality and thoroughness of the reports.

8. Unclear Print Options for Safeguard Follow-Up

Facilitators found it difficult to print out only the safeguards needed for follow-up on implementation. The existing printout options did not support easy tracking of safeguard measures, making it harder for facilitators to ensure that all safety requirements were met during the risk assessment and design phase.

Impact: The inability to easily print and follow up on safeguard measures increased the risk of overlooking critical safety actions, potentially compromising the quality of the final risk assessment.

9. Printouts Could Not Be Saved Directly to Local PCs

The Safexpert printouts could only be saved to the company’s OneDrive, with no option to save them directly to the local PC. This limitation caused inconvenience, particularly when facilitators needed quick access to the files without an internet connection or when using different file management systems.

Impact: The restriction on saving printouts locally complicated file management, making it harder for facilitators to organize and access their reports, especially when working offline or sharing via email.

10. Projects Disappearing or Being Renamed Without Notification

There were instances where a project disappeared from the Safexpert application, or the name would be changed without notifying the facilitators involved in the project. This created confusion and made it difficult to locate and access critical project information.

Impact: The unexpected disappearance or renaming of projects disrupted workflow and created confusion, potentially resulting in delays and lost work.

11. Unnecessary Pictograms Not Relevant to Metso’s Needs

The Safexpert pictogram library contained several pictograms that were not relevant to company's specific safety requirements, cluttering the library and making it difficult for facilitators to find the appropriate pictograms for their risk assessments.

Impact: The presence of irrelevant pictograms in the library reduced the efficiency of selecting the appropriate symbols, creating confusion and leading to inconsistent visual representation in the risk assessment reports.

12. Missing Pictograms for Explosive Atmospheres

Facilitators noted that the Safexpert pictogram library lacked certain critical pictograms, such as those for explosive atmospheres (ATEX). This limitation made it difficult to document specific hazards accurately in the reports.

Impact: The absence of necessary pictograms compromised the completeness of the visual hazard communication, potentially affecting the quality and compliance of the final risk assessments.

13. Inability to Print Out the Pictogram Library

Facilitators were unable to print the contents of the Safexpert pictogram library for reference or training purposes. This restriction made it difficult to use the library as a learning or reference tool for new facilitators or during risk assessment sessions.

Impact: The inability to print the pictogram library limited facilitators' access to visual references, making it harder to ensure consistent usage of pictograms across projects.

14. Inability to Delete Projects from Safexpert

Safexpert did not provide an option for facilitators to delete outdated or obsolete projects from the application. And they did not have a clear guidance identify the personals who might delete the draft / faulty projects for them. As a result, the project lists became cluttered, making it challenging to manage and navigate active projects.

Impact: The inability to remove old projects resulted in cluttered project management, increasing the difficulty of locating and focusing on current projects.

15. Safexpert Freezing and Inaccessibility

Facilitators encountered issues with Safexpert freezing and becoming unresponsive. Since the application was located on a server, restarting it using the local Task Manager was not possible, resulting in extended downtime.

Impact: Frequent freezing of the application disrupted the risk assessment process, post risk assessment editing, causing delays and affecting the productivity of facilitators.

16. No Change Tracking Feature

Safexpert did not include a change-tracking feature, making it difficult for facilitators to see what changes had been made to a project over time. This limitation prevented facilitators from tracking progress or recovering previous versions of the assessment or report.

Impact: The lack of change tracking increased the likelihood of outdated or incorrect information being included in the reports, leading to potential inaccuracies in the final documents.

17. Signal Words Not Automatically Identified

During risk estimation, Safexpert did not automatically suggest signal words (e.g., Note, Caution, Warning, Danger) based on the assigned risk levels. This limitation required facilitators to manually select appropriate signal words, leading to inconsistencies in risk communication.

Impact: The manual selection of signal words increased the risk of inconsistencies in how hazards were documented, potentially affecting the clarity and effectiveness of the risk assessment reports.

18. No Zoom Option for Better Visibility

The Safexpert application did not provide a zoom function to adjust the view during screen-sharing sessions, making it difficult for participants to see the content clearly. Facilitators could only adjust the font size of certain texts, which did not sufficiently improve visibility for all elements.

Impact: The lack of a zoom option compromised the effectiveness of collaborative risk assessment sessions, as participants found it challenging to read and discuss the content being presented.

4.1.2 Impact on the Quality of Outcome Reports

The 18 identified issues significantly impacted the quality and accuracy of Safexpert reports. The main impacts included inefficiencies in the risk assessment process, data loss risks, incomplete documentation, and difficulties in collaboration. These problems also affected the usability of the Safexpert application, resulting in delays and inconsistencies in the reports, ultimately compromising the accuracy and reliability of the IOMS manuals.

These findings highlight the need for improvements in software functionality, communication channel, proper guidelines and standardized libraries to enhance productivity and ensure high-quality documentation.

4.2 Problems Associated with Adapting SE Report into IOMS Manual

A total of 13 issues were identified by technical writers during the adaptation of Safexpert risk assessment reports into IOMS manuals. Below is a detailed description of each issue and its impact.

4.2.1 Identified Problems

1. Sentence Structures and Wording for IOMS

The sentence structures and wording used in Safexpert reports were often unsuitable for IOMS manuals. Additionally, there was no clear procedure for facilitators on how to add standard texts that were appropriate for IOMS. The reports frequently contained technical jargon or sentence structures that did not align with the tone and style required for user manuals, making it difficult for technical writers to adapt the content.

Impact: This issue increased the workload for technical writers, who had to rephrase or rewrite significant portions of the Safexpert reports to meet the requirements of the IOMS manual format. This extra step increased their workload and extended the time required for manual creation.

2. Changes in Safexpert Reports Are Not Easily Visible

Technical writers found it challenging to track changes in Safexpert reports, especially when reports varied across different projects for the same proprietary equipment. There was no easy way to identify modifications, requiring writers to double-check the entire scope of each report (in reference to the source project) to ensure accuracy. For example: risk assessment of Anode Casting Shop consists of over 100 pages. The case company delivers 5-7 similar machines every year. Risk assessment reports contain slight modifications but require a Technical Writer to check 100 pages every time.

Impact: The inability to track changes effectively led to inefficiencies in the manual creation process, as technical writers had to spend additional time reviewing reports for potential updates. This increased the time required to complete the IOMS manuals and heightened the risk of incorporating outdated information.

3. Unclear Assignment of Lifecycle Phases

There was ambiguity regarding which lifecycle phase a particular message belonged to in the Safexpert reports. Facilitators did not consistently assign messages to the correct lifecycle phase, leaving technical writers uncertain about where to place the information in the IOMS manuals.

Impact: Technical writers had to frequently seek clarifications from facilitators to determine the correct lifecycle phase for various messages. This slowed down the manual creation process and added extra steps to their workflow.

4. Unclear or Missing Signal Words

The Safexpert reports often lacked clear indications of the appropriate signal words (e.g., Note, Caution, Warning, Danger). Technical writers frequently encountered messages where the type of alert or instructional language was either unclear or missing.

Impact: Without clear signal words, technical writers had to interpret the level of severity and manually select appropriate terms, increasing the potential for inconsistencies. This extra decision-making process also added time to the manual preparation.

5. Uncertainty About Whether Text Belongs in IOMS

Certain warnings and instructions were included within the descriptions of safety measures in the Safexpert reports, but there was no indication as to whether these warnings should be part of the IOMS manual or not.

Impact: Technical writers had to make additional judgments about whether to include certain information in the manual, often seeking further guidance from facilitators. This added to their workload and slowed down the adaptation process.

6. Confusion About Pictogram Placement

There was ambiguity regarding where pictograms should be mounted, whether on the equipment itself, in the IOMS manual, or within the equipment's surroundings. This confusion led to inconsistent use of pictograms, making it difficult for technical writers to standardize the visual representation of hazards.

Impact: The ambiguity regarding pictogram placement required technical writers to spend extra time determining the most appropriate location for each pictogram, often consulting with facilitators for guidance. This increased the time and effort needed to finalize the manuals.

7. Outdated and Non-ISO Standard Pictograms

The pictograms available in the Safexpert reports differed from those used in the IOMS manuals, with some being non-ISO standard. Additionally, some of the pictograms in Safexpert appeared to be outdated, adding to the confusion.

Impact: The use of outdated and non-standard pictograms in Safexpert reports led to inconsistencies in the visual communication of hazards. Technical writers had to spend additional time updating or replacing these pictograms to ensure compliance with ISO standards in the IOMS manuals.

8. Language Discrepancies Between Safexpert Reports and IOMS Manuals

Although rare, there were instances where the language used in Safexpert reports differed from the intended language of the IOMS manuals. This required additional translation or adaptation efforts by technical writers to ensure consistency across all manuals.

Impact: Language discrepancies added to the workload of technical writers, who had to rephrase content to align with the language standards of the IOMS manuals. This slowed down the overall manual preparation.

9. Delays in Receiving Clarifications from Engineers and Safety Experts

Technical writers often faced delays in getting the necessary information or clarifications from engineers and safety experts regarding the Safexpert reports. This lag in communication slowed down the conversion process.

Impact: The delays in communication extended the time needed to finalize IOMS manuals, causing bottlenecks in the workflow. Technical writers had to wait for responses, which disrupted their progress and affected project timelines.

10. Ambiguity in Describing Multiple Safety Components

In some Safexpert reports, it was unclear whether the mentioned safety components (e.g., safety gates, disconnecting switches) referred to previously noted items or additional components. This ambiguity made it difficult to determine the total number of safety components required.

Impact: The ambiguity required technical writers to spend extra time verifying details with facilitators or engineers. This added extra steps to their workflow and delayed the completion of the IOMS manuals.

11. Lack of Standard Guidelines for Converting Reports

There were no standardized guidelines available for converting Safexpert reports with special issues (such as issues mentioned in point 1-10) into IOMS manuals. Although the "IOMS Structure and Contents Guideline" provided directions to write the IOMS manuals, it did not cover all types of issues or variations encountered in Safexpert reports.

Impact: The absence of comprehensive guidelines resulted in inconsistencies in the way technical writers adapted Safexpert reports into IOMS manuals. This increased the time and effort required for manual creation, as writers had to make individual judgments about how to handle various scenarios.

12. Pictograms in MS Quick Parts Library Not Updated

The pictograms in the Microsoft Quick Parts library used by technical writers for reference were not updated according to ISO 7010 standards and differed from the pictograms available in the Appendix library. This inconsistency made it challenging for technical writers to select the correct pictograms when converting Safexpert reports into IOMS manuals.

Impact: The outdated and inconsistent pictogram references required technical writers to cross-check multiple sources or manually update pictograms to ensure compliance with ISO standards. This added time to the process and increased the effort needed to maintain visual consistency across manuals.

13. No Formal Training for Technical Writers

There was no structured training program available for technical writers on converting Safexpert reports into IOMS manuals. Although senior technical writers offered guidance, there were no structured courses or resources available in the company's online training centre, Learning Point.

Impact: The lack of formal training resulted in a steep learning curve for new technical writers, who had to rely on informal mentorship and trial-and-error to understand the conversion process. Which increased the likelihood of errors and inconsistencies in the manuals.

Figure 12 visualizes the number of issues identified by the facilitators and technical writers in the risk assessment and documentation process.

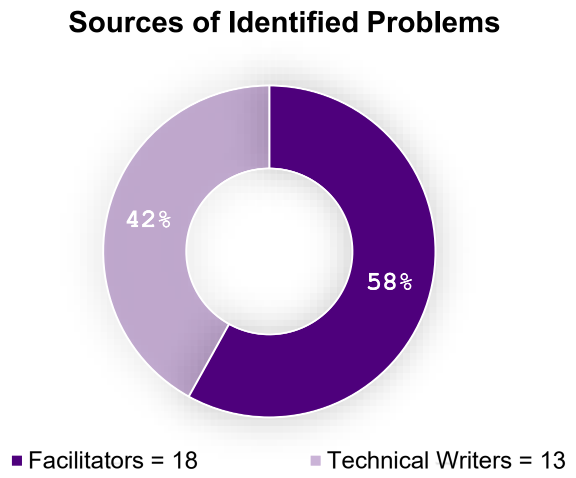

Figure 12. *Issues Identified by Technical Writers and Facilitator*

4.2.2 Impact on IOMS Manual Creation

The 13 identified issues significantly affected the workload and efficiency of technical writers during the conversion process. The lack of clarity and standardized procedures forced technical writers to spend extra time rephrasing content, manually tracking changes, seeking clarifications, and making judgment calls on content inclusion. These inefficiencies extended the time required to produce IOMS manuals, increased the likelihood of inconsistencies, and disrupted workflow.

These findings highlight the need for standardized procedures for Safexpert report generation and improved tools to support more efficient manual creation and ensure consistency across IOMS documentation.

4.3 Streamlining the Risk Assessment Process

Streamlining the Safexpert risk assessment process at the case company was a key focus of this study, as identified inefficiencies impacted the quality and timeliness of risk assessments. Both facilitators and technical writers highlighted challenges that hindered the process, many of which stemmed from software limitations, way of working, software improvement opportunity and Safexpert report clarity. A total of 31 issues were identified by both facilitators and technical writers during the Safexpert risk assessment process. Of these, 27 issues were directly related to streamlining the risk assessment process, with 18 identified by facilitators and 9 by technical writers. To address these problems, a series of solutions were proposed during three brainstorming sessions, leading to actionable steps taken based on these proposals. Figure 13 categorizes problems identified by facilitators and technical writers, showcasing the diversity of challenges encountered.

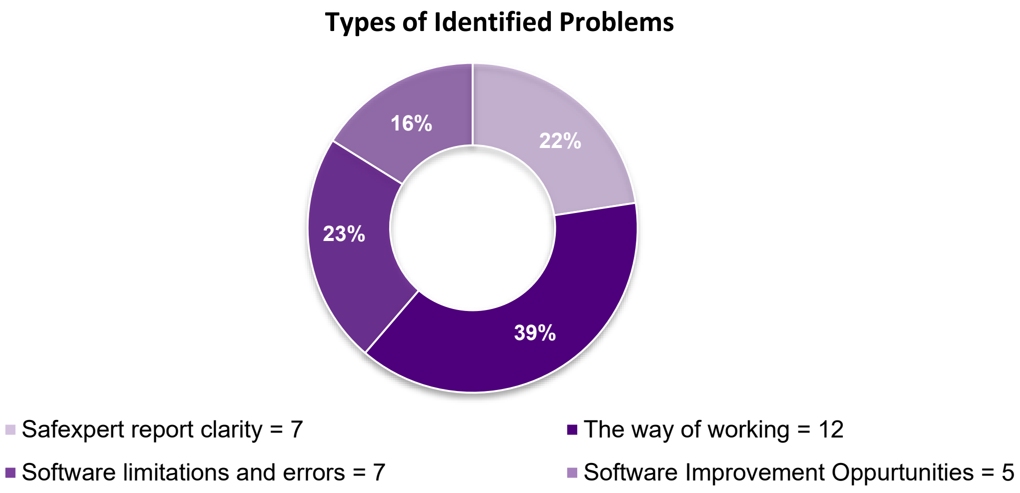

Figure 13. *Problems Based on Types (Identified by facilitators and technical writers)*

4.3.1 Solutions Implemented

To resolve the **27 issues hindering the Risk Assessment process**, **five main solution methods** were implemented. Figure 14 illustrates the solutions implemented to streamline the Saferxpert risk assessment process and IOMS manual creation.

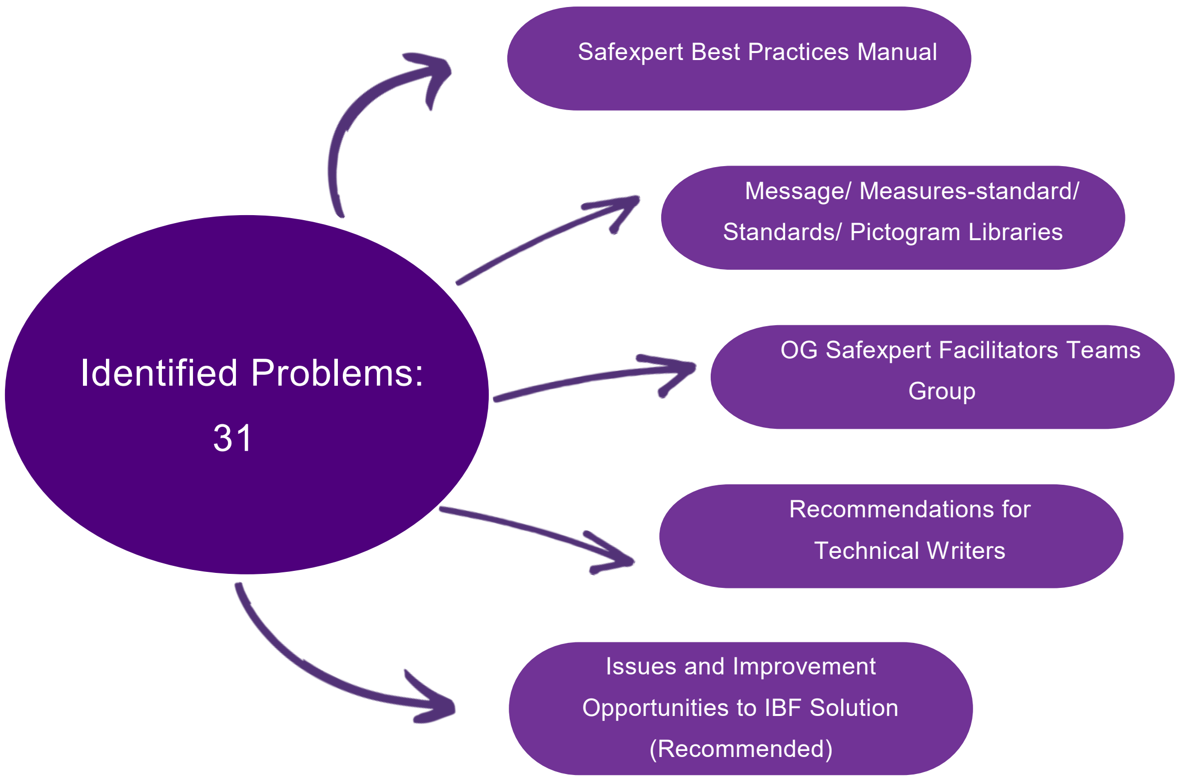

Figure 14. *Solutions Implemented to Streamline Safexpert Risk Assessment Process*

A. Creation of the Safexpert Best Practices Manual

The Safexpert Best Practices Manual was developed as a comprehensive guide to assist facilitators in navigating the Safexpert software and resolving common issues encountered during the risk assessment process. The manual serves as a crucial resource for both new and experienced facilitators, as well as a reference for technical writers, offering standardized practices to ensure consistency and accuracy across all risk assessments. It addresses several key problems identified by facilitators and technical writers, making it a cornerstone for streamlining the Safexpert risk assessment process.

Content and Structure of the Manual

The manual is structured to cover the entire risk assessment workflow, from initiating a new project in Safexpert to finalizing reports for IOMS manual creation. It includes:

Detailed Recommendations for Facilitator to Conduct RA Using SE: Step-by-step instructions on how to create a project for risk assessment and keep working on it (before the session, during the session and after the session) by using the Safexpert application. It includes the use specific guideline to create a new risk assessments draft project from scratch or copying it from a reference project, instruction to inviting technical writer during the RA, way to use two screens during the RA, using proper language for the report writing, guideline of using colored text to improve trackability from other projects, printing and sharing the report with stakeholders and the way of deleting of draft projects.

Standardized Guidelines for Report Creation: The manual provides clear guidelines on structuring Safexpert reports, including how to create measures and selecting standards for them, way of writing descriptions of hazards (IOMS messages), selection of risk levels & assign signal words, and categorize messages according to lifecycle phases. Ensuring the use of emergency stops. It also covers the appropriate use of pictograms, ensuring visual consistency.

Instructions to Solve SE Bugs and Errors: The Best Practices Manual includes illustrated solutions for the common errors and bugs (e.g., changes are currently not possible, freezing issue, that facilitators encounter when using Safexpert. The manual provides step-by-step instructions on how to handle these issues effectively, ensuring minimal disruption during the risk assessment process.

Visual Aids and Diagrams: To help clarify complex procedures, the manual is equipped with visuals that show workflows, screen layouts, and best practices for using specific features within Safexpert. This includes diagrams that explain the placement of pictograms, navigation within the software, and troubleshooting steps for common problems.

B. Development of the Safexpert Best Practices Manual Appendixes

The Safexpert Best Practices Manual was enhanced with four detailed appendixes, designed to support facilitators by providing easily accessible resources that address specific needs identified during the risk assessment process. These appendixes are crucial for streamlining the process, ensuring consistency, and improving the accuracy of Safexpert reports. Each appendix addresses different aspects of the risk assessment process, while also including guidelines to facilitate proper usage. The appendixes underwent versioning to ensure they remain relevant and up to date with evolving requirements. Figure 15 displays the appendices of the Safexpert Best Practices Manual, which serves as the guideline for improving risk assessment procedure especially for the facilitators.

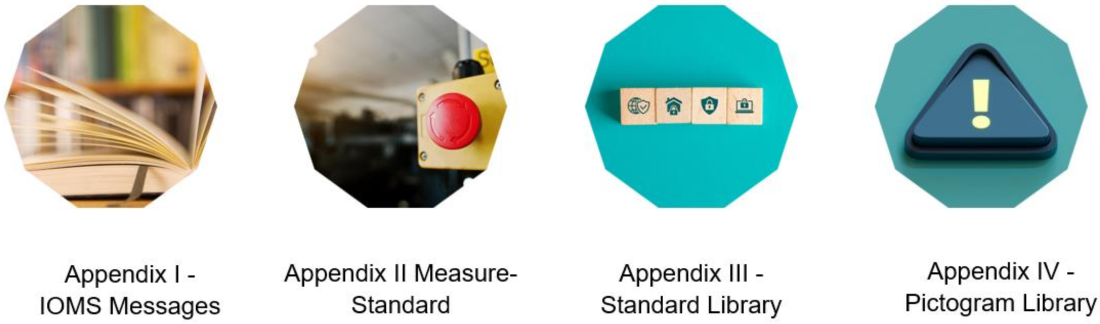

Figure 15. *Safexpert Best Practices Manual Appendix*

i. **Appendix I - IOMS Messages**:

This appendix provides a standardized library of messages that facilitators can use during risk assessments, specifically tailored to align with IOMS (Instruction, Operation, Maintenance, and Spares) manual requirements. The appendix features pre-formulated messages, including keywords and examples, that can be applied to various risk scenarios. Each message is categorized according to its purpose (e.g., Falling from a height, electrical hazard, unexpected start-up), making it easier for facilitators to select appropriate texts.

Purpose and Impact:

The IOMS Messages appendix helps facilitators ensure that the language used in Safexpert reports is consistent with the requirements of IOMS manuals, addressing issues related to inappropriate sentence structures and wording.

By providing standardized phrases and examples, the appendix reduces the time facilitators spend drafting messages from scratch and minimizes inconsistencies in the language used across different reports.

The inclusion of keywords also aids in the quick identification of suitable messages, making it easier to apply the correct terminology for specific hazards.

Guidelines for Use:
Facilitators are encouraged to modify the provided messages to suit the particular context of their assessments. The appendix is intended as a reference, not a strict template, allowing for flexibility in message formulation. Facilitators should refer to the Safexpert Best Practices Manual for further guidance on the ideal procedures for drafting texts.

ii. Appendix II - Measure-Standard:

This appendix lists standards relevant to various safety measures, offering facilitators a quick reference guide to identify the correct standards needed for different risk scenarios. The standards are categorized based on the type of safety measure (e.g., emergency stop, safety gate, disconnecting switch), with each entry linked to the corresponding international or industry-specific standard.

Purpose and Impact:
The Measure-Standard appendix addresses the issue of limited access to up-to-date safety standards by merging all relevant standards related to frequently used measures in one location. Facilitators no longer need to search multiple sources for the applicable standards.

This appendix assists facilitators in ensuring that risk assessments comply with the latest safety regulations, reducing the likelihood of errors due to outdated or incorrect standards.

By categorizing standards by type and providing references for each, the appendix speeds up the process of identifying the appropriate safety requirements for specific hazards, making the risk assessment more efficient.

Guidelines for Use:
Facilitators should filter the standards based on the measures identified during the risk assessment. The appendix is intended to simplify the process of selecting standards, helping facilitators ensure that all safety measures comply with the latest regulations.

iii. Appendix III - Standard Library:

The Standard Library is a comprehensive collection of safety standards, continuously updated to reflect the latest changes in regulations. It categorizes standards by keywords (e.g., IOMS, lighting, radiation) and by group (e.g., risk assessment, mechanical safety, noise) allowing facilitators to quickly find relevant standards for their specific project needs. The appendix includes both general safety standards (e.g., ISO 12100 for machinery safety / risk assessment) and specialized standards (e.g., ATEX directives for explosive atmospheres).

Purpose and Impact:
The Standard Library appendix helps address issues related to the inconsistency in the application of safety standards by providing facilitators with a reliable and comprehensive reference. It ensures that all facilitators have access to the same up-to-date standards.

The categorization by sector and keyword enables facilitators to locate relevant standards more quickly, streamlining the process of referencing safety requirements during risk assessment.

Regular updates to the appendix ensure that facilitators are always working with the most current information, enhancing compliance with regulatory standards and improving the quality of risk assessment reports.

Guidelines for Use:
Facilitators should use keywords to search for standards within the library. Once identified, they should review the list of standards to select the most suitable one for their specific project requirements.

iv. Appendix IV - Pictogram Library:

This appendix provides a library of ISO 7010-compliant pictograms, along with the company (Smelting BL) - specific pictograms that have been added to address unique requirements not covered by the standard. The pictograms are categorized based on their hazard type (e.g., high pressure hazard / pressure hazard, Corrosive substance, hot surface hazard/ burning hazard), making it easy for facilitators to find the appropriate symbols for use during risk assessments. The appendix also includes safety signs (visuals for each pictogram), their names as per ISO standards and as mentioned in Safexpert pictogram library and keywords.

Purpose and Impact:

The Pictogram Library appendix addresses the issue of outdated or inconsistent pictogram usage by providing a standardized set of visual aids that facilitators can use during risk assessments. This ensures uniformity in the visual representation of hazards.

The inclusion of case company-specific pictograms allows for the customization of reports to reflect the company's specific safety needs, while still adhering to international standards.

By categorizing pictograms based on application and providing usage guidelines, the appendix helps facilitators select and place pictograms accurately, reducing the need for revisions and ensuring clarity in the risk assessment reports.

Guidelines for Use:

Facilitators can search for the appropriate pictogram based on the hazard category and/or keywords and search for the same in Safexpert pictogram library using the short name.

Overall Impact of the Appendixes

The development of the Safexpert Best Practices Manual Appendixes plays a critical role in streamlining the risk assessment process by providing facilitators with comprehensive and easily accessible resources. Each appendix addresses specific issues identified during the brainstorming sessions, improving the consistency and efficiency of risk assessments. By equipping facilitators with standardized messages, up-to-date safety standards, and a reliable pictogram library, the appendixes contribute to the production of high-quality Safexpert reports and facilitate a smoother transition to IOMS manual creation.

C. Establishment of the OG Safexpert Facilitators Teams Group

The creation of the OG Safexpert Facilitators Teams Group was a strategic initiative aimed at improving communication and collaboration among facilitators and between facilitators and technical writers. The dedicated Teams group functions as a centralized hub for sharing information, resolving issues, and providing access to essential resources related to the Safexpert risk assessment process. The platform was designed to facilitate real-time interaction, enhance problem-solving capabilities, and streamline the distribution of important documents, such as the Best Practices Manual and its appendices.

Purpose and Functionality of the Teams Group

The Teams group was established to address several key challenges that were impeding the risk assessment process:

Real-Time Communication: The platform allows facilitators to communicate in real time, providing a quicker and more effective means of discussing issues as they arise. Facilitators can seek advice, share updates, and collaborate on problem-solving without the delays associated with traditional communication methods like email.

Knowledge Sharing and Best Practices: The Teams group serves as a forum for facilitators to share experiences, insights, and best practices. This collaborative environment encourages the exchange of ideas, helping facilitators learn from one another and adopt more efficient methods for conducting risk assessments.

Access to Key Documents: Facilitators can easily access important resources, such as the Safexpert Best Practices Manual, appendixes, and other training materials, through the document repository in the Teams group. This centralization ensures that all users have the latest versions of documents and can easily find the information they need.

Event Announcements and Training Opportunities: The platform is also used to announce training sessions, webinars, or risk assessment workshops. This ensures that facilitators are aware of opportunities to enhance their skills and stay updated on best practices.

Enhanced Collaboration with Technical Writers: Technical writers can be added to the Teams group to facilitate direct communication with facilitators, particularly when clarifications are needed for Safexpert reports. This collaboration ensures that technical writers have immediate access to information, reducing the time spent on revisions or manual preparation.

D. Recommendations for the Technical Writing Department

To streamline the process of converting Safexpert reports into IOMS manuals and to improve the workflows for technical writers, a series of targeted recommendations were made for the Technical Writing Department. These recommendations aimed to address specific challenges faced by technical writers, enhance their understanding of the Safexpert risk assessment process, and ensure that the resources they used were aligned with current standards. The following key recommendations were implemented to support these objectives:

Creation of a Learning Point Training Module: A formal training module should be developed and integrated into the company's Learning Point platform, specifically focused on converting Safexpert reports into IOMS manuals. The training module will be designed to standardize the conversion process, ensuring that all technical writers follow consistent procedures when adapting risk assessment reports.

The purpose of the training module is to meet the need for a structured learning program, particularly for new technical writers, by offering a step-by-step guide to the conversion process. It should also incorporate quizzes and practical exercises to reinforce the learning experience, ensuring that writers can effectively apply the knowledge in their daily tasks.

Participation in Risk Assessment Sessions: Technical writers were encouraged to actively participate in risk assessment sessions, allowing them to gain a deeper understanding of the Safexpert software and the overall risk assessment process. By being present during these sessions, technical writers could observe the facilitators' work firsthand, ask questions, and provide immediate feedback on the documentation requirements. It will also help them to enhance the network and familiarize themselves with the project persons and can be effective if the technical writer needs any clarification about any issues during the IOMS creation process for the same equipment for that very project.

The purpose of this recommendation is to bridge the gap between technical writers and facilitators, as well as safety, project, and product teams, enabling writers to gain a better understanding of the context and content of the Safexpert reports for specific proprietary equipment. Participation in risk assessment sessions will also give writers the opportunity to suggest improvements in how risk information is documented, ensuring that the final reports are more suitable for adaptation into IOMS manuals. This approach aims to reduce the need for follow-up communications and accelerate the report finalization process.

Updating the Quick Parts Library: The Quick Parts Library, a resource used by technical writers for inserting frequently used pictograms, is set to update to ensure consistency with the latest standards. The library should match the resources outlined in the Safexpert Best Practices Manual Appendixes, particularly the Pictogram Library.

The purpose of updating the Quick Parts Library is to ensure that the pictogram library and other resources are current and aligned with ISO 7010 standards, which is essential for maintaining consistency in hazard communication. This update will also provide technical writers with a standardized set of resources that can be easily integrated into IOMS manuals, reducing the time spent searching for or manually updating visual elements.

4.4 Adapting Streamlined SE Report in IOMS Manual

With the recent improvements to the Safexpert risk assessment process, the approach to adapting these reports into IOMS (Instruction, Operation, Maintenance, and Spare) manuals has become more structured and systematic. The new workflow involves a series of steps aimed at ensuring consistency and accuracy in documentation, supported by key resources such as the standardized SE report, Style Guide, and updated Quick Parts Library. The integration of these elements, along with phased implementation through pilot projects and a gradual organization-wide rollout, is helping to refine the process and ensure seamless adoption across all departments, ultimately enhancing the quality of risk management and safety documentation.

Firstly, with the recent improvements to the risk assessment process, technical writers have adopted a more structured approach when converting Safexpert reports into IOMS manuals. Once facilitators complete and finalize the Safexpert risk assessment, the reports are handed over to technical writers for conversion. The writers begin by thoroughly reviewing the hazard descriptions, safety measures, signal words, and other relevant content to ensure everything aligns with the requirements for the IOMS manual. In cases where any information is unclear, they collaborate with the facilitators, safety team, or project team for clarification. Next, the writers structure the IOMS manual according to a standardized template, using the Style Guide to maintain consistency in tone, style, and layout across all manuals. After this, they adapt the content to fit the specific context of each manual, integrate pictograms and visual elements while cross-checking them against the Quick Parts Library for ISO compliance, and finally conduct a comprehensive quality check to ensure the manual meets company's standards.

Secondly, to facilitate the adaptation and assess the impact of the changes, pilot projects are being used to test the updates in a controlled setting. This phased approach allows for the evaluation of software updates, standardized text libraries, and new communication protocols in selected departments, ensuring the changes are practical and effective in various contexts. Feedback from the pilot teams is essential in refining the processes and addressing any issues that arise during testing. By gathering insights from these pilot projects, the organization can make necessary adjustments and optimize the implementation strategy before rolling out the improvements more broadly.

Thirdly, once the pilot projects have demonstrated the effectiveness of the changes, the organization will proceed with a progressive, organization-wide rollout. This broader integration will ensure that the updates are seamlessly incorporated across additional projects, in alignment with existing workflows. Training initiatives will be introduced to keep stakeholders up to date on best practices for risk assessment, documentation, and communication, while also promoting the use of the new text libraries, software functionalities, and communication protocols. The goal is to integrate these improvements into the organization's standard safety management practices, ensuring consistent, high-quality risk management and documentation across all operations.

4.5 Open Problems and Proposed Future Actions

This chapter addresses the remaining challenges in Safexpert Risk assessment process and IOMS manual creation workflow. The findings in this section are categorized into open problems and corresponding recommendations for future actions.

4.5.1 Open Problems

As part of streamlining the Safexpert risk assessment process, a total of 31 issues were identified that impacted both facilitators and technical writers. After implementing various solutions, these issues were categorized as either closed (resolved) or open (requiring further attention). The resolution status provides insight into the progress made and highlights areas needing continued focus. Out of the 31 identified issues, 24 problems have been successfully resolved and closed through solutions such as the Safexpert Best Practices Manual, Best Practices Manual Appendix and OG Safexpert Facilitators Teams Group. Despite significant progress, 7 issues remain open, indicating ongoing challenges that still need to be addressed. All of them are in the scope of IBF Solution (Software Limitations) and Technical Writing Department (Creation of Training Module).

As mentioned, several of these unresolved issues for IBF Solutions require modifications to the Safexpert software itself to address software-related limitations and enhance overall functionality. These enhancements, outlined below:

List of Issues and Improvement Opportunities for IBF Solutions

During the analysis of the Safexpert risk assessment process, it became evident that some issues could not be resolved through internal process improvements alone and required modifications to the Safexpert software itself. As the creator of the Safexpert application, IBF Solutions was identified as the responsible party for addressing software-related limitations and performance issues. A list of key improvement opportunities was compiled, and the case company will submit it to IBF Solutions, with the goal of enhancing the overall functionality, usability, and performance of the software. These recommendations aimed to resolve existing pain points and ensure that Safexpert could better support facilitators in conducting efficient and accurate risk assessments.

Software Performance Enhancements: Solutions to address delays during startup, loading libraries, and saving changes.

User Interface Improvements: To add features such as an auto-save function, undo option, track changes, and zoom capabilities.

Resolving Functional Limitations: Addressed the inability to repeat hazard types under the same hazard zone in a lifecycle phase and to fix issues for automatically selecting signal words.

Here, figure 16 represents the status of the identified issues, providing an update on the progress made in addressing the overall challenges and their current state.

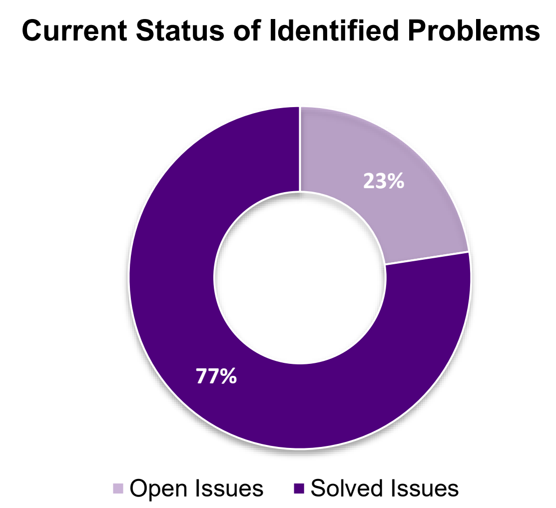

Figure 16. *Status of the Identified Issues*

4.5.2 Proposed Future Actions

1. Track Open Problems for Final Solutions

A systematic approach should be implemented to monitor the progress of open problems, ensuring they are actively addressed until fully resolved. This includes working closely with IBF Solutions to prioritize software updates and enhancements needed for Safexpert.

2. Regularly Update the Safexpert Best Practices Manual Appendixes

Since the appendixes are live documents, they should be regularly reviewed and updated to reflect new standards, practices, and any changes in Safexpert functionalities (updates of the libraries). Keeping these resources, current will help facilitators and technical writers maintain consistency and compliance.

3. Enhance Collaboration Among Facilitators, Risk Assessment Teams, and Technical Writers

Strengthening collaboration is essential to ensure accurate and efficient risk assessments. More frequent interaction and information sharing will help address any emerging issues quickly and improve the overall process.

Figure 17 outlines the proposed future actions, suggesting further steps for improvement and refinement of the risk assessment process.

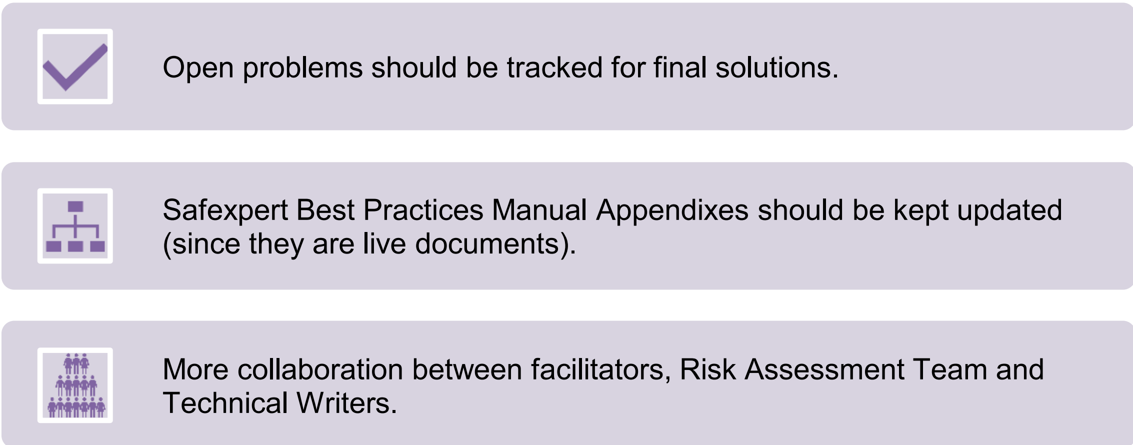

Figure 17. *Proposed Future Actions*

These future actions are aimed at ensuring that the solutions implemented as part of this thesis have a lasting effect on the quality and efficiency of risk assessment practices.

5. DISCUSSION

5.1 Review of the Results and the Reliability and Validity of the Study

5.1.1 Review of the Results

The study identified several critical issues related to Safexpert's usability and its impact on risk assessment and documentation processes at case company. The findings revealed significant limitations in the software's interface, data integration, and customization options for report generation. These usability challenges directly affected the efficiency and accuracy of risk assessment tasks, with users often resorting to manual workarounds to complete tasks. Interviewees reported difficulties in navigating the tool, inputting data, and producing reports, which created additional workload and inconsistencies in the risk assessment report. The observations during software evaluations aligned with these accounts, highlighting a gap between the intended use of Safexpert and its practical application.

Inconsistencies in SE reports were also identified mostly caused by absence of standardized libraries (text, standards and pictograms), with technical writers struggling to standardize safety documentation due to a lack of clear guidelines and formal, readily available training. These issues resulted in additional work for technical writers, who had to invest significant time adjusting the IOMS manuals to ensure compliance. The variability in documentation not only affected the clarity and reliability of safety instructions but also extended the time required to produce consistent and compliant safety manuals. Additionally, technical writers noted that SE reports lacked adequate instructions for customizing outputs for different projects, further complicating the documentation process.

The study also found that communication barriers among risk assessors, technical writers, and project teams complicated collaboration. These findings point to the need for improvements not only in the software but also in organizational processes, such as clearer communication protocols and standardized workflows.

5.1.2 Qualitative Rigor and Data Collection Methods

The research employed a qualitative approach with multiple data collection methods, including semi-structured interviews, software evaluations, and document analysis, to provide a comprehensive understanding of Safexpert's as well as documentation challenges. This triangulation ensured a comprehensive analysis, revealing insights that might not have emerged from a single method. Participants were drawn from various roles, such as technical writers, facilitators, and product managers, to capture diverse perspectives on how Safexpert was used.

Efforts to enhance the study's rigor included using a flexible semi-structured interview format to cover key topics while allowing participants to share their experiences freely. The study also employed strategies to minimize bias, such as using open-ended questions to avoid leading responses and guaranteeing participant anonymity to encourage honesty. Although the focus on a single company could limit the generalizability of the findings, the robust data collection methods helped to strengthen the study's reliability and validity.

5.1.3 Mitigation of Bias

Participants were selected from different roles with varying levels of experience to ensure a balanced understanding of the issues. This diversity in experience levels and outlook helped to minimize the selection bias since the findings were formed by a range of viewpoints rather than a single person’s or group’s perspective. The inclusion of different stakeholders from various stages of the process ensured that the information and insights gathered were comprehensive and represented organizational realities.

Additionally, structured interview protocols were employed to facilitate the data collection method and minimize the interview bias. Anonymity was ensured throughout the study to encourage honest feedback, reducing the likelihood of responses being influenced by external pressure or fear.

While some degree of bias is inherent in qualitative research, these planned measures enhanced the credibility and reliability of the findings. By adopting these strategies, the study achieved a balanced illustration of the challenges related to Safexpert risk assessment and IOMS manual creation at the case company.

5.2 Research Contribution

5.2.1 New Findings and Novel Insights

The study contributes new insights into the limitations of risk assessment tools like Safexpert. While the software is intended to facilitate safety management, users reported struggling with interface navigation, data integration, and limited customization options. These challenges required frequent workarounds, such as manual reformatting and using external tools, indicating a significant gap between the tool's design and practical usage.

The inconsistencies in SE report highlighted the need for standardized documentation practices, suggesting that Safexpert's capabilities alone are insufficient to ensure uniformity. Communication barriers also emerged as critical factors affecting the risk assessment process, demonstrating that collaboration challenges can be as significant as technical limitations.

The findings emphasize the importance of user-centered improvements in risk management tools and structured documentation protocols, contributing to the literature by illustrating how practical software limitations can impact safety practices in industrial settings.

5.2.2 Comparison with Existing Literature

The study aligns with existing literature that recognizes risk management software's role in improving safety processes and documentation quality. For example, Chinniah (2015; Del Giudice et al. (2024) highlights the critical role of systematic hazard identification and risk assessment in ensuring safety compliance. However, this study extends current understanding by highlighting real-world usability challenges that are not fully addressed by these theoretical models. While previous research (Huck et al., 2021; Kaplan, 2024; Pantano et al., 2022) has focused on the benefits of software for hazard identification and risk assessment, this study demonstrates how issues such as navigation difficulties and documentation customization can disrupt these processes.

The literature often assumes that risk management tools inherently promote documentation uniformity (Kaplan, 2024). However, the inconsistencies observed in the SE reports suggest otherwise, pointing to a need for integrated user-friendly interface within the software and proper guidelines by the manufacturing companies to achieve consistency. This finding diverges from the expectation that software alone can standardize processes, emphasizing the need for organizational standards alongside tool enhancements.

The communication challenges identified resonate with studies on collaboration in safety management. For example, Kivistö-Rahnasto (2000), document the positive impact of communication and collaboration on safety practices. This study builds on that by showing how communication barriers emerge in the use of Safexpert at the case company, providing the need for more robust communication protocols.

Additionally, the finding that users developed informal workarounds reveals a gap in the literature regarding adaptive behaviors in response to software limitations. While previous research, such as Kaplan (2024), focuses on the theoretical benefit of the risk management tools, this study emphasizes the practical challenges experienced by the users. These findings suggest that future research should focus on user centered design improvements to align risk management tools (software) with real world workflows and extend the discussion on software usability and safety management.

5.2.3 Unresolved Issues and Future Research

While the study provides valuable insights into the challenges associated with Safexpert, some issues remain unresolved which require further attention. The single company focus limits the generalizability of findings, indicating a need for future research across different companies and industries. Investigating whether similar usability and communication challenges exist elsewhere could help determine if these problems are widespread.

The study also identified the need for standardized documentation but did not explore the implementation of such practices across different teams. Future research could focus on developing comprehensive frameworks that include customizable templates and automated formatting options within Safexpert. Evaluating the long-term effects of suggested software updates based on user reviews, training programs, and documentation protocols would provide insights into whether these interventions lead to sustainable improvements.

The communication barriers identified suggest an opportunity for further research into optimizing collaboration during risk assessment. Future studies could examine integrating collaborative features within Safexpert or similar tools to facilitate real-time communication and task tracking. Understanding how organizational culture influences communication practices could also inform strategies for enhancing coordination.

5.3 Practical Contribution

5.3.1 Implications for Metso

The findings have practical implications for the case company, particularly in improving the usability of Safexpert, standardizing documentation processes, and addressing communication challenges. To enhance usability, the company should collaborate with the software provider to implement user-centered updates, such as refining the interface, improving data input functionalities, and providing more customization options for generating documentation outputs. These changes could reduce manual workarounds and improve risk assessment efficiency.

Developing training for IOMS manuals creation would also help to achieve consistency in safety documentation. This could involve creating improved guidelines to guide technical writers through the documentation process and training them in standardized practices.

Addressing communication barriers is crucial for improving collaboration. The case company should establish formal communication protocols, such as regular cross-departmental meetings and shared communication channels such as OG Safexpert Facilitators Teams Group, to enhance information flow.

A phased implementation approach would allow the company to pilot these changes, assess their effectiveness, and adjust before organization-wide scaling. Feedback from pilot projects can be used to refine the improvements to ensure they meet the needs of various departments involved in risk assessment and documentation.

5.3.2 Recommendations for Other Machinery Manufacturers

The study's recommendations extend beyond the case company, offering insights for other machinery manufacturers using Safexpert or similar tools. Enhancing risk management software usability, adopting standardized documentation practices, and improving communication protocols can streamline risk assessment processes across the industry. Other companies should work with software vendors to ensure tools meet practical user needs, thereby reducing manual interventions.

Standardized safety documentation with clear guidelines can help reduce inconsistencies, while formal communication practices and collaborative software features can enhance coordination across departments. Gradually implementing these changes with pilot testing allows companies to adjust practices to different operational environments effectively.

5.3.3 Implementation Roadmap

A phased implementation approach is essential for integrating the recommended changes in risk assessment and documentation practices. The process should start with pilot projects to test software updates, standardized text libraries, and communication protocols within selected departments. This phase will assess the impact in different operational contexts, enabling refinements based on real-world feedback. For broader applicability, pilot projects can be tailored to meet industry-specific needs and regulatory requirements.

After successful pilot testing, a gradual organization-wide rollout should follow, integrating improvements across projects while aligning with existing workflows. Training initiatives are critical at this stage to ensure stakeholders are equipped with best practices for risk assessment and documentation. Incorporating new tools and protocols into current safety management processes should prioritize compliance and adaptability to various regulatory standards.

Scaling improvements should also consider cultural differences and varying technical expertise across teams. Customizing training and fostering knowledge-sharing will support sustainable change. Organizations can further benefit by sharing best practices with industry partners, encouraging continuous improvement and elevating safety standards across the sector.

Finally, continuous evaluation should involve regular monitoring of key metrics, such as documentation quality and risk assessment efficiency, to identify areas for further enhancement. Incorporating user feedback into software updates will ensure the tools remain aligned with evolving industry needs.

6. CONCLUSIONS

The aim of this study was to streamline the Safexpert risk assessment process to enhance safety documentation for proprietary equipment at Metso. The research sought to address the challenges that impact the efficiency and accuracy of risk assessments and the creation of Installation, Operation, Maintenance, and Spares (IOMS) manuals. Specifically, the study aimed to identify existing problems in risk assessment processes, evaluate the issues encountered in documentation, and propose practical improvements to streamline workflows and enhance compliance with international safety standards.

The essential findings revealed several challenges in the current Safexpert risk assessment process. These included software usability issues, inconsistencies in the documentation of risk assessments, difficulties in converting technical risk data into user-friendly IOMS manuals, and collaboration barriers between facilitators and technical writers. The software’s limitations in generating uniform reports and the lack of standardized templates contributed to inconsistencies, which, in turn, affected the quality and clarity of safety documentation. Furthermore, the study identified that communication gaps between different stakeholders complicated the documentation process, leading to delays.

The practical implications of these findings are significant for improving machinery safety at the case company. By addressing the identified software and procedural challenges, the company can enhance the consistency and accuracy of its risk assessment reports and IOMS manuals, which are critical for ensuring machinery safety and regulatory compliance. Implementing streamlined workflows, adopting standardized documentation processes, and improving collaboration among stakeholders can lead to more efficient risk management processes. These enhancements not only reduce the likelihood of machinery-related incidents but also improve the overall quality of safety documentation, thus supporting the case company’s commitment to a "zero-harm" culture and sustainability goals.

Future research should focus on evaluating the long-term effects of the proposed improvements on the quality of risk assessment and documentation. Additionally, investigating the application of alternative risk assessment tools in various organizational contexts could offer broader insights. Expanding the study to other industries that rely on complex safety management systems could further validate the findings and recommendations presented here, providing a pathway for continuous improvement in safety management practices for machinery safety.

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APPENDIX A: USING TEXT STYLES IN MS WORD

APPENDIX 1: QUESTIONNAIRE

A. Questionnaire for Facilitators

Information of the interviewee:

Name:
Job Title:
Years of Experience as Product Safety Expert (Facilitator / Safexpert User):

Questions:

1. Understanding the role of Product Safety Expert (Safexpert User):

i. Can you please describe your role and responsibilities in performing the risk assessment via Safexpert application for projects? And for how long have you been working as a facilitator?
ii. Which manual/guide do you follow for risk assessment (if any)?
iii. Do you normally use the existing project template as a starting draft?
iv. How much do you usually modify /update the referent (template) project? Is it possible/convenient to make significant changes?
v. For which parameter (based on risk factors) do you use danger, warning, caution and notice in risk assessment? Do you completely rely on the project people for this?
vi. In which cases standards are referred to as safety measures? What is the logic behind? Is it referred when anyone remembers related standard or is there any method used?
vii. In your experience, how challenging is it to create a Safexpert project from scratch?

2. Integration and Collaboration:

i. How do you collaborate with project engineers/managers while creating risk assessment reports? Is it through team groups, email communication, or a combination of both?
ii. Have you encountered any challenges or communication issues while working with these stakeholders? If yes, can you please provide examples?
iii. Have you encountered issues with the accuracy of data provided by project people for your documentation (risk assessment) tasks? Can you provide examples of situations where inaccuracies or incomplete data posed challenges?
iv. How familiar are you with the IOMS creation process (from the risk assessment report)?

v. Do you invite Technical Writers to risk assessment sessions, and do they actively participate in the discussions? How frequently do you receive feedback from them, and what is the feedback typically about? What you do to make the risk assessment report understandable for technical writers.
vi. How often have Technical Writers contacted you for clarifications or suggestions? Have you encountered difficulties in clarifying risk assessment reports to them, such as due to unclear formulations or complex terminology?
vii. How do you instruct a Safety Team before the risk assessment session?

3. Challenges in Using Safexpert:

i. Have you encountered any difficulties or issues while using the Safexpert application to create risk assessment reports? Any issues while using or selecting pictograms?
ii. How do you ensure the quality and consistency of texts / instructions generated from Safexpert? Are there any particular aspects of consistency or quality that you find challenging to maintain?

4. Compatibility and Integration:

i. Does Safexpert seamlessly integrate with your documentation tools and processes? Have you faced any compatibility issues?
ii. Please describe any integration challenges you've experienced while working with the Safexpert application.

5. Training and Support:

i. Have you received adequate training on using Safexpert to perform your tasks? Was there any formal training before you started your tasks here?
ii. If yes, was the training helpful? If not what additional training and support would be beneficial to you?

6. Expectations:

i. What is your expectation from the Safexpert application? Please provide an example to illustrate your expectation.

7. **Suggestions:**

i. Any suggestions for a new facilitator?

B. Questionnaire for Technical Writers

Information of the interviewee:

Name:
Job Title:
Years of Experience as Technical Writer:

Questions:

1. Understanding the Role of Technical Writers:

   i. Can you describe your role and responsibilities in creating IOMS instructions based on the Safexpert report?

2. Understanding Documentation Process:

   i. Can you please show the process (steps) of creating IOMS instructions based on the Safexpert input (reports)?
   ii. Are there any specific templates or guidelines you follow in this process?
   iii. In which cases do you use pictograms? Are there any predefined guidelines for technical writers for this?
   iv. For which parameter do you use danger, warning, caution and notice in IOMS? Are there any guidelines or do you just follow the risk assessment report?

3. Integration and Collaboration:

   i. How do you collaborate with project engineers/managers and safety experts (product safety managers)?
   ii. Have you encountered any challenges or communication issues while working with these stakeholders? If yes, can you please provide examples?
   iii. Would you like to participate in the risk assessment sessions? And do you think it'll be fruitful to join the session?

4. Challenges in Using Safexpert Data:

   i. Have you encountered any difficulties or issues while using the Safexpert data to create IOMS instructions? Can you please show an example where you had trouble understanding the Safexpert report text? Also, another example where the Safexpert risk assessment report was very easy to understand.
   ii. How do you ensure the quality and consistency of IOMS instructions generated from Safexpert data? Are there any particular aspects of consistency or quality that you find challenging to maintain?
   iii. Have you encountered issues with the accuracy of data provided by Safexpert for your documentation tasks? Can you provide examples of situations where inaccuracies or incomplete data posed challenges?

iv. Are there any particular segments of the report which troubles you the most (e.g., warnings, cautions etc.)?

5. Compatibility and Integration:

   iii. Does Safexpert seamlessly integrate with your documentation tools and processes? Have you faced any compatibility issues?
   iv. Please describe any integration challenges you've experienced.

6. Training and Support:

   iii. Have you received adequate training on using Safexpert for your documentation tasks?
   iv. If yes, was the training helpful? If not what additional training and support would you support beneficial?

7. Expectations:

   ii. What is your expectation from the Safexpert reports? Please explain with an example!

8. Suggestions for Improvement:

   i. Are there any specific features you believe Safexpert report should incorporate or enhance to better support your documentation needs?
   ii. Do you have any suggestions for improving the use of Safexpert report in your documentation process?

C. Questionnaire for Product Managers

Information of the interviewee:

Name:
Job Title:
Years of Experience as Product Manager:

Questions:

1. Understanding the Role of Project Personals (Engineers / Managers):

   i. Can you describe your role and responsibilities in the risk assessment process?
   ii. Can you please mention for how long you've been participating in the Safexpert sessions?

2. Understanding Risk Assessment Process:

   i. During risk assessment sessions, what parameters (legislations, directives, design parameters etc.) do you usually keep in mind?
   ii. Are there any specific rules or guidelines you follow during the risk assessment?
   iii. For which parameter do you use danger, warning, caution and notice in risk assessment? Do you always rely on Safexpert for the outcome?
   iv. In which cases standards are referred to as safety measures? What is the logic behind, is it referred when anyone remembers related standard or is there any method used?

3. Integration and Collaboration:

   i. How do you collaborate with Facilitators and technical writers? How your response to them in case they need quick feedback or information regarding any issues?
   ii. Have you encountered any challenges or communication issues during and after the risk assessment?

4. Challenges in During the Risk Assessment:

   i. How do you ensure the quality and consistency of the provided data during a risk assessment? Are there any particular aspects of consistency or quality of information that you find challenging to maintain?
   How do you maintain the quality and consistency (uniform, coherent, and free from contradictions) of the data provided by you or your team during a risk assessment? Are there specific aspects of information quality or consistency in information/data flow that you find challenging to uphold?
   ii. Are there any particular segments, which trouble you the most during the risk assessment (e.g., warnings, cautions etc.)?
   iii. Do you think Safexpert tool is enough to assess the risks in an equipment? If not, can you please explain?
   iv. Is it difficult to create clear hazard descriptions/warning messages during the RA session?
   v. Have you experienced challenges to understand the hazard descriptions/warning messages written by others (e.g., referent project)? What were the reasons *(too short, wrong terms, too general etc.)*
   vi. What is used for visualization during risk assessment? (Drawings, 3d)
   vii. How do you decide when standard to be referred to as safety measure?

5. Training and Support:

   v. Have you received any training on using Safexpert or related to your role in the risk assessment?
   vi. If yes, was the training helpful? If not, what additional training and support would you like to have on it?
   vii. Is there any Manual supporting your role in risk assessment? Would it be useful (if no)

6. Expectations:

   i. What is your expectation from the Safexpert risk assessment sessions?

7. Suggestions for Improvement:

   i. Are there any specific features you believe Safexpert should incorporate or enhance this risk assessment process?
   ii. What could help to make risk assessment sessions more efficient?