

The safety advisor in 2036: what skills and knowledge will be needed to cope with the complex adaptative world of Industry 4.0

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List Of Abbreviations

AI – Artificial Intelligence

CPS - cyber-physical systems

DNA - Deoxyribonucleic acid

ETTO - efficiency and thoroughness trade-offs

FOD WASO – Federal Public Service Employment, Labour and Social Dialogue

I4.0 – industry 4.0

IRQ - interquartile range

ISO – International Standardisation Organisation

IT – Information Technology

KPIs - Key Performance Indicators

KU – Royal University

OH&S - Occupational Health And Safety

RAG - Resilience Assessment Grid

Q - Question

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Abstract

This thesis investigates the evolving role of safety professionals in the context of Industry 4.0, aiming to delineate the requisite skills and knowledge for effective practice in the year 2036. Through a comprehensive literature review and two rounds of Delphi method analysis, the study explores the transformative impact of technological advancements on the safety profession and the broader implications for occupational health and safety (OH&S) practices.

The core of the investigation centres on identifying current gaps in safety professionals' competencies and predicting future needs, particularly in an industrial landscape increasingly influenced by cyber-physical systems and smart technologies. The research hypothesises that the future safety professional will need a robust blend of technical, interpersonal, and strategic skills to navigate the complexities of Industry 4.0. The thesis articulates a future where safety professionals are not only compliance officers but also integral business partners who contribute to organisational resilience and innovation.

The methodology employed combines a review of existing literature with two rounds of Delphi studies involving safety professionals and industry leaders. This approach facilitates a forward-looking discussion that integrates diverse expert opinions on the future state of safety practice. Initial findings from the first Delphi round underscore a consensus on the increasing importance of system thinking, risk management capabilities, and proactive safety measures. Further insights from the second round reveal an expected shift towards greater emphasis on cross-functional collaboration, continuous learning, and adaptation skills.

This study contributes to the field by offering a visionary perspective on the role of safety professionals, emphasising the need for an updated educational framework that aligns with the technological, organisational, and environmental dynamics of Industry 4.0. The proposed educational reforms aim to enhance the strategic importance of safety professionals, preparing them to effectively manage both existing risks and emerging challenges.

In conclusion, the thesis advocates for a redefined role of safety professionals as proactive, integral components of organisational leadership teams, equipped with the skills to anticipate, respond, and adapt to the dynamic demands of a technologically advanced workplace. The findings are expected to inform both academic curricula and professional training programs, ultimately contributing to the development of a new generation of safety professionals who are well-prepared for the challenges and opportunities of the future industrial landscape.

Introduction

Raison d’Etre

The safety profession has been part of my life since I started working. At first, as a chemical operator in a refinery and later in a chemical plant, safety was the number one priority we were told. The field was dominated by engineers who have become safety professionals. This is a logical evolution as the primary focus of safety in the 80ies was technical measures (Pillay, 2015). The legislation around the safety professional training also doesn’t allow much room for innovation or interpretation (Belgian Welfare Codex; annexe II.4-3, II.4-4).

But when it comes to the practice of the safety professional, the legislation was published on the twelfth of May 2007, at this moment almost 18 years old. Knowing that it takes around five to ten years to publish a piece of legislation on safety in Belgium, the final thoughts of how the training should look, date to 2002, even possibly 1997. In 1997 cell phones were just phones with buttons that one could make a phone call with, now phones contain all our personal information, even providing access to certain parts of society during the COVID-19 pandemic. In 1997 Princess Diane died in France, Tiger Woods was the youngest player to win the Masters tournament and Deep Blue II defeated Kasparov in chess. In the past sixteen to twenty-six years, a lot has happened in the world. Looking at the example of Deep Blue II, the data input and the play were still conducted by a human, whilst in 2023 the finger of a Russian child was broken by a robot that autonomously plays multiple chess games at the same time.

Industry 4.0 (I4.0), “the fourth industrial revolution, in particular, has impacted the ecosystem of the industries where the focus is on developing cyber-physical systems (CPS). The ultimate goal of I4.0 is building “smart“ machines that can predict and take intelligent/smart decision(s)” (Rana & Rathore, 2022). Zorzenon, Lizarelli, & de A. Moura (2022) point out that four areas need further research to understand the influence of I4.0 on occupational health & safety: system, environment, work and oriented to an overview (such as training and legislative

structure). The last finding of the study poses the question if training and legislation can fulfil the needs of the future. The paper doesn't go into further detail but points out that this is an opportunity for further research.

The Research Question

The thesis question, what are the needs in terms of knowledge and skills for the safety professional operating in industry 4.0 in 2036, consists of four sub-questions that need to be addressed.

- How does the safety professional gain knowledge and skills?
- What does Industry 4.0 mean for the safety professional?
- What do employers, hierarchical lines and safety professionals perceive as a good safety practice?
- What does the safety professional training of the future look like?

The thesis's rationale is to better understand how I can be part of a safer occupational world for my children. In 2036 my son will turn twenty-three, about the age he will be done with university and start his professional career for the next 45 or more years. Will Industry 4.0 change much of the perception of safety? How will this revolution influence the safety professional in the future?

In 2015 the Federal Government for Work (FOD WASO) requested a study on the future of safety manager education (FOD WASO, 2015). The methodologies that were used in this study were focus groups and online questionnaires. The conclusions that were made, were that the next generation of safety managers should get a more practical approach to the theoretical parts, there is a need for more human-centred modules, a greater focus is needed on communication skills and lastly, there should be a more coherent way of training so different modules do not have the same topic. In other words, when one asks people what they need, they will ask for a faster horse.

The main question that arises, is whether there is even any need to change the current approach to safety professional education. At the Prenne 51 (network event by Prebes) in 2019, Jan Dillen administered a questionnaire consisting of eight topics on ‘new view’ safety. This questionnaire was filled in by the participants of the module *does the safety professional have sufficient knowledge?* Of the 70 participants, five didn’t have one question filled, and only three people were familiar with the Skill-Rule-Knowledge model of Rasmussen and as used by Reason (sic.). None of the participants were familiar with the notion of tight coupling of Perrow’s Normal Accident Theory (1984) (J. Dillen, personal communication, November 19, 2019). Of the participants, 65% considered a lack of knowledge of new developments by those who train safety professionals.

The question arises; why are theories from more than three decades old not addressed in the current curriculum of the safety professional? One explanation is that the safety professional is traditional (Hill, 2006), with the saying “If it is not broken, do not fix it”. Another explanation is that the regulatory body in Belgium makes it harder to adapt to new insights. Therefore this thesis will not focus on what is needed to change the system as such, but rather to describe the needs that safety professionals have today.

In the chapter Methodology: Delphi, the Delphi methodology is explained in regards to the theoretical background. The thesis concentrates on two Delphi rounds:

- the first Delphi round (see **Annexe Two – Questions Delphi Round One**) is a translation of the Agoria I4.0 questionnaire (Annexe One: Agoria Self-Scan),
- the second round (**Annexe Six – Questions Delphi Roun**) will dive deeper into the questions from round one that needed more research. In **Annexe Eight: Future State** there is a proposal to rebuild the education of the safety professional, based on the results of the Delphi rounds

Due to the nature of the research, the structure of the thesis foresees two sub-conclusions and an overall conclusion. The first sub-conclusion (**Findings from Delphi**

Round One) represents the conclusions of the first Delphi rounds. The second round of iteration is a direct result of the first Delphi round and rephrases the questions where the consensus between the participants wasn't met. The second round of conclusions can be found in the chapter **Findings Delphi Round Two**. In the chapter **Conclusion**, the end conclusion is made, reflecting on both Delphi rounds, reflecting the overall finding of the study.

Industry 4.0

Introduction

Lichtblau et al (2015) describe Industry 4.0 as the advantages where the internet and supporting technologies serve as a backbone to enhance physical objects and human actors to create a new intelligent, networked, and agile value chain. The Industry 4.0 framework is developed in Germany but has a slow start (Such et al, 2020), only around 4% of German manufacturers are actively engaged in Industry 4.0 projects. In Belgium, Essencia and Agoria are pioneering with different projects and seminars. Essencia is the umbrella organisation for the chemical and life science industry, whereas Agoria is the umbrella organisation for technological companies in the making industry.

Agoria has identified seven transformation points that are necessary to move to the factory of the future:

- Advanced Manufacturing Technologies
- Digital Factory
- Eco Factory
- End-to-end Customer Focussed Engineering (design for manufacturing)
- Human Centred Organisation
- Flexible/Smart Manufacturing
- Value Chain-Oriented Open Factory

Agoria has developed a self-scan that contains twenty-two questions divided under these seven transformation points. The self-scan (see Annexe One: Agoria Self-Scan) is used as the basis for the questionnaire in the first policy Delphi round one.

Effect Of Industry 4.0 On The Frontline Worker

For frontline workers, I4.0 can have a significant impact, and designers of animation (Jahormi & Ghazinoory, 2024) can benefit from artificial intelligence and big data. Kopening et al. (2024) point out that the connected, smart and highly efficient can benefit the full transparency for all the actors in the manufacturing cycle. In terms of deep learning technology being recognised as a benefit during the COVID-19 crisis (Sood et al., 2022), the results of this paper should continue to increase collaborations with emerging technologies. This can lead to improvements in 4D printing, machine learning and deep training.

The possibilities for the application of I4.0 are widely spread and will impact workers on all levels. Use of heads-up displays for maintenance workers, use of portable tablets that give operators the right information at the right time, even ensuring correct procedures are started in case of an emergency.

Effect Of Industry 4.0 On The Work Of The OH&S Professional

When it comes to process safety, Boogaerts & Toeter (2022), introduce a new approach in the one-year process safety master program in Leuven, Belgium. The master's program is based on what the industry needs today and what they expect process safety to be in the future. This is due to the nature of the organisation, KU Leuven works together with Essencia, the umbrella organisation of chemistry and life science in Belgium.

There is further international research: Blair (2004) used the Hooijberg & Quinn (Hooijberg & Quinn, 1992) framework to get an understanding of what competencies safety managers should embody for the future. Blair concluded that good communication, better coverage surrounding inadequate safety performance indicators and focus on business areas that are important to the safety professional are needed to improve the position of the safety manager. Blair also questioned the need for safety managers to be certified. Weimer (1996) concluded that “the academic training received by the safety professional concentrates on the basic safety principles in the field, and often overlooks the management skills needed to integrate

that knowledge into the company culture and to interact with peers and subordinates”. For the safety professional, safety on the sharp end, Flin et al. (2008) described safety needs from the practitioner's view from a more human factors approach. Flin et al argue that decision-making, fatigue management, leadership, managing stress and other interpersonal skills are needed to become a good safety person at the sharp end. More recent work by Provan (2018) and Van Wassenhove et al. (2022) described a hybrid method where the safety professional is seen as a mentor, coach and manager.

The question arises, why isn't the safety professional training including new models? The question is to be asked to the specialists, the safety professionals; what does good look like to you? What is needed to make your work successful?

Methodology: Delphi

The Delphi method, a structured communication technique aimed at achieving consensus among experts, emerged in the mid-20th century. Developed by RAND Corporation researchers Norman Dalkey and Olaf Helmer in the 1950s, it was initially employed for military purposes, specifically to forecast technological advancements and strategic trends during the Cold War.

Named after the ancient Greek oracle at Delphi, this method relied on a series of questionnaires or rounds of feedback. Experts have provided their opinions or predictions on a thesis topic, and these responses were aggregated and redistributed in a second round. Participants revised their responses based on the collective feedback and gradually converged towards a group consensus.

The research and method required great transparency of the goal of the thesis, as the idea was to ensure that there was open and honest feedback on the questions. The result will go to a government body to help the further education and development of the safety advisor. There was no commercial gain with this thesis for the participants or the author.

The premise of the thesis was to understand what the needs are of the safety advisor in I4.0. this will be the main topic of the questionnaires. Building the questionnaires, the gap between the current curriculum and the needs of I4.0 was investigated. These needs were researched in the literature to see if there were already ideas on how to tackle these needs. The literature was translated into questions that excluded the technical jargon as much as feasible. This required an in-depth understanding of the literature.

Delphi methodology

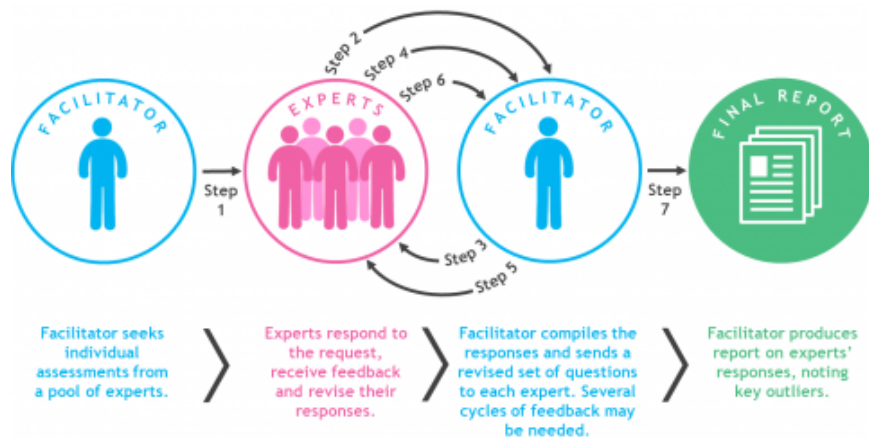
The research method that was used in this thesis, is the Delphi method (Franklin and Heart, 2007). The policy Delphi method was chosen because of the hybrid between qualitative and quantitative methods, which was suited to identify emergent and future issues (Franklin and

Heart, 2007). The policy Delphi method was used as an iterative process to collect data from different people with relevant knowledge. de Loë et al (2016) described the method as follows:

- A panel of knowledgeable people about an issue.
- Multi-round process: it takes two or more rounds to finalise.
- Responses from the initial round are synthesised and returned to the panel for evaluation, commonly with a rating system.
- Third and subsequent rounds refine the group's evaluation and open new lines of inquiry.

Figure 1

The Policy Delphi Method



Note. The policy Delphi method. From Delphi Method, University of Phoenix, n.d.

(<https://research.phoenix.edu/content/research-methodology-group/delphi-method>)

Research design – Delphi characteristics of the populations to be sampled

Two groups were targeted; one group of safety professionals and one group of employers. It was anticipated that both had different views on what the safety professional needs to look like in 2036.

Having both views helped to take a broader view of the topic, rather than exclusively a safety professional's view. The views from an operational point had different expectations of the worker, then the safety advisor.

The group representing employers were plant leaders, or leaders that come into close contact with the operational side of safety. The employers' group was a group that gave input on the strategic and operational levels.

The group of safety professionals was the largest as there were three areas of interest; the safety professional that is a manager spending less than 25% of his/her time on legal tasks, a second group of starting safety professionals with less than five years of experience and a third group, the more experienced safety professional without any management responsibilities. It was expected that the former group would also have needs for people management, whilst that is not the case in the latter groups.

The population was voluntary and was asked to participate by e-mail. The contact details will be provided by the participants after a LinkedIn post by the thesis author. The data collection was done by Microsoft Forms, a relatively easy way to create questionnaires and collect data. Once the data was gathered, the data was labelled to find the patterns.

Reflection during this phase was important as some bricks got lost in the cleaning phase that seemed irrelevant but appeared to hold the key in the end. Miles & Huberman (1994) gave a good overview of what can be encountered during the data management phase.

Data explication

Table 1

Different types of data collected

Type	How does it look
Raw data	Field notes, interview tapes, documents from the field
Partially analysed data	Interview transcripts, corrected and commented interview transcripts
Coded data	Coded interview transcripts
Coding scheme	For every phase, there is an adjusted coding scheme
Memo's	Reflections on the analyses of the data
Search functions	Specific searches to connect data
Data analyses scheme	Matrix of networks that give an overview of the analyses
Analyses history	Step-by-step overview of the process
Reports	Different phases and versions of the end report
Chronological log	Overview of the data collection and analyses
Index of above	The place where to keep all the overviews

The data was recompiled, as the whole was more than the sum of the different components. The archaeologist will look for the meaning of certain rooms and the usage of the discovered tools, in the thesis, the quest was more in terms of understanding why certain parts of the education stick, and why those parts were or were not useful for the future.

Another pitfall that needed to be considered, was confirmation bias, looking for patterns that the author would like to see in the result. To cope with this bias, two persons were asked to be thesis correctors. Although this was not a formal requirement or role, the two were experienced system safety practitioners. One person did the Lund program, and the other is a giant in the field of just culture and has a background in safety science. Although both were considered progressive safety practitioners, they were critical to the body of knowledge. The data that came from Delphi can be analysed in many ways: descriptive analyses, dissent analyses, sentiment analyses and scenario analyses (Beiderick et al., 2021).

Expected results from the Delphi round and analysis

The policy Delphi took the form of three main phases; preparing, conducting, and analysing (Beiderick et al., 2021). The data analysis was the last step of the process.

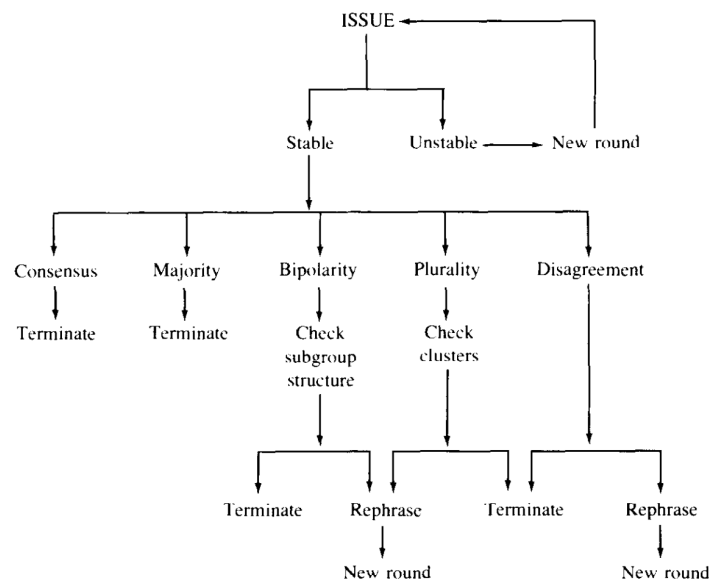
Policy Delphi is a hybrid method i.e. mixed method between quantitative and qualitative data (Franklin and Heart, 2007). The check for non-response bias, the Mann-Whitney-U method was used (Sheikh & Mattingly, 1981).

For the qualitative part of the analyses, the labelling was *whole sentences*, *phrases* and *catchwords*. The whole sentence indicated a high involvement in the study (Förster & von der Gracht, 2014). Beiderick et al. (2014) recommended to use of the arithmetic mean values and standard deviations for the statement-related dimensions and interquartile ranges to assess the consensus. As Project Delphi also highlighted the dissent voices in the discussion, it was also important to assess the desirability bias (Ecken, Gnatzy & von der Gracht, 2011).

Policy Delphi method would reach for consensus, but consensus needed to be defined. A 100% of the informants agreeing on 100% of the topics seemed to be an illusion. The interquartile range, the difference between quartiles one and three, should be lower than 50% to be an indicator of consensus (Birko, Dove & Özdemir, 2015). A bipolarity analysis was conducted on every set to see if there were groups with opposing views, this is when a split between two groups was almost equal (Dajani, Sincoff & Talley, 1979). When bipolarity was present, it prohibited consensus, the two groups with contrary opinions would not come to one answer. It was more valuable to study both groups separately and come to understand both visions.

Figure 2

Hierarchical stopping criteria for Delphi studies



Note. Hierarchical stopping criteria for Delphi studies. Dajani, Sincoff & Talley, 1979.

The expected results were to define what the needs are for the safety professional in 2036, at the level of knowledge, soft skills and practice. Provan (2018) connected the future of the safety professional to the model of guided adaptability: anticipation, readiness to respond, synchronisation and proactive learning. The same approach was used for the questionnaires, to be statistically relevant, 15 responses or more will be needed. The relevance was critically approached in the conclusions, although Mann-Whitney could be applied to small samples, the greater the sample, the more accurate.

How

The organisation of the research was done via an Excel spreadsheet that was made available to the thesis supervisor at Lund University. The research itself and the summaries of papers and books were not publicly available, these were used in the final report and thesis.

The questionnaire consisted of three different parts:

- a n state,
- a then state and

- open questions.

The now-and-then state has the same questions, in the first part, the participant was required to score a question on a scale from one to six on how the participant perceives where the domain is at this current moment in 2023. The same question was returned in part two where the participant was asked to score the relevance of this question for the profession in the future. How did the participant envision this question to be relevant in 2036? As a final part, there were open questions where the participant had free text to give their own opinion on the question, rather than only scoring the question.

Being fair in others' research is a core competence a master's student in human factors and system safety at Lund University should excel in. If one is unable to do so, one should ask him/herself the question of whether they are worthy of obtaining this degree.

Theoretical background derivation round one questions

Introduction

The first questionnaire is structured in line with the Agoria (umbrella organisation Belgian chemical and life science sector) self-scan (Annexe One: Agoria Self-Scan), this self-scan has seven core transformations (categories) that are needed to evolve into the factory of the future. Six of these core transformations have been used to shape the questionnaire's direction. Only the core transformation *eco-factory* has been replaced with the category *compliance* as compliance is one of the key competencies of the current safety professional according to the Belgian Welfare law.

Core Transformation One: Advanced Manufacturing Technologies

The core transformation defined by Agoria addresses three different topics:

- vision,
- capacity, and
- implementation level.

For vision, Agoria requires companies to have a clear investment policy that is in line with the strategic vision of the company. For capacity, Agoria requires companies to foresee that their employees are qualified to work with the technologies and for the implementation level the requirement is that maintenance strategy requires a high overall equipment effectiveness.

In terms of vision, an OH&S policy is required by the ISO 45001 standard but is not explicitly included in the dynamic risk management system in the legislation, although it is a logical result of the requirements in the basic requirements section of the welfare law (Belgian Codex, book I, Title 2) to have a policy statement.

An OH&S policy would benefit from the work of Rasmussen's gradient model (1997). This model echoes the different pressures that a socio-technical system can be influenced by. Rasmussen identified three influences: unsafe, unacceptable workload and economic failure. For

a system to be efficient, and economical, it must be safe and the workload needs to be feasible. Rasmussen identified that the experiments that are conducted to improve performance, create Brownian movements (Rasmussen, 1997). A drift to failure can arise when workers navigate towards production improvements by deviating from the work plan (Dekker, 2011). The goal conflicts that arise in this space led to Q1 (see **Annexe Two – Questions Delphi Round One**)

Capacity building for frontline workers is seen as crucial by Agoria in the factory of the future. For the OH&S professional, this is equally true. Koukoulaki (2010) warns that there is growing evidence that new technologies hurt the safety of frontline workers. The current legislation in Belgium is considered to be technically orientated, but there is a strong need to broaden this view (Provan et al., 2017 & Blair, 2004). Blair concluded that good communication, better coverage surrounding inadequate safety performance indicators and focus on business areas that are important to the safety professional are needed to improve the position of the safety manager. Provan et al. (2017) argued that four different categories influence the personal beliefs of the OH&S professional: safety beliefs, domain safety knowledge, knowledge worker skills, and risk understanding. The need to understand the latest insights of OH&S worldwide, technical and non-technical, led to Q2 (**Annexe Two – Questions Delphi Round One**)

Agoria identified a third category in advanced manufacturing technologies, high overall equipment effectiveness. This leads to the integration of new technologies and new risks at the workplace (Arana-Landin et al, 2023), resembling these factors in Q3 (see **Annexe Two – Questions Delphi Round One**).

Core Transformation Two: Digital Factory

Within the second core transformation, Agoria identified supporting infrastructures and digital capabilities as two main areas of improvement for the future. Supporting infrastructure includes a connected floor shop and cyber security. Digital capabilities include a transparent overview of real-time information, and digital capability to be a core part of the DNA of the company.

Creating operational intelligence is done via one of the principles of Hollnagel's resilience engineering (Hollnagel, 2016), where the double learning loop (Argyris & Schön, 1974) is a crucial part of the possibility of learning from daily work. There is a need to anticipate and foresee the necessary resources to be allocated. This led to Q4 of the questionnaire (see **Annexe Two – Questions Delphi Round One**).

Cyber-security is an IT topic, rather than it is an OH&S topic. Therefore, this topic is reframed to reliable safe operations. One of the difficulties for the OH&S professional is to help the management prioritise the resources towards the most important risks. The need for operational intelligence to determine these priority risks is fundamental to moving towards a safer world. In Q5 (see **Annexe Two – Questions Delphi Round One**), this topic is brought up.

There is a growing critique of the staggering bureaucracy of safety (Dekker, 2017) where safety compliance is not integrated into daily work, but rather an extra check that needs to be signed off. This safety bureaucracy is an eco-system of its own that lives outside the world of the frontline workers. The need to integrate safety into the work instead of on top of work has been echoed in multiple works (Hale & Borys, 2012, Hasle & Sørensen, 2011). There is a need to reconnect safety with daily work, integrating this work of safety with real-time information can lead to safe production first, rather than safety first.

In Q6 (see **Annexe Two – Questions Delphi Round One**) this topic is posed to the participants. Safi et al. (2022) researched the applicability of the Resilience Assessment Grid (RAG) in health care. They conclude that RAG brings tools to manage current and future challenges.

A part of the RAG resilience potential (Hollnagel, 2018), anticipates is to know what to expect, this comes as a result of monitoring (another RAG resilience potential) that is undertaken where work is occurring. One of the challenges is to digitalise the information of the monitoring phase and translate this into operational intelligence. Digitalising these monitoring programs is a big step towards gathering big data without creating double work. (Yeuk-Mui, 2011, Breit et al,

2020). The digitalisation of observation methods is discussed in Q7 of the questionnaire (see Annexe Two – Questions Delphi Round One).

Core Transformation Three: Compliance (In Agoria Self-Scan: Eco-Factory)

As the eco-factory is not directly linked with the work of the OH&S professional, an important part of the daily work is chosen as the fourth transformation. Environmental impact is not one of the domains within the welfare law, this is exclusively for environmental coordinators, a Flemish accreditation. Compliance with regulatory and internal rules is a core task of the OH&S department (Provan, 2017). Therefore, the topic of eco-factory is replaced by compliance.

As the Belgian regulation states that compliance with rules and procedures is a task of the hierarchical line, there is a need to integrate these rules and regulations into daily work. This requires the needed capability building towards a more knowledgeable workforce. Q8 of the questionnaire (see Annexe Two – Questions Delphi Round One) describes this state.

A second important part of the daily work of the OH&S professional is to act as a partner between the frontline workforce and management. A balance needs to be created between operational demands, learning and innovation. Q9 of the questionnaire (see Annexe Two – Questions Delphi Round One) questions how the OH&S professional is to be seen within the organisation.

Core Transformation Four: End-To-End Customer-Focused Engineering (Design For Manufacturing)

The Agoria self-scan includes in this core transformation a customer approach, where the customer is the drive towards the changes that need to take place at the factory. For an OH&S professional, the customers are internal stakeholders such as workers and management, and external stakeholders such as the inspectorate, and governmental and non-governmental organisations.

As the internal stakeholders are the customers of the OH&S professional, a need to serve arises from that relationship. An effective way to meet these needs is to base policy on

operational needs. Evolving with the needs of the operation by collecting day-to-day data and adjusting the policy where needed. The added value of the OH&S is to translate the data into intelligence (Wang et al, 2022). The OH&S professional is currently seen too much as a burden, rather than a partner of the stakeholders. Partly this is because OH&S has operated in a silo and prescribes rules rather than collaborating with the different stakeholders. Q10 and Q11 of the questionnaire (see [Annexe Two – Questions Delphi Round One](#)) discuss the need for partnership.

Another important part of the factory of the future is to be able to deliver quality in every stage of the production process, from development to customer information at the end of the process. Preventive and corrective actions are taken deliberately and serve as input for KPIs. Translating this to the OH&S world, this would be a meaningful monitoring plan where KPIs are built from big, rich and thick data. There is a sensitivity to operations (Weick & Sutcliff, 2007) instead of a focus on safety. Q12 of the questionnaire (see [Annexe Two – Questions Delphi Round One](#)) describes this need.

Core Transformation Five: Human-Centered Organisation

The core transformation human-centred organisation focuses on the employee individually, in a team and the influence of leadership and organisation. There is a strong emphasis on the experience and knowledge of the individual employee as well as the sharing of this information. Another topic is that autonomy is required to let workers flourish in what is perceived as continuous improvement. Leadership is seen as the key driver of the vision and strategy but with great flexibility towards change. The fourth pillar is open communication within the company which ensures information flow between all different levels.

Frontline workers have the operational knowledge of the way the systems they work in function. This knowledge can be transformed into intelligence, where the information is transferred to data that can help all levels make better decisions. It is up to the frontline supervisor to translate the intelligence into workable procedures. The safety department supports

the frontline supervisors in this process and creates a safer work environment for all workers. This process helps to create a more shared view of risk that is adjusted to new insights and thus creates the dynamic risk management system that is required by the law (Belgian Codex, Book 1, Title 2).

Autonomy, purpose and mastery are seen as the key drivers for workplace engagement (Deci & Ryan, 1991), it is important to involve different stakeholders in the process of creating new instructions, procedures or work methods. One of the possible options is to use a multi-disciplinary team, or tiger team, that combines shared knowledge (mastery) on a topic and lets that team work on a better way to make processes, such as permit-to-work, work in practice in the way they perceive as improving (autonomy). The result of this tiger team is widely supported in the organisation as stakeholders work actively to improve their work conditions (purpose). Introducing tiger teams can be beneficial to increase the impact of new ideas.

Safety is seen as a bottom-up accountability, rather than a top-down responsibility (Dekker, 2018, p.71). To improve this perception, the Belgian law foresaw that the hierarchical line is to be responsible for giving input on the dynamic risk management system. A yearly action plan is part of this management system and is often done by the safety department. To ensure that the hierarchical line is meeting its responsibilities and presenting leadership, conversations on the topic of safety and risk are to be facilitated by all employees. The input for the dynamic risk management system that is adapting to the daily needs of the workers must come from where the intelligence is created.

To facilitate information flowing through the organisation, a culture of speaking up must be created. That culture is fostered by many tools such as a just culture. A balance between patient safety and the analyses of human error in combination with the use of engineering controls, is beneficial for both parties (Boysen, 2013). An emergent property of systems, the whole is more than the sum of the pieces, is another complex issue that arose in the last decades. Automated systems, while designed with precision, can sometimes manifest unexpected

behaviours due to complex interactions between various components. This unpredictability can compromise both occupational safety, as workers interact with automated machinery, and process safety, as automated processes may lead to unforeseen hazards or accidents Becker et al. (2014, p.7). Questions 13-16 (see **Annexe Two – Questions Delphi Round One**) are posed to bring the view of the practitioners on these subjects

Core Transformation Six: Flexible/Smart Manufacturing

The core transformation 6: flexible/smart manufacturing by Agoria is focused on smarter interactions between humans and machines. The focus of Agoria is on the productivity of the interaction, where maximum efficiency is key. The second spearpoint is to ensure batches are produced within the specs from the first time, integrating quality and process control systems into the manufacturing lines.

To increase smart manufacturing, human-machine interactions must be considered to meet another legal requirement, adjusting the workplace to the person (Belgian Codex), which is the basis of the Welfare law and is integrated into every part of it. Efficiency and productivity can benefit from identifying the risks and mitigating controls before starting work (Mushara et al, 2021). Also, debriefing moments can help the company identify the right controls after work has been done.

Flexible and smart manufacturing will introduce more interactions between different parts of the system. These interactions will lead to tighter coupling and increasing complexity. The danger is that operator error is seen as causal, whilst operators may be confronted with impossible tasks or tasks that go above cognitive comprehension due to the complexity. To understand why actions make sense, an investigation must focus more on learning, pre- and post-mortem. The notion of a learning review (Pupulidy, 2015) is a new tool in the box of the workers. This section is translated into questions 17-19 in **Annexe Two – Questions Delphi Round One**.

Core Transformation Seven: Value Chain-Oriented Open Factory

The open factory of Agoria is built around smart networks inside and outside the factory. This environment thrives on innovation with continuous improvement. The networking must lead to the connection between internal and external knowledge. This networking is actively and deliberately, unfolding an issue deep within companies; silo-thinking between different companies and within the company itself leads to lesser intelligence.

The more insight on intelligence that is received, the better the company can protect itself against error and failure. The company therefore can invest in operational resilience that makes a difference for the frontline worker. The more knowledge is created, the more intelligent a company becomes, this does mean that silos are to be destructed and that resilience is to become part of every level of the company.

There is a strong need to connect with other stakeholders to solve the complex problems that companies face today. The need to involve external stakeholders such as interest groups becomes more important as they influence operation licenses. The umbrella organisations such as Agoria and Essencia facilitate workgroups that help to tackle more complex problems. These workgroups are limited in time and resources, missing an opportunity to innovate faster together. The involvement of universities can lead to better framing of questions and increase views on certain topics. At the moment there is little to no involvement of universities in the safety field besides the internships that are included in the master's and bachelor's degrees. Scientific work in companies or strong connections with universities are non-existent. The core transformation 7: Value Chain Oriented Open Factory led to questions 19 to 21 in **Annexe Two – Questions Delphi Round One**

Delphi Round One

Introduction

The results of the first Delphi round can be found in Annexe Three – Results Delphi Round One. The detailed analysis includes the use of IRQ (interquartile range) values within the different experience levels as well as overall. The questions were asked in two repetitions: in the first repetition the question was answered about how the situation is today in 2023, and the second time the question was asked about how far this is to be included in the ideal state of 2036.

Findings from Delphi Round One

General (Q1 – Q3)

The first cluster of the questionnaire assesses the readiness of safety professionals for Industry 4.0 across different levels of experience, from Junior to Senior. In general, readiness appears consistent among all levels, with a slight increase from Junior to Medior professionals. Analysis of data clustering indicates that scores are closely grouped around the median for each experience group, demonstrating agreement among participants about their readiness.

The variability in scores is low across all levels, suggesting uniformity in the respondents' assessments. Overall, the study concludes that safety professionals show a moderate level of readiness for Industry 4.0, improving slightly with more experience. Both the close clustering of scores and low variability highlight a shared understanding or perception of readiness among the professionals. The survey also examines the adequacy of current risk assessment models in the context of automation and human-robot interactions. Generally, there is a moderately positive sentiment towards the current models, especially among Senior professionals who show a more favourable view compared to their Junior and Medior counterparts. This section also notes that while consensus exists, there is a noticeable diversity of views among Medior and Senior levels.

Regarding the role of safety professionals as business partners, the prevailing opinion supports this transition, particularly among Medior and Senior professionals. This suggests a

strong endorsement for the business partner role at higher experience levels, whereas opinions vary more widely among Junior professionals, indicating diverse perspectives within this group.

Core Transformation One: Advanced Manufacturing Technologies (Q4-Q6)

The analysis of future-oriented Occupational Health and Safety (OH&S) policies highlights a consensus on the need for a balanced approach between regular tasks and overall effectiveness. Currently, this balance is undervalued, indicating significant potential for policy enhancement. A comparison of the ideal and actual states of OH&S policies shows a gap in aligning perceptions with aspirations, particularly in multi-disciplinary learning across fields like sociology and technology. Although there's a recognised need for the practical application of this knowledge, current practices do not prioritise such learning sufficiently.

Senior OH&S professionals display a wider range of opinions compared to their junior and medior colleagues, suggesting substantial variability in perceptions across experience levels. This variability underscores the diverse perspectives within each professional tier. The study also notes a crucial need for improved anticipation of risks and future scenarios, particularly in response to new technologies. Current risk evaluation practices are seen as inadequate, with a call to elevate their importance in OH&S policies. Despite these challenges, junior professionals exhibit a more optimistic view of the current state than their more experienced counterparts, reflecting diverse viewpoints even among those at similar professional levels.

Core Transformation Two: Digital Factory (Q7-Q9)

Safety is envisioned as a crucial part of standard work procedures in the future, but currently, it does not receive the necessary priority. There is a significant variation in safety practices, particularly among medior and senior professionals, which may be due to different industry backgrounds. This variation is highlighted by a wide range of opinions on working methods among these more experienced groups.

A comparative analysis between the desired and current states of safety integration shows a considerable gap, especially in high-risk environments. Junior professionals tend to view the

current state more favourably than their medior and senior counterparts. This disparity across experience levels suggests diverse perspectives within the field.

There's a clear discrepancy in the allocation of resources for risk reduction, with current priorities not aligning with future needs for reliable and safe operations. A closer look at the data reveals a significant perception gap in resource allocation for reducing risks.

Despite the importance of digital tools in enhancing safety measures, their prioritisation remains low across all professional levels. Both current and future perspectives on the digitalisation of safety processes do not match the envisioned importance, with junior professionals again showing a more positive outlook compared to their peers. The variability in views within each experience level highlights the range of opinions on digitalisation in the safety profession.

Core Transformation Three: Compliance (Q10-Q11)

Compliance is recognised as a priority for both the future and current states of the safety profession, and safety professionals strongly identify with the term "compliance." This alignment is attributed to the emphasis on compliance in current courses and the social identity of safety professionals. There is a widespread consensus on the significance of compliance across different professional groups.

However, when comparing the future state with the current state, a noticeable gap in the perception of compliance integration and competence building for safety professionals is identified. Junior professionals express a more positive perception of the current state in contrast to their medior and senior counterparts. The variability in perceptions within each experience level indicates diverse perspectives on this topic.

The perception of the partnership between the safety professional and the workforce varies significantly between the junior group and the medior/senior group. Junior professionals tend not to prioritise relationships with other actors, while those with more experience strongly

feel the need to act as partners. The comparison between the future state and the current state indicates a notable gap in the perception of safety professionals functioning as partners.

Moreover, junior professionals express a more positive perception of the current state in contrast to their medior and senior counterparts. The variability in perceptions within each experience level highlights diverse perspectives, indicating that individual experiences shape these views.

Core Transformation Four: End-to-end Customer Focused Engineering (Q12-Q14)

The assessment of the importance of frontline data reveals a moderate priority currently and in the future, suggesting no immediate urgency to prioritise this aspect. However, a notable distinction in responses among different experience levels underscores a lack of unanimous agreement, particularly between medior and senior professionals compared to juniors. This variance highlights the need for ongoing discussions and efforts to build consensus on the significance of frontline data within the organisation.

During core transformations, the acknowledgement of the Occupational Health and Safety (OH&S) department as a partner is emphasised, envisioned to integrate more closely with day-to-day work and various projects in the future. Yet, the current state shows a misalignment, as partnerships within the organisation are not seen as a priority, indicating a significant perception gap.

Furthermore, there is a clear intent to prioritise Key Performance Indicators (KPIs) in the future, driven by dissatisfaction with current KPI utilisation, which encompasses data from diverse sources. Disagreements across different groups may indicate unclear survey questions, pointing to significant gaps in perceptions regarding monitoring plans and data collection processes. Junior professionals, in contrast to their medior and senior counterparts, have a more positive view of the current situation. The variability in views within each experience level emphasises the diversity of perspectives on these issues.

Core Transformation Five: Human-Centered Organisation (Q15-Q18)

Future projections anticipate a transformative shift in the role of frontline workers, who are expected to become the primary source of intelligence. This evolution sees safety professionals increasingly facilitating and supporting operational workers to gather relevant data, with human interaction playing a crucial role in their responsibilities. Currently, there is a consensus among respondents indicating a lack of recognition for frontline workers as a valuable intelligence source.

There is a significant perceived gap between the current and future roles of frontline workers in operational intelligence. Notably, junior professionals view the current state more positively than their medior and senior counterparts, highlighting diverse perspectives across experience levels that call for a deeper understanding of the changing dynamics between safety professionals and frontline workers.

Regarding Tiger Teams used for risk management, characterised as skilled groups collaboratively addressing challenges, there's limited favourability in their current perception. Additionally, a lack of familiarity with the term "tiger team" in personal correspondences suggests potential misunderstandings about their role, contributing to ambiguity about their future utilisation.

The concept of safety as a moral responsibility is widely recognised among future-oriented safety professionals as applicable to all organisational stakeholders. However, current perceptions vary significantly, potentially reflecting differences across companies and countries. There's a notable gap in the commitment to viewing safety as a moral responsibility, with junior professionals again showing a more favourable view of the current state compared to their peers.

The importance of a culture that encourages open communication to fulfil ethical obligations is acknowledged. Yet, there exists a disparity in integrating a speaking-up culture within safety practices today. This gap highlights the need for a more unified approach to foster

an open communication culture across the safety sector, emphasising the importance of articulating diverse perspectives to ensure robust safety practices.

Core Transformation Six: Flexible/Smart Manufacturing (Q19-Q20)

Participants unanimously agree that operational learning is a key aspect of the future role of safety professionals, with consistent recognition across junior, medior, and senior levels. Despite slight variations, the importance of operational learning is universally acknowledged, though the lower average scores in the current context highlight areas needing improvement and further exploration to boost the effectiveness of these initiatives.

The comparison between current and future perceptions reveals a significant gap in how operational learning and machine interaction are viewed, with junior professionals showing a more positive outlook than their medior and senior peers. This indicates diverse perspectives within each experience level.

Regarding the coupling and interaction between components, the assessment shows a moderate perception of its importance in the future role of safety professionals. The data reflects a broad range of views, especially highlighted by the diversity in the first and third quartile scores, suggesting varying levels of emphasis on this aspect. The current state of component interaction is perceived as inadequate, with the broader range of opinions and lower average scores indicating a need for enhanced focus on effective coupling and interaction strategies.

In summary, these insights emphasise the diverse and nuanced perspectives on the crucial aspects of coupling and operational learning, highlighting the need for targeted improvements to foster better integration and collaboration in the safety profession.

Core Transformation Seven: Value Chain-Oriented Open Factory (Q21-Q23)

The future outlook for coupling and interaction within the organisation is optimistic, with anticipated enhancements in operational learning, collaboration, and interaction quality. Stakeholders are expected to adopt a more holistic and timely approach to sense-making. To maintain a balanced and consistent approach, it's crucial to monitor and manage the increasing

variability in responses across all experience levels. Currently, the understanding of coupling and interaction shows variation among stakeholders at different experience levels, with an overall moderate proficiency but noticeable differences among junior, medior, and senior members.

The organisation's focus on initiatives that boost resilience has led to notable improvements in workforce performance across all levels, enhancing innovation and adaptability. This strategic commitment not only reduces the impact of failures but also positions the organisation for continued success in a dynamic business environment.

Investment in knowledge from both internal and external sources has significantly improved the desired state compared to the current state. By fostering collaboration across departments and engaging with external partners to address complex issues, the organisation has transformed positively. The desired state metrics reveal a workforce that is adept at managing complex issues and integrating diverse knowledge sources, ensuring adaptability and promoting innovation. This proactive approach strategically prepares the organisation for ongoing success in a competitive landscape.

Open Question One: What Is Safety?

In exploring the complex concept of safety, it becomes evident that it transcends the mere absence of accidents. Safety is deeply ingrained in the ethos of organisations and individuals, evolving as a dynamic process that integrates seamlessly into daily routines. It's not merely a set of regulations but a core organisational value that shapes the way work is conducted, emphasising operational control, continuous learning, and improvement.

The significance of safety is universally recognised across different levels of experience within the workplace, viewed not just as an outcome but as a continuous journey. It involves sound operational competence fostered by proper hiring, onboarding, and front-line management's active role in setting expectations. Technological advancements, especially the integration of AI, further enhance safety measures by reducing human error, showcasing the evolving nature of safety practices.

From an individual perspective, safety is about being free from harm and ensuring both physical and psychological well-being. It is a fundamental human need and plays a crucial role in maintaining a secure society. Safety is also seen as a shared responsibility within a company, not confined to specific departments but involving continuous collective effort towards improvement.

The multifaceted nature of safety is highlighted by its proactive approach—preparing for, responding to, and adapting to changes and potential risks. It requires managing performance variability, assessing risks, and fostering an organisational culture conducive to safety. As systems become more digitised, transparency in operations and safety outcomes becomes critical, underscoring the need for continuous qualitative improvement.

Ultimately, safety is a complex, emergent property of organisational dynamics, integral to operational efficiency and effectiveness. It demands a comprehensive understanding and a commitment to continuous improvement, ensuring the well-being of everyone involved in the organisational framework.

Open Question Two: What Is Resilience?

Exploring resilience reveals diverse perspectives on its dynamic nature, highlighting that it can be developed through challenges. Resilience in business is about maintaining operations despite adversity, involving detection, adaptation, learning, and anchoring lessons into everyday business practices. It focuses on learning from incidents and adapting rather than merely avoiding them. Communication is crucial in building resilience, with the safety department playing a key role in disseminating information and fostering resilience through education. This highlights the link between communication, education, and resilience in fostering a strong safety culture.

Resilience also involves reliably performing under various conditions, anticipating, monitoring, and adapting to manage variability for reliable outcomes. On an individual level, resilience is about bouncing back and maintaining stability through adversity, emphasising the

personal capacity to overcome obstacles. Organisationally, resilience is seen as self-sufficiency and adaptability, crucial for minimising damage and restarting operations independently when unexpected events occur. This includes adjusting behaviours to current circumstances and maintaining safety. Beyond recovery, resilience involves proactive capacity building and creating robust safeguards, emphasising a holistic approach that not only reacts to challenges but also prepares and strengthens systems in advance.

Woods' four views on resilience—anticipation, response, recovery, and learning—offer a framework for understanding and enhancing resilience. While some perspectives may critique resilience for potentially hindering teamwork, the overarching view is that resilience is essential for adapting to and recovering from challenges, emphasising quick, wise action in unexpected situations.

In summary, resilience is a complex, multifaceted concept involving proactive measures, adaptability, and continuous improvement. Whether at an individual or organisational level, it is a dynamic quality that evolves through experience and a commitment to learning and adaptability.

Delphi Round Two

Introduction

After Delphi round one was completed and analysed, questions arose from the answers of the respondents. The questions for round two are connected to a question from round one, to ensure the questions were clear enough, some questions from round one resulted in two or more questions in round two. Feedback from the respondents made clear that some questions contained multiple statements that could lead to different answers. The goal of round two is to simplify and dig deeper into the challenges of the safety professional. The approach of the questionnaire is as in round one, except this round will not have open questions.

Questions For Round Two

Round one question seven (and 27) OH&S policy should balance the goal conflicts between people, growth and operations. The policy should be based on normal work and envision making work more successful. This question came back with a clear demand for the future state, but for the current state, the answers were scattered.

Separating the part of goal conflicts needed to be done in terms of making this topic have its results. Research on goal conflict (Presseau et al, 2011) and prioritisation to avoid these goal conflicts (Freund & Tomasik, 2021) showed that there are ways to name goal conflicts in the workplace safely and potentially solve them. This results in questions 44 (and 62): The OH&S professional should be mindful of the different goal conflicts between time and resources on the one side and safety and human reliability on the other hand. The second question that arose from the result of question seven of round one was question 45 (and 63): The OH&S professional should be part of the work preparation to educate frontline supervisors and workers on the trade-offs between efficiency and thoroughness. (ETTO). Here the ETTO principle of Erik Hollnagel (2009), where the discussion is made between operations, time pressure and safety. Having these conversations before the work starts can have a significant impact on the work itself.

Round one, question nine (and 29), “the safety department is continually looking at risks and anticipating future operational scenarios to strengthen the resilience within the organisation.” Had a high future state potential, but was in the current state very scattered. This required more analyses and brought two new questions. Risk assessment is to be done with the involvement of operational parties. The future OH&S professional’s task is to coach and understand the complexity of these tasks (questions 46 and 64). The second question goes further on the risk assessment, as this is a cornerstone of the Belgian Welfare legislation. Risk assessments should recognise that frontline workers will make decisions based on their expertise and experience and recognise that most situations show incomplete, dynamically changing conditions and competing goal structures (questions 47 and 65). Risk assessments should begin by observing the work and understanding how work is done. With that understanding a mutual decision can be made to make a risk assessment that describes the work, rather than the theoretical view of the work.

Question ten (and 30), “safety is an integrated part of the working methods. The feedback loop is closed by debriefings of high-risk work” gave a less positive perception in the current state, whilst in the future state, this was a clear positive perception. This led to four new questions. Risk assessments should begin by observing the work and understanding how work is done. With that understanding a mutual decision can be made to make a risk assessment that describes the work, rather than the theoretical view of the work. (questions 48 and 66). A job safety analysis is not a separate document, but safety and environmental concerns are integrated into the standard operating procedures. These standard operating procedures are a result of the work of multiple stakeholders.. (questions 49 and 67). After a task, routine or non-routine, is done there is a discussion (feedback loop) where frontline workers give input on what did work as planned, what deviated from the plan and where workers were surprised. This intelligence is used to create lessons learned and to optimise the standard operating procedures. (questions 50 and 68) and as the fourth question; Workers are to be given time to conduct a last-eight-minute

meeting after a task where they can evaluate how the work went. This last-eight-minute meeting is facilitated by operations and OH&S professionals (questions 51 and 69).

Question eleven (and 31) “the organisation invests in risk reduction by allocating resources to create operational intelligence” gave a scattered future state. After contacting respondents, they addressed that this question was not specific enough to make a clear statement. Therefore this question was reframed into a new question. The operational plan has to foresee time for pre- and post-mortems. Discussions should focus on how workers can be safe and productive. The pre- and post-mortem discussions are a tool to educate the entire workforce, from managers to frontline workers. (questions 52 and 70).

Question thirteen (and 33). Safety professionals ensure that compliance (legal and group) is an integrated part of the day-to-day work. There is competence building on every level with the integration of the day-to-day data. Gave a high future state, but a scattered current state. This needed to be clarified in depth, as the concept of competence building wasn't sufficiently addressed. Competence building has to differentiate between education of skill and education of knowledge. The education of knowledge can be done by slideshows and e-learning, whilst the education of skills is to be done in on-the-job training or workshops (questions 53 and 71). A second question; Education of the workforce should include the latest insights of regulations, company requirements and technological trends. Therefore, education is to be updated regularly with input from the workforce (questions 54 and 72).

Question fourteen (and 34) looked at the safety professional as a function within the company. As there are many differences in the job itself, it was not surprising that the answers were scattered. Therefore it was needed to separate the question into three different statements that could be scored. The OH&S professional has to invest in the relationships with frontline workers. This can be done by appointing OH&S champions at the frontline who are coached diligently and understand how human performance works to gather better intelligence from work as done (questions 55 and 73).

Question sixteen (and 36) was also around how the position of a safety department can be within a company. The OH&S department is a partner in the company, understanding the challenges of those who do the day-to-day work. Safety is integrated from start to finish in projects as in daily work. Here the current state was negative, whilst the answers for the future state were scattered. This required a reformulation of the question, more focused on leadership: The OH&S professional's main task within the leadership team is to communicate the intelligence from the workforce together with the operational managers (questions 56 and 74)

Question nineteen (and 39) of the first round were around multi-disciplinary teams (tiger teams). Tiger teams are created to develop new methods of risk management and operational learning. These tiger teams are multi-disciplinary and exist out of the most knowledgeable persons on the subject with a high understanding of the complexity and operational challenges. Here the term tiger team wasn't known by everybody which led to a possible misinterpretation of the question. The question therefore was separated into three different questions: Frontline workers and OH&S professionals are included in the design of new equipment to ensure that the gap between work as done and work as imagined is identified in the early stage of a project. The OH&S professional acts as a bridge between the project team and the frontline (questions 57 and 75). Cross-functional teams (operations, maintenance, OH&S, finance, project,...) are assembled every time some projects impact the organisation on multiple levels. Projects such as permit-to-work can benefit from operational knowledge and the understanding of how contracts with subcontractors are set up to have a realistic ask (questions 58 and 76). Risk assessment techniques are tailored to the needs of the work. Rather than making an arbitrary choice on risk ranking, the focus is on how the work is done and interconnected with other steps in the process. (questions 59 and 77).

Question seventeen (and 37) from round one were two questions in one line, making the responses not accurate. Safety is seen as a moral responsibility for all actors, the OH&S plan adapts to the needs of this responsibility in collaboration with all levels within the enterprise. All

workers are expected to provide ideas that lead to a better workplace. This question was separated into two different questions: The OH&S plan should not be a separate yearly safety plan of the OH&S department but is a collective document to improve the company where OH&S is part of every department's plan. The OH&S plan should be the improvement plan of the OH&S department as a part of the company improvement plan (question 60 and 78) and final question (61 and 79): Safety is seen as a responsibility towards all employees and not as an obligation of these employees.

Results Delphi Round Two

The results of the second Delphi Round can be found in Annexe Seven – Results Delphi Round

Findings Delphi Round Two

The OH&S professional should be mindful of the different goal conflicts between time and resources on the one side and safety and human reliability on the other hand. There is a notable enhancement in both Q1 and Q3 metrics across all levels in the future state. This suggests that the OH&S professional is anticipated to achieve higher scores in addressing goal conflicts related to time, resources, safety, and human reliability. The IRQ values exhibit variations, with an increase for Junior and Senior levels in the future state. This indicates a potential shift in the distribution of data and a broader range of responses to goal conflicts. Standard deviation and average values display nuanced changes. While the standard deviation values show consistency in Junior and Senior levels, there is a notable decrease for the Medior level in the future state. The average scores, particularly for Junior and Senior levels, demonstrate improvements, suggesting a positive trend in overall performance. Overall, the future state implies positive advancements in the OH&S professional's ability to navigate goal conflicts, emphasising a potential strengthening of safety and human reliability considerations. These conclusions highlight the anticipated growth and effectiveness of the OH&S professional in managing occupational health and safety challenges in the coming period.

For the statement OH&S professional involved in work preparation and educating frontline supervisors and workers on trade-offs between efficiency and thoroughness, the following findings emerge: in the future state, there is a significant improvement in both Q1 and Q3 metrics across all levels. This suggests an increased effectiveness in educating frontline supervisors and workers, emphasising a better understanding of the trade-offs between efficiency and thoroughness. The IRQ values show a remarkable reduction, particularly in the Junior and Senior levels. This indicates a more consistent response to the challenges posed by goal conflicts,

potentially leading to a clearer understanding of the balance between efficiency and thoroughness. The standard deviation values demonstrate a notable decrease for all levels in the future state. This reduction suggests a more standardised approach to addressing trade-offs. Additionally, the average scores exhibit improvements across Junior, Medior, and Senior levels, signifying an overall advancement in the OH&S professional's capacity to educate and guide others in work preparation.

The future state portrays a positive trajectory for the OH&S professional's role in work preparation and education regarding trade-offs. The improvements in Q1 and Q3 metrics, the substantial reduction in IRQ, and the decrease in standard deviation collectively indicate a more effective and consistent approach to balancing efficiency and thoroughness within the workforce. This suggests a strengthened position for the OH&S professional in contributing to occupational health and safety considerations within the organisation.

In matters of the OH&S professional's task of coaching and understanding the complexity of risk assessments involving operational parties, the future state reveals substantial advancements in both Q1 and Q3 metrics across all levels, indicating an increased proficiency in coaching and understanding the complexity of risk assessments. The OH&S professional is expected to guide operational parties more effectively, ensuring a comprehensive grasp of the tasks at hand. The IRQ values demonstrate a noteworthy decrease for Junior and Senior levels in the future state. This implies a more consistent and aligned understanding among operational parties regarding the complexity of risk assessments, facilitated by the coaching efforts of the OH&S professional. There is a reduction in standard deviation values for Medior and Senior levels in the future state. This signifies a more standardised and less variable approach to risk assessments. Additionally, the average scores show improvements across all levels, reflecting an overall enhanced ability of the OH&S professional to coach and navigate the complexities associated with risk assessments.

The future state indicates a positive transformation in the OH&S professional's role, particularly in coaching operational parties and fostering a deeper understanding of risk assessments. The improvements in Q1 and Q3 metrics, the significant decrease in IRQ, and the reduction in standard deviation collectively suggest a more streamlined and effective process for managing risk, showcasing the OH&S professional's evolving impact in enhancing safety within the organisation.

Examining the future and current states of risk assessments concerning the acknowledgement that frontline workers base decisions on expertise and experience, recognising incomplete and dynamically changing conditions, the future state reveals an improvement in Q1 and Q3 metrics across all levels, indicating an increased recognition of frontline workers' expertise. The OH&S professional is anticipated to better acknowledge and incorporate the decision-making expertise of frontline workers into risk assessments. The IRQ values remain relatively stable, suggesting that the future state maintains a balanced recognition of dynamically changing conditions. The OH&S professional's approach aligns with the understanding that most situations present incomplete and evolving scenarios, emphasising adaptability in risk assessments. The standard deviation values exhibit consistency, showcasing a stable approach to recognising incomplete and dynamically changing conditions. Additionally, the average scores improve across all levels in the future state, indicating an overall strengthened ability of the OH&S professional to navigate and assess risks in varying and uncertain circumstances.

The future state reflects a positive evolution in risk assessment practices, emphasising a heightened recognition of frontline workers' expertise and a consistent approach to dynamically changing conditions. The improvements in Q1 and Q3 metrics, coupled with stable IRQ and standard deviation values, underscore the OH&S professional's commitment to adaptability and expertise in managing risks within an environment of incomplete and evolving conditions. This suggests a more robust and effective risk assessment framework in the future state.

Examining the future and current states of risk assessments, with an emphasis on initiating the process by observing work and understanding how work is done, the future state demonstrates a substantial enhancement in Q1 and Q3 metrics across all experience levels. This suggests notable progress in the ability of OH&S professionals to observe and comprehend work processes, facilitating a more comprehensive and informed risk assessment. The IRQ values show a consistent and balanced approach in the mutual decision-making process for risk assessments. This implies that, in the future state, OH&S professionals at various levels are likely to collaborate effectively, leading to a shared understanding and agreement on the description of work conditions. The standard deviation values indicate a reduction in variability among experience levels in the future state. This signifies a more standardised and consistent approach to risk assessments. Additionally, the average scores demonstrate improvements across all levels, suggesting an overall increase in the effectiveness of describing and understanding work conditions.

The future state reflects a positive transformation in the initiation of risk assessments by prioritising the observation and understanding of work processes. The improvements in Q1 and Q3 metrics, coupled with harmonious mutual decision-making and reduced variability in standard deviation, highlight a collaborative and standardised approach among Junior, Medior, and Senior OH&S professionals. This approach is anticipated to lead to more accurate and comprehensive risk assessments, fostering a safer work environment.

The future and current states of integrating safety and environmental concerns into standard operating procedures, rather than having a separate job safety analysis document, the future state demonstrate a significant advancement in Q1 and Q3 metrics across all experience levels. This indicates a notable enhancement in the integration of safety and environmental concerns into standard operating procedures. The OH&S professionals are expected to play a pivotal role in ensuring a thorough incorporation of these concerns into the daily work routines. The IRQ values show a considerable decrease, suggesting a more consistent approach to

integrating safety and environmental concerns into standard operating procedures in the future state. This reduction in variability emphasises a shared understanding among Junior, Medior, and Senior professionals regarding the importance of safety and environmental considerations. The standard deviation values indicate a decrease in variability among experience levels in the future state. This implies a more standardised and consistent implementation of safety and environmental considerations into standard operating procedures. Moreover, the average scores demonstrate improvements across all levels, reflecting an overall increase in the effectiveness of integrating safety measures into routine work practices.

The future state suggests a positive shift towards a more integrated and standardised approach to safety and environmental concerns within standard operating procedures. The improvements in Q1 and Q3 metrics, coupled with decreased variability in IRQ values and standard deviation, underscore a collaborative effort among Junior, Medior, and Senior OH&S professionals. This collaborative approach is expected to contribute to a safer and more environmentally conscious work environment.

In the feedback loop where frontline workers provide input after completing tasks, routines, or non-routines, the future state reveals a significant improvement in both Q1 and Q3 metrics across all experience levels. This suggests that, in the future, frontline workers are expected to provide more constructive input on what worked as planned, what deviated, and instances of surprise. The higher scores indicate a more comprehensive understanding of task outcomes. The IRQ values show a consistent decrease in the future state, indicating a reduction in variability among responses from Junior, Medior, and Senior workers. This suggests a more standardised and aligned approach in the feedback provided, leading to a clearer understanding of areas that need improvement or optimisation. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. This signifies a more uniform and consistent input from frontline workers. The average scores also show

improvements across all levels, reflecting an overall enhancement in the effectiveness of the feedback loop in gathering valuable insights.

The future state points toward a more refined and effective feedback loop, with frontline workers providing more detailed input after task completion. The improvements in Q1 and Q3 metrics, along with decreased variability in IRQ values and standard deviation, indicate a collaborative effort among Junior, Medior, and Senior workers to contribute valuable insights for creating lessons learned and optimising standard operating procedures. This suggests a positive evolution in the organisational learning process and continuous improvement culture.

In the last-eight-minute meeting, where workers evaluate how the work went, facilitated by operations and OH&S professionals, the future state demonstrates a substantial enhancement in both Q1 and Q3 metrics across all experience levels. This suggests that, in the future, workers are expected to provide more insightful evaluations of the work conducted during the last-eight-minute meeting. The higher scores indicate a more detailed and comprehensive understanding of task outcomes. The IRQ values show a consistent decrease in the future state, indicating a reduction in variability among responses from Junior, Medior, and Senior workers. This suggests a more standardised and aligned approach in the evaluations provided during the last-eight-minute meeting, leading to a clearer understanding of work performance. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. This signifies a more uniform and consistent evaluation process during the last eight-minute meeting. The average scores also show improvements across all levels, reflecting an overall enhancement in the effectiveness of the evaluation conducted in this brief meeting.

The future state suggests a more refined and effective last-eight-minute meeting, where workers provide detailed evaluations of the work facilitated by operations and OH&S professionals. The improvements in Q1 and Q3 metrics, along with decreased variability in IRQ values and standard deviation, indicate a collaborative effort among Junior, Medior, and Senior

workers to contribute valuable insights for continuous improvement. This reflects a positive evolution in the organisation's culture of feedback and learning from each task.

Analysing the current and future states of incorporating pre- and post-mortem discussions into the operational plan with a focus on worker safety and productivity, the future state indicates a consistent improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the pre- and post-mortem discussions are expected to become more effective in addressing worker safety and productivity concerns, with workers providing more insightful feedback. The IRQ values show an increase for the Medior level in the future state. While this may indicate some variability in responses among Medior workers, it could also suggest that the discussions are facilitating a more nuanced and diverse set of perspectives from this experience level. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. This implies a more uniform and consistent approach to pre- and post-mortem discussions across Junior, Medior, and Senior levels. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of these educational tools.

The future state suggests a positive evolution in the incorporation of pre- and post-mortem discussions into the operational plan, with a focused emphasis on worker safety and productivity. The improvements in Q1 and Q3 metrics, along with a balanced increase in IRQ values for the Medior level and decreased variability in standard deviation, indicate a collaborative effort to enhance the educational aspects of these discussions across the entire workforce. This reflects a commitment to continuous learning and improvement in the organisation's safety and productivity practices.

The OH&S professional's involvement in work preparation and education on trade-offs between efficiency and thoroughness, the future state shows a modest improvement in Q1 metrics across Junior, Medior, and Senior levels. While there is a slight enhancement, particularly for Junior and Senior levels, it indicates an ongoing effort to educate frontline supervisors and

workers on the trade-offs between efficiency and thoroughness. There is a consistent improvement in Q3 metrics for all experience levels in the future state. This suggests an enhanced understanding and awareness among frontline supervisors and workers regarding the balance between efficiency and thoroughness, reflecting the positive impact of the OH&S professional's involvement in work preparation. The IRQ values and standard deviation values show stability across both the current and future states. This indicates a consistent level of variability in responses, with a balanced approach to addressing trade-offs. The stability suggests that efforts to educate on efficiency and thoroughness are being consistently applied across different experience levels. The average scores demonstrate incremental improvement across all experience levels in the future state. This signifies an overall positive trend in the OH&S professional's effectiveness in educating on trade-offs between efficiency and thoroughness during work preparation.

The future state reflects a gradual but positive evolution in the OH&S professional's role in work preparation and education on trade-offs. The improvements in Q1 and Q3 metrics, coupled with stable IRQ and standard deviation values, suggest a continuous commitment to enhancing the understanding of frontline supervisors and workers regarding the balance between efficiency and thoroughness. This ongoing educational effort is expected to contribute to a safer and more efficient work environment in the future.

Analysing the current and future states of workforce education, focusing on incorporating the latest insights of regulations, company requirements, and technological trends, with regular updates and input from the workforce, the following conclusions can be drawn: the future state demonstrates an improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests a more effective incorporation of the latest insights into regulations, company requirements, and technological trends, reflecting a positive impact on the workforce's understanding. There is a consistent decrease in IRQ values across experience levels in the future state. This indicates a reduction in variability among responses, suggesting a more standardised

and aligned approach to updating education with input from the workforce. The decrease in variability implies a clearer consensus on the importance of staying informed about the latest insights. The standard deviation values remain relatively stable, suggesting a consistent level of variability in responses. The average scores demonstrate incremental improvement across all experience levels in the future state, reflecting an overall positive trend in the effectiveness of education updates with workforce input.

The future state indicates a positive evolution in the approach to workforce education, with a focus on incorporating the latest insights and regular updates. The improvements in Q1 and Q3 metrics, along with decreased IRQ values and stable standard deviation values, suggest a collaborative effort among Junior, Medior, and Senior workers to stay informed about regulations, company requirements, and technological trends. This commitment to continuous learning is expected to contribute to a workforce that is well-informed and adaptable to the evolving landscape of regulations and technology.

The OH&S professional's investment in relationships with frontline workers through the appointment of OH&S champions, the future state shows a moderate improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the OH&S professional's investment in relationships, particularly through the appointment of OH&S champions, is expected to lead to a more comprehensive understanding of how human performance factors into occupational health and safety. There is a substantial decrease in IRQ values across experience levels in the future state. This indicates a reduction in variability among responses, suggesting a more standardised and aligned approach to the coaching and understanding of human performance by OH&S champions at the frontline. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. The average scores also show incremental improvement across all levels, reflecting an overall positive trend in the effectiveness of the OH&S professional's investment in building relationships and coaching OH&S champions.

The future state indicates a positive evolution in the OH&S professional's strategy of investing in relationships with frontline workers through the appointment of OH&S champions. The improvements in Q1 and Q3 metrics, along with decreased IRQ values and standard deviation, suggest a more standardised and effective approach to coaching and understanding human performance at the frontline. This proactive engagement is expected to enhance the overall safety culture within the organisation.

The OH&S professional's role in communicating workforce intelligence within the leadership team, the future state demonstrates a substantial improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the OH&S professional's communication of workforce intelligence, in collaboration with operational managers, is expected to become more effective. The higher scores indicate a more comprehensive understanding and transmission of information. There is an incremental increase in IRQ values across experience levels in the future state. While this may indicate a slight increase in variability among responses, it could also suggest a more nuanced and diverse set of perspectives being communicated within the leadership team. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of the OH&S professional in communicating workforce intelligence within the leadership team.

The future state suggests a positive evolution in the OH&S professional's role in communicating workforce intelligence within the leadership team. The improvements in Q1 and Q3 metrics, along with decreased standard deviation and elevated averages, indicate a more refined and effective communication process. This collaborative effort is expected to contribute to a more informed and responsive leadership team, fostering a culture of safety and continuous improvement within the organisation.

Where frontline workers and OH&S professionals are included in the design of new equipment to bridge the gap between work as done and work as imagined, the future state reveals

a substantial improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the inclusion of frontline workers and OH&S professionals in the design process has led to a more comprehensive understanding of the gap between conceptualised work and the actual work performed in the early stages of a project. There is a significant decrease in IRQ values across experience levels in the future state. This indicates a reduction in variability among responses, suggesting a more consistent and aligned approach in identifying and addressing the gap between work as done and work as imagined. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of involving frontline workers and OH&S professionals in the design of new equipment. The transformation from lower average scores in the current state to higher averages in the future state suggests a positive impact on the early-stage identification of discrepancies between work as done and work as imagined. This transformation indicates a more thorough and reliable design process.

The future state illustrates a positive and transformative impact of including frontline workers and OH&S professionals in the design process of new equipment. The improvements in Q1 and Q3 metrics, along with decreased IRQ values and standard deviation, signify a more standardised and effective approach to addressing the gap between conceptualised and actual work. This collaborative effort is expected to enhance the overall safety and efficiency of work practices in the early stages of projects.

Where cross-functional teams are assembled for projects impacting the organisation on multiple levels, such as permit-to-work, the future state indicates a substantial improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the assembly of cross-functional teams has led to a more comprehensive and effective project management approach, resulting in higher scores for all levels. There is a notable decrease in IRQ values across experience levels in the future state. This indicates a reduction in variability among responses,

suggesting a more standardised and aligned approach in assembling cross-functional teams for projects impacting the organisation on multiple levels. The standard deviation values demonstrate stability in variability among experience levels in the future state. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of assembling cross-functional teams for projects such as permit-to-work. The transformation from lower average scores in the current state to higher averages in the future state indicates a positive impact on project management practices. The higher averages suggest that cross-functional teams are contributing more effectively to the successful execution of projects impacting the organisation on multiple levels.

The future state reflects a positive and transformative impact of assembling cross-functional teams for projects with broader organisational implications. The improvements in Q1 and Q3 metrics, along with decreased IRQ values and stable standard deviation values, signify a more standardised and effective approach to project management. This collaborative effort is expected to enhance the overall success and efficiency of projects, particularly those with a significant organisational impact like permit-to-work.

When questioned about risk assessment techniques that are tailored to the needs of the work, with a focus on how the work is done and interconnected with other steps in the process, the future state demonstrates a substantial improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the tailoring of risk assessment techniques to the specific needs of the work, with a focus on process interconnections, has resulted in higher scores across all levels. There is a significant decrease in IRQ values across experience levels in the future state. This indicates a reduction in variability among responses, suggesting a more standardised and aligned approach to risk assessment techniques tailored to the intricacies of the work. The standard deviation values demonstrate a notable decrease in variability among experience levels in the future state. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of risk assessment techniques that are aligned

with the unique needs and interconnections of the work. The transformation from lower average scores in the current state to higher averages in the future state indicates a positive impact on risk assessment practices. The higher averages suggest that tailoring risk assessment techniques to the specific needs of the work, with a focus on process interconnections, is contributing to a more thorough and effective risk management approach.

The future state illustrates a positive and transformative impact on risk assessment techniques, emphasising tailoring to the needs of the work and considering process interconnections. The improvements in Q1 and Q3 metrics, along with decreased IRQ values and standard deviation, signify a more standardised and effective approach to risk management. This tailored approach is expected to enhance the overall effectiveness of risk assessments across all levels.

When the OH&S plan is integrated into every department's plan as a collective document for company improvement, the future state demonstrates a significant improvement in both Q1 and Q3 metrics for Junior, Medior, and Senior levels. This suggests that the integration of the OH&S plan into every department's plan has led to higher scores, indicating a more comprehensive and effective safety approach across all levels. The future state shows a complete elimination of IRQ values, indicating zero variability among responses across experience levels. This suggests a standardised and consistent understanding and implementation of the OH&S plan as part of the company improvement plan. There is a drastic decrease in standard deviation values across experience levels in the future state. The average scores also show improvements across all levels, reflecting an overall increase in the effectiveness of integrating the OH&S plan into every department's plan. The transformation from lower average scores in the current state to higher averages in the future state indicates a positive impact on the integration of the OH&S plan into overall company improvement efforts. The higher averages suggest that OH&S is more effectively embedded within the broader organisational improvement strategy.

The future state demonstrates a positive and transformative impact of integrating the OH&S plan into every department's plan as part of the company improvement plan. The improvements in Q1 and Q3 metrics, along with the elimination of IRQ values and the drastic decrease in standard deviation, signify a more standardised, consistent, and effective approach to occupational health and safety across all levels. This integrated approach is expected to contribute to a safer and healthier work environment within the organisation.

Discussion

The results of the questionnaire indicate that the current generation of safety professionals isn't fully confident that they have the needed skills and knowledge to be ready for the needs of the role in 2036. When asked the question, the majority of the respondents indicated that they have a moderate readiness for Industry 4.0

Needs

Risk assessments generally receive positive feedback, especially from Senior professionals who appreciate the tailored approaches to specific work requirements. There is strong support for safety professionals to adopt a business partner role, with a significant endorsement from Medior professionals and consensus across all levels. However, there is a noticeable perception gap between the current and future roles of safety professionals and the OH&S department as partners.

Future-oriented OH&S policies are focusing on balancing regular tasks with improving overall effectiveness. It's important to integrate daily work aspects into these policies to bridge existing perception gaps. This integration is vital for aligning OH&S initiatives with overall company improvement plans, fostering a safer and more effective work environment.

There's a clear priority for refining KPIs, driven by dissatisfaction with current practices. Despite the need for diverse data sources, clarity issues in survey questions must be addressed to improve future KPI efforts.

Safety professionals agree that moral responsibility is crucial and should be shared across all organisational stakeholders. Yet, the current state shows varied perceptions among companies and nations, with Junior professionals viewing it more positively than their Medior and Senior counterparts. This highlights the need for a unified approach to strengthen moral responsibility across all levels.

The concept of coupling and interaction looks promising, with expected enhancements in operational learning and collaboration. Managing variability in responses will be crucial to maintaining consistency across experience levels.

The organisation's focus on resilience could significantly enhance workforce performance, fostering a culture of innovation and adaptability. This strategic approach not only reduces failure impacts but also positions the organisation for long-term success in a dynamic business environment.

Knowledge

The future safety professional is distinguished by a proactive inclination to acquire new insights and techniques through a multi-disciplinary approach, spanning fields such as sociology and technology. Despite the echoed necessity to apply this knowledge in practice, the current occupational landscape assigns a lower priority to multi-disciplinary learning. Bridging this gap by emphasising the practical application of diverse knowledge sets is essential for nurturing safety professionals who can effectively navigate the complexities of the evolving professional environment.

Compliance holds a recognised priority in both the future and current states of the safety profession, with safety professionals strongly identifying with the term "compliance." This alignment is linked to the emphasis on compliance in current courses and the social identity of safety professionals. There is a widespread consensus on the importance of compliance across various professional groups. However, when comparing the future state with the current state, a noticeable gap emerges in the perception of integrating compliance and building competence for safety professionals. Addressing this gap is crucial for ensuring that safety professionals are well-equipped for evolving challenges and expectations in their field.

The prevailing positive perception indicates a consensus on the integration of safety and environmental concerns into standard operating procedures. Limited variability in opinions among Junior and Medior professionals suggests a consistently positive view in these groups.

Additionally, the overall positive perception implies unanimous agreement on the effectiveness of the last-eight-minute meeting after tasks. Senior professionals exhibit the most positive perception, with Medior professionals showing a slightly lower average score. However, moderate variability in opinions within each experience level signals diverse perspectives on the last-eight-minute meeting. This diversity highlights the need for a nuanced understanding of individual viewpoints to further enhance the effectiveness of safety practices.

The overall positive perception indicates a consensus on the effectiveness of competence building, with Senior professionals expressing the most positive views. In contrast, Junior and Medior professionals exhibit slightly lower average scores. The higher variability in opinions within each experience level suggests diverse perspectives on competence building, emphasising the need for tailored approaches to meet individual needs. Similarly, the overall positive perception implies agreement on the effectiveness of workforce education, underlining a shared belief in its efficacy across professional levels. Acknowledging the varied perspectives within each experience level will be essential for optimising competence-building strategies and ensuring their widespread success.

The organisation's dedication to investing in knowledge from both internal and external sources has significantly improved the desired state when compared to the current state. By fostering collaborative efforts among departments, actively engaging with external umbrella companies to address complex issues, and integrating acquired knowledge into their workgroups, the organisation has undergone a positive transformation across various performance metrics. The desired state metrics portray a workforce adept not only at managing intricate issues but also at actively seeking and incorporating knowledge from diverse sources, ensuring adaptability, and fostering innovation. This proactive approach strategically positions the organisation for sustained success in a dynamic and competitive business landscape.

Skills

A comparative analysis reveals a significant gap in safety integration and feedback loop closure in high-risk environments. Despite this, a generally positive perception suggests agreement on the feedback loop's effectiveness post-task, with Medior professionals showing the highest approval and Juniors and Seniors slightly less. Variability within levels indicates diverse perspectives, highlighting the need for a nuanced understanding.

The importance of frontline data is moderately prioritised currently and expected in the future, with distinct responses suggesting areas for further exploration in safety practices. There's also a notable gap in the perception of digital tool digitalisation for safety professionals, pointing to the need for tailored communication and training to resolve goal conflicts and enhance understanding.

Anticipated changes suggest a transformative role for frontline workers as primary intelligence sources, with significant human interaction in their evolving roles. This shift emphasises the balance between technological advances and human elements in future safety practices.

Organisations should leverage the positive views of Junior professionals to foster a culture involving OH&S professionals in work preparation. Exploring diverse perceptions among Medior professionals could provide insights for targeted improvements. The positive consensus on involving OH&S professionals and frontline workers in equipment design highlights the value of collaborative efforts to enhance safety and equipment effectiveness.

Lastly, while 'Tiger Teams' currently see limited favourability, there's broad agreement on the benefits of cross-functional teams for significant projects. The need for open communication and ethical adherence also stands out, especially to bridge gaps in the safety department's speaking-up culture, with Juniors viewing the current state more favourably than other groups.

In the evolving landscape of occupational health and safety (OH&S), how safety professionals gain knowledge and skills is undergoing a significant transformation. Traditionally rooted in classroom-based learning and field training, the acquisition of expertise in safety practices has been primarily driven by direct instruction and experiential learning through mentorship and on-the-job practice. However, the integration of modern technologies and the increasing emphasis on collaborative networks are reshaping this educational paradigm.

The future of safety professional education is envisioned as a more dynamic and interconnected system, where knowledge and skills are not only derived from traditional educational settings but are also heavily supplemented by digital platforms and tools. This approach leverages technologies such as videos, podcasts, and AI-driven platforms akin to ChatGPT, which facilitate instant access to a wealth of up-to-date safety information and best practices. Such tools democratise knowledge acquisition, making it more accessible and tailored to the needs of the safety community. Moreover, these platforms foster a culture of continuous learning and collaboration among safety professionals, enabling them to share insights and learn from each other in real time.

This shift towards a more collaborative and technology-enhanced learning environment not only enhances the efficiency of knowledge transfer but also ensures that safety professionals are equipped with the most current and relevant information. By standing on the shoulders of giants—drawing on the collective intelligence and experiences of the global safety community—safety professionals are better prepared to tackle the complex challenges presented by modern work environments. This new paradigm highlights a critical transition from a solely instructional model to a more fluid, community-driven approach, reflecting broader trends in educational methodologies and the needs of contemporary professional practice in the field of occupational health and safety.

How Does the Safety Professional Gain Knowledge And Skills?

Currently, safety professionals follow a classic school approach where they get knowledge from the person in the front of the class. The skills are taught in the field, mostly by experimenting and mentorship. There are umbrella groups, such as Prebes, that provide extra training and networking movements.

The future safety professional is part of an interconnected network where best practices and approaches are shared and accessible. A ChatGPT-like approach for the safety community in Belgium can be a step forward. Information sharing can also be done by modern tools like videos, podcasts and other forms of technology that make information easily available limiting the research work for the community and building upon the standards of others. Standing on the shoulders of the giants can be a significant step forward for the whole community of interconnected peers.

What Does Industry 4.0 Mean For The Safety Professional?

We can discern several impacts of Industry 4.0 on safety professionals in their daily work and their perceptions of the future from this research:

- **Increased Emphasis on Collaboration and Partnership:** Safety professionals are increasingly seen as integral partners in business operations rather than solely enforcers of safety protocols. This shift implies a more collaborative approach in daily work, involving closer integration with other departments and stakeholders.
- **Integration of Industry 4.0 Technologies:** The advent of Industry 4.0 brings about the integration of advanced manufacturing technologies, digitalisation, and smart manufacturing processes into safety practices. This implies that safety professionals must adapt to and leverage these technologies to ensure workplace safety effectively.
- **Multi-disciplinary Learning and Proactivity:** The future safety professional is envisioned as someone who actively seeks new insights and techniques from diverse fields such as sociology and technology. This suggests that safety professionals need to engage in

continuous learning and stay updated with advancements in various domains to address evolving safety challenges proactively.

- **Shift towards Risk Anticipation and Continuous Evaluation:** There's an increasing recognition of the importance of anticipating risks and continuously evaluating safety practices, especially in response to new technologies. This implies that safety professionals need to adopt a forward-thinking mindset and prioritise risk assessment and management in their daily routines.
- **Cultural Shift towards Open Communication:** There's a growing emphasis on fostering a culture of open communication and speaking up within safety departments. This implies that safety professionals must actively promote and facilitate open dialogue to address safety concerns effectively and prevent incidents.
- **Adoption of Resilience and Innovation Strategies:** The future safety professional is expected to embrace resilience and innovation strategies to navigate complex and dynamic business landscapes successfully. This suggests that safety professionals need to develop adaptive and innovative approaches to address emerging safety challenges effectively.
- **Overall, safety professionals are facing a transformative shift in their roles and responsibilities, driven by advancements in technology, evolving workplace dynamics, and changing expectations. The future outlook emphasises collaboration, proactivity, adaptability, and innovation as essential traits for safety professionals to thrive in an increasingly complex and interconnected world.**

What Do Employers, Hierarchical Line And Safety Professionals Perceive As Good Safety Practice?

Good safety practices are closely linked to resilience according to the results of the respondents. They emphasise that safety is not just about preventing incidents but also about being prepared to respond and adapt to dynamic and changing risks. This proactive stance towards safety contributes to building resilience within organisations, enabling them to anticipate

and mitigate potential hazards effectively. Additionally, the emphasis on continuous learning and improvement in safety processes fosters a culture of resilience by equipping individuals and organisations with the skills and knowledge to overcome challenges and bounce back from adversity. Overall, the integration of safety into organisational culture and operations enhances resilience by ensuring that individuals and systems are well-prepared to navigate uncertainties and maintain stability in the face of disruptions.

What Does The Safety Professional Training Of The Future Look Like?

How do safety professionals see their role in the future, how do they see themselves now, and how in the future? How is this influencing the future identity of safety professionals? The thesis started from the current state in the light of Industry 4.0 and moved towards the ideal state in 2036, where Industry 4.0 will be a significant influence on the daily work of all employees in the manufacturing world, including safety professionals. From the interviews, it appears that safety professionals see their role evolving in the future to encompass a more comprehensive and effective approach to managing occupational health and safety challenges. Currently, they may view their role as primarily focused on addressing immediate safety concerns and ensuring compliance with regulations. However, in the future, they anticipate playing a more proactive and strategic role in educating, coaching, and guiding both frontline workers and operational managers. They aim to foster a deeper understanding of safety considerations and promote a culture of continuous improvement within the organisation. This evolution involves enhancing communication, collaboration, and standardisation of safety practices across different levels of experience. Overall, safety professionals envision themselves transitioning from reactive problem-solving to proactive risk management and safety leadership in the future. Safety professionals need a range of competencies and capabilities to effectively navigate the evolving landscape of occupational health and safety challenges. These competencies include:

- **Educational and Coaching Skills:** Safety professionals must be adept at educating and coaching frontline supervisors and workers on various safety considerations, including trade-offs between efficiency and thoroughness, risk assessments, and safety protocols. They need to facilitate a deeper understanding of safety concepts and foster a culture of safety within the organisation.
- **Analytical and Problem-Solving Skills:** They require strong analytical and problem-solving skills to assess risks, identify potential hazards, and develop effective risk management strategies. This involves analysing data, conducting thorough risk assessments, and implementing appropriate control measures to mitigate risks.
- **Communication and Collaboration Skills:** Safety professionals need excellent communication and collaboration skills to effectively communicate safety protocols, provide feedback, and facilitate discussions among cross-functional teams. They must collaborate with operational managers, frontline workers, and other stakeholders to implement safety measures and drive continuous improvement initiatives.
- **Adaptability and Flexibility:** Given the dynamic nature of occupational health and safety challenges, safety professionals must be adaptable and flexible in their approach. They need to stay updated on regulatory changes, technological advancements, and industry best practices to ensure that safety measures remain effective and relevant.
- **Leadership and Influencing Skills:** Safety professionals should possess strong leadership and influencing skills to drive change and promote a culture of safety within the organisation. They need to inspire others to prioritise safety, gain buy-in from stakeholders, and effectively implement safety initiatives.

These competencies and capabilities evolve from the skills and knowledge that safety professionals currently possess. While they may already have a foundational understanding of safety principles, regulations, and risk management techniques, the evolving role of safety professionals requires them to continuously enhance and expand their skill set. This evolution involves acquiring advanced knowledge of emerging safety trends, developing expertise in new

technologies and methodologies, and honing their communication and leadership abilities to effectively address complex safety challenges. Overall, safety professionals must adapt and grow alongside the changing demands of the occupational health and safety landscape to remain effective in their roles.

How Does The Curriculum Of The Safety Professional Look Like For Industry 4.0?

Based on the research, the conclusion can be made that there is a strong need to rethink the curriculum of the safety professional to be ready for Industry 4.0.

Current State

The curriculum outlined in Codex Book II, Title 4, Annexe II.4-2 and subsequent sections is a structured educational framework aimed at equipping safety advisors with the necessary skills and knowledge to manage occupational health and safety effectively across various industries. This curriculum is distinguished by its comprehensive coverage of both foundational and specialised content, tailored to meet the demands of different risk environments from high-risk industries to more controlled settings.

Skills Development

The skills component emphasises interdisciplinary collaboration, leadership, communication, and the practical application of scientific information. Safety advisors are expected to integrate welfare considerations into daily operations and effectively direct and coach teams within the workplace.

Knowledge Base

The knowledge required spans a broad array of topics:

- **Preventative and Interventional Approaches:** This includes a variety of methods for discovering, analysing, and diagnosing safety issues, underpinned by a solid understanding of legal frameworks.
- **Human and Organisational Factors:** Insights into human anatomy, psychology, and the social dynamics of workplaces are coupled with knowledge of organisational work structures and cultures.

- **Risk Management:** Advisors must understand global approaches to risk, including specific techniques for analysing job-related risks, occupational diseases, and accident epidemiology.
- **Preventative Strategies:** There is a focus on industrial hygiene, environmental and biological risks, ergonomics, and other workplace hazards.
- **Policy Implementation:** Knowledge of dynamic risk management systems, emergency protocols, and stakeholder engagement is crucial for developing effective safety policies.

Specialisation For High-Risk Industries

For those specialising in high-risk industries (Level One Safety Advisors), the curriculum intensifies both the depth and breadth of required competencies.

Advanced Skills

These professionals must possess acute hazard identification skills, advanced accident analysis capabilities, and the ability to integrate safety principles into company-wide quality assurance systems. They are also tasked with overseeing the technical and administrative aspects of safety policies.

Specialised Knowledge

- **Comprehensive Risk Management:** Detailed knowledge of occupational hygiene, ergonomics, and the psychosocial aspects of work are crucial.
- **Regulatory and Logistical Frameworks:** Advisors need a thorough understanding of relevant regulations and the logistical aspects of implementing well-being policies.
- **Specific Risk Domains:** Detailed knowledge in areas such as mechanical and electrical risks, chemical and physical agents, and fire and explosion hazards is mandatory.

Lower Risk Industry Specialisation

For Level Two Safety Advisors, focusing on lower-risk industries, the requirements are similar but adjusted for contexts with inherently lower risks.

Skills And Knowledge

The skills and knowledge bases are largely paralleled to those of Level One, with adaptations to reflect the reduced risk levels in their operational contexts. This includes a continued emphasis on risk assessment, accident analysis, and the integration of safety management into broader organisational practices.

Specific Domains

These advisors must also be well-versed in specific risk domains pertinent to their industries, including but not limited to construction safety, emergency planning, and building security.

Future state

The future state of occupational health and safety (OH&S) education, as envisioned in this curriculum proposal, is characterised by a comprehensive, dynamic approach that integrates diverse disciplines, methodologies, and stakeholder inputs to enhance safety management and practice. This approach recognises the complexity of modern work environments and aims to prepare OH&S professionals who are not only well-versed in traditional safety protocols but also equipped with the skills to innovate, adapt, and effectively communicate within their organisations.

Curriculum Framework

The curriculum is structured around several key modules, each designed to address specific aspects of safety management while contributing to a holistic understanding of OH&S as a critical business partner and a central element of organisational culture.

Competence Building In Understanding Risk Assessments

This module focuses on foundational risk management principles, emphasising practical applications such as hazard identification, risk communication, and the integration of complex systems theories (e.g., Perrow's and Hollnagel's frameworks). It underpins the need for

continuous competence building through engagement with real-life case studies and academic literature.

Recognition Of Frontline Expertise in Evolving Scenarios

Frontline workers' insights are vital in dynamic risk assessment scenarios. This part of the curriculum advocates for their active involvement in safety decision-making processes, facilitated by leadership styles that prioritise open communication and adaptability to changing circumstances.

OH&S As A Business Partner

Strategic alignment of OH&S objectives with broader organisational goals underscores this module. It explores how OH&S can demonstrate its value through effective metrics, stakeholder engagement, and integration with other business units, leveraging strategic and operational frameworks to reinforce safety as a key business function.

Operational Learning For OH&S Professionals

Continuous professional development is addressed here through action learning and reflective practices. This module encourages OH&S professionals to apply lessons learned from both successes and failures, fostering a culture of ongoing learning and feedback within safety management practices.

Acquiring New Insights Through Sociology And Technology

With an emphasis on the sociological and technological aspects of safety, this module explores how emerging technologies and sociological theories can enhance the design and implementation of safety systems, addressing ethical considerations and human factors in safety management.

Compliance Capability Building

This traditional yet critical aspect focuses on understanding and implementing regulatory frameworks and standards. It promotes a proactive approach to compliance, where ethical and legal obligations are aligned with an organisation's moral responsibilities towards its workforce.

Education Of Workforce

Addressing the diverse needs of the workforce, this module highlights the importance of tailored training programs that account for varying levels of expertise and responsibilities within an organisation, advocating for a multi-level approach to capability building.

Advanced Modules

Further depth is added through advanced modules focusing on systems thinking, partnership between frontline staff and OH&S, and the integration of safety into everyday business processes and decision-making.

Task Mapping And System Interactions

Advanced risk assessment techniques are discussed, emphasising the interdependencies within complex systems and the need for dynamic systems modelling and systems thinking in understanding and mitigating risks.

Partnerships And Collaborative Decision-Making

This module covers strategies for building and maintaining effective partnerships between OH&S professionals and other organisational members, fostering a shared responsibility for safety and enhancing the decision-making processes through collaborative practices.

Holistic Risk Assessment And Operational Learning

An integrative approach to risk assessment that incorporates environmental, health, and safety factors, supported by comprehensive learning and adaptation strategies, is central to this module.

Innovation And Safety Culture

The curriculum culminates in a focus on fostering innovation, improving safety culture through participatory design, and embedding safety as a core value within organisational practices and culture.

Conclusion

This visionary curriculum is designed not only to prepare safety professionals for the current demands of their roles but also to equip them with the skills and knowledge to lead future advancements in safety management. Through a blend of theoretical knowledge and practical application, this educational program aims to transform the landscape of OH&S, ensuring it is a proactive, integral part of organisational success and worker well-being.

The table shows the comparison between the new curriculum and the core transformations of the Agiora Self-Scan.

Table 2*New curriculum and the connection with the core transformations*

Section	Module Title	Key Focus Areas	Core Transformation	Transformation Category
A. Competence Building	Understanding Risk Assessments Involving Operations	<ul style="list-style-type: none"> • Introduction to Risk Management Principles • Hazard Identification Techniques • Risk Assessment Methods and Tools • Risk Communication Strategies • Case Studies and Real-life Applications 	Advanced Manufacturing Technologies	Strategy
A. Competence Building	Recognition of Frontline Expertise in Evolving Scenarios	<ul style="list-style-type: none"> • Importance of Frontline Input in Risk Assessment • Engaging Frontline Workers in Safety Decision-making • Scenario Planning and Adaptability • Effective Communication Channels • Continuous Improvement Strategies 	Advanced Manufacturing Technologies	Awareness

A. Competence Building	Occupational Health and Safety (OH&S) as a Business Partner	<ul style="list-style-type: none"> • Integration of OH&S with Organisational Goals • Strategic Planning for Occupational Health and Safety • Collaboration with Business Units • Demonstrating Value through OH&S Metrics • Stakeholder Engagement Techniques 	Human-Centred Organisation	Goals and KPIs
A. Competence Building	Operational Learning for OH&S Professionals	<ul style="list-style-type: none"> • Continuous Professional Development in OH&S • Action Learning Techniques • Reflective Practice in Safety Management • Learning Review and Lessons Learned • Implementing Feedback Mechanisms 	Human-Centred Organisation	Professional Development Path
A. Competence Building	Acquiring New Insights: Sociology and Technology	<ul style="list-style-type: none"> • Sociological Perspectives on Safety Culture • Technology Trends in Occupational Safety • Human Factors and Ergonomics in Safety Design • Implications of Digital Transformation on OH&S • Ethical Considerations in Technology Adoption 	Human-Centred Organisation	Acquired knowledge and experience

A. Competence Building	Compliance Capability Building	<ul style="list-style-type: none"> • Regulatory Frameworks and Standards • Compliance Auditing Techniques • Ethical and Legal Obligations • Proactive Compliance Strategies 	Eco Factory	Regulations and standards
A. Competence Building	Education of Workforce	<ul style="list-style-type: none"> • Training Needs Analysis • Designing Effective Training Programs • Delivery Methods and Techniques • Assessing Training Effectiveness • Promoting a Culture of Learning Training 	Human-Centred Organisation	Talent and competency development
B. Task Mapping	Coupling and Interaction Between Components	<ul style="list-style-type: none"> • Systems Thinking in Safety Management • Understanding Complex Systems Interactions • Interdependencies Between Safety Components • Risk Amplification and Mitigation in Interconnected Systems • Dynamic Systems Modelling for Safety Analysis 	Smart Manufacturing	Tasks on the shop floor

B. Task Mapping	Partnerships Between Frontline and Occupational Health and Safety (OH&S)	<ul style="list-style-type: none"> • Collaborative Decision-making Processes • Empowering Frontline Workers in Safety Initiatives • Communication Strategies for Partnership Building • Shared Responsibility for Risk Identification and Mitigation • Case Studies on Successful Frontline-OH&S Partnerships 	Human-Centred Organisation	Open Dialogue
B. Task Mapping	Integration of All Aspects in Risk Assessment: Pivotal Role for OH&S	<ul style="list-style-type: none"> • Holistic Approach to Risk Assessment • Incorporating Environmental, Health, and Safety Factors • OH&S Professional as Facilitator in Risk Integration • Balancing Technical and Human Factors in Risk Analysis 	Integrated Engineering	Continuous improvement

		<ul style="list-style-type: none"> • Continuous Improvement in Risk Assessment Practices 		
B. Task Mapping	Including Work Routines in Safety Protocols	<ul style="list-style-type: none"> • Observational Techniques for Work Routine Analysis • Identifying Safety Gaps in Work Processes • Designing Safety Protocols Aligned with Work Routines • Implementing Safety Checks and Balances within Workflows • Cultivating a Culture of Safety-Conscious Work Practices 	Smart Manufacturing	Flexible & rapid response
C. Task Analyses	Tailoring the Risk Assessment to Work Methods	<ul style="list-style-type: none"> • Adapting Risk Assessment Techniques to Different Work Environments • Customising Risk Assessment Tools for Specific Industries • Integrating Work Methodologies into Risk Assessment Processes 	Integrated Engineering	Standards, tools, and approaches

		<ul style="list-style-type: none"> Assessing and Mitigating Risks Associated with Work Methods 		
C. Task Analyses	Involvement in Work Preparation	<ul style="list-style-type: none"> Understanding the Pre-Work Planning Process Role of Safety Professionals in Work Preparation Collaborative Work Preparation Practices Identifying and Addressing Safety Concerns in Pre-Work Activities 	Integrated Engineering	Customer-oriented Customisation
C. Task Analyses	Fostering Innovation on Every Level	<ul style="list-style-type: none"> Promoting a Culture of Innovation in Safety Management Encouraging Creativity in Safety Solutions Recognising and Rewarding Innovative Safety Practices Engaging Frontline Workers in Innovation Processes Implementing Innovation in Occupational Safety Policies and Procedures 	Networked Factory	Innovation culture

D. Observations	Human Interactions for Frontline Supervisors	<ul style="list-style-type: none"> • Communication Skills for Safety Leadership • Conflict Resolution Techniques • Building Trust and Rapport with Frontline Workers • Active Listening and Empathy in Safety Conversations • Motivating and Engaging Teams Towards Safety Goals 	Human-Centred Organisation	Well-being and quality of work
D. Observations	Goal Conflicts: Understanding and Improving	<ul style="list-style-type: none"> • Recognising and Addressing Conflicting Goals in Safety Management • Strategies for Alignment of Safety Goals with Operational Objectives • Collaborative Decision-making to Resolve Goal Conflicts 	Integrated Engineering	Stakeholder collaboration and involvement

<p>D. Observations</p>	<p>Occupational Health and Safety (OH&S) Coaching on the Floor</p>	<ul style="list-style-type: none"> • Techniques for On-the-Job Safety Coaching • Providing Constructive Feedback on Safety Performance • Coaching for Safety Behaviours and Mindset • Addressing Safety Concerns in Real-Time Situations 	<p>Human-Centred Organisation</p>	<p>Well-being and quality of work</p>
<p>D. Observations</p>	<p>Work as Done vs. Work as Imagined</p>	<ul style="list-style-type: none"> • Understanding the Gap Between Planned and Actual Work Practices • Importance of Resilience Engineering in Safety Management • Bridging the Work-As-Done and Work-As-Imagined • Learning from Variability in Work Processes • Implementing Adjustments in Safety Protocols 	<p>Smart Manufacturing</p>	<p>First time right</p>

D. Observations	Investing in Relationships (Champions)	<ul style="list-style-type: none"> • Identifying and Cultivating Safety Champions • Leveraging Influence Networks for Safety Improvement • Empowering Champions to Drive Safety Culture Change 	Human-Centred Organisation	Horizontal & Vertical Direction
D. Observations	Gathering Operational Intelligence	<ul style="list-style-type: none"> • Techniques for Collecting Data on Operational Safety • Importance of Near Miss Reporting and Incident Investigation • Utilising Technology for Real-Time Data Collection 	Digital Factory	Connected floor
E. Post Mortems	Anticipation of Risks and Future Scenarios	<ul style="list-style-type: none"> • Forecasting Emerging Risks in Safety Management • Scenario Planning Techniques for Safety Professionals • Trend Analysis and Predictive Modelling in Risk Assessment 	Smart Manufacturing	Flexible & rapid response

		<ul style="list-style-type: none"> • Strategic Foresight Methods for Anticipating Future Safety Challenges • Incorporating Risk Resilience in Business Continuity Planning 		
E. Post Mortems	Feedback Loops for Non-routine and Routine Tasks	<ul style="list-style-type: none"> • Implementing Feedback Mechanisms for Non-routine Tasks • Developing Standardised Feedback Processes for Routine Tasks • Importance of Timely and Constructive Feedback in Safety Improvement • Continuous Improvement through Iterative Feedback Loops 	Integrated Engineering	Continuous improvement
E. Post Mortems	Post and Pre-mortems in Operating Plans	<ul style="list-style-type: none"> • Conducting Post-Incident Reviews (Post-mortems) for Learning • Proactive Pre-Incident Planning (pre-mortems) for Risk Mitigation 	Integrated Engineering	Quality and robustness management

		<ul style="list-style-type: none"> • Facilitating Post and pre-mortem Sessions Effectively • Incorporating Lessons Learned into Future Operating Plans • Creating a Culture of Continuous Improvement through Mortem Analysis 		
E. Post Mortems	Communicating Workforce Intelligence	<ul style="list-style-type: none"> • Techniques for Gathering and Analysing Workforce Data • Effective Communication Strategies for Sharing Intelligence • Utilising Data Visualisation Tools for Clear Communication • Fostering a Culture of Open Dialogue and Information Sharing • Leveraging Workforce Intelligence for Decision-making and Strategy Development 	Human-Centred Organisation	Open Dialogue

E. Post Mortems	Communication of Work-As-Done (WAD) and Incident Investigation	<ul style="list-style-type: none"> • Importance of WAD Communication for Understanding Safety Practices • Conducting Effective Incident Investigations • Communicating Incident Findings and Recommendations to Stakeholders • Strategies for Transparent Communication of WAD and Incident Data • Promoting a Learning Culture Through WAD and Incident Communication 	Smart Manufacturing	Flexible & rapid response
E. Post Mortems	Safety's Ability to Respond, Be Prepared, and Adopt	<ul style="list-style-type: none"> • Developing Emergency Response Plans and Procedures • Building Organisational Resilience in Safety Management • Implementing Adaptive Safety Strategies for Rapid Response • Training and Preparedness Exercises for Safety Team 	Smart Manufacturing	Flexible & rapid response

		<ul style="list-style-type: none"> • Embracing Change and Innovation in Safety Practices 		
E. Post Mortems	Improving Operational Learning, Collaboration, and Interaction Quality	<ul style="list-style-type: none"> • Creating Opportunities for Cross-functional Collaboration • Implementing Knowledge Management Systems for Operational Learning • Fostering Communities of Practice for Continuous Learning • Enhancing Communication Channels for Quality Interaction • Promoting a Culture of Shared Learning and Best Practice Sharing 	Integrated Engineering	Continuous improvement

Conclusion

This thesis reports research that was conducted, based on the Delphi technique, interviewing OH&S professionals on the topic of Industry 4.0 and the readiness of OH&S professionals for the impact of Industry 4.0 on their role in the organisation. The research question this is in the service of what skills and knowledge will be needed to cope with the complex adaptative world of Industry 4.0. It is answered through multiple different aspects.

The first aspect is to understand how *'good'* is perceived by the respondents. The research highlights a nuanced understanding of safety among respondents, emphasising that effective safety is not merely the absence of accidents but a proactive, inherent process integrated into daily operations and decision-making. Safety is depicted as a continuous, evolving practice embedded in the organisational culture and workflows, underlining the importance of proactive rather than reactive measures. Respondents advocate a shared responsibility model for safety, which includes all organisational levels, emphasising that safety is a collective commitment that transcends departmental boundaries. This approach encourages an environment where safety protocols are not just followed but are continuously evaluated and improved upon to meet new challenges effectively.

The second aspect is how *'good'* is perceived to look in 2036, concerning Industry 4.0. The integration of technology, especially advancements in digital systems and artificial intelligence, is recognised as critical for enhancing safety measures. These technologies help reduce human error and improve the efficiency and reliability of safety protocols, facilitating better monitoring and proactive management of potential risks.

By 2036, the safety professional will need a broad set of skills and knowledge to effectively navigate the complex landscape of Industry 4.0. This will include a deep understanding of advanced technologies and their impact on safety protocols, emphasising the importance of integrating digital systems into safety practices. Safety professionals will be expected to exhibit

strong leadership qualities and the ability to foster a culture of safety that is proactive rather than reactive. They will need to engage in continuous learning and adaptability to keep pace with technological advancements and changing regulatory environments. Furthermore, communication skills will be crucial for collaborating across various levels of an organisation and with external stakeholders. The safety professional's role will increasingly focus on human-centred approaches that prioritise worker well-being alongside compliance and operational efficiency.

By 2036, the greatest challenge for safety professionals in learning will be keeping pace with the rapid advancements in technology and regulatory changes. As Industry 4.0 technologies become increasingly integrated into workplaces, safety professionals will need to continuously update their knowledge and skills to manage the complex interaction between humans and automated systems. Additionally, adapting to global standards and changing safety regulations will require ongoing education and flexibility. The challenge will be not only in acquiring new technical knowledge but also in developing soft skills such as critical thinking, problem-solving, and effective communication to navigate the multidisciplinary landscape of safety management. This will necessitate a shift in training methodologies towards more dynamic, real-time learning processes that are integrated into daily work routines.

In conclusion, the research outlines that effective safety management necessitates a holistic approach. This includes embedding proactive safety practices in every aspect of organisational culture, supported by advanced technology and characterised by an ongoing commitment to learning and improvement. Such an approach ensures a robust, secure working environment that adapts to evolving risks and technologies, fostering a stable and protective atmosphere for all employees. The challenge will lay in what the regulator sees as the priorities and how this fits in the greater framework of occupational health and safety challenges that Industry 4.0 will bring in the future. A further point for research will be how subcontractors, that do highly hazardous work, will align with these needs.

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Annexe One: Agoria Self-Scan

Table 3

Agoria Self-Scan - Translation

Core Transformation	Category	Level 1	Level 2	Level 3	Level 4	Level 5
1. Advanced Manufacturing Technologies	Strategy	Outdated machines are replaced ad hoc.	Investment in replacing outdated machines.	Detailed multi-year plan for new technologies.	Technology roadmap including feasibility studies.	R&D method in the technology roadmap.
1. Advanced Manufacturing Technologies	Awareness	Passive input from suppliers.	Active gathering of information on business technology.	A broader range of technologies is actively obtained.	Structural monitoring of technological progress.	Development of technology roadmap at the sectoral level.
1. Advanced Manufacturing Technologies	Technology	Comparable level with competitors.	Working with some state-of-the-art technologies.	All technologies are state of the art.	Implementation of technological adjustments for advantage.	Development of new technologies to production-ready.
1. Advanced Manufacturing Technologies	Integration	Off-the-shelf solutions from technology suppliers.	Off-the-shelf solutions based on specific design.	Full utilisation of implemented technology.	Adaptation to future-oriented production requirements.	Seamless integration into existing production.

1. Advanced Manufacturing Technologies	Quality	Quality comparable to competitors.	Competitive advantage through quality aspects.	Technological boundaries explored for quality enhancement.	High quality through technological innovation.	Standard setting in the quality of the final product.
1. Advanced Manufacturing Technologies	Employees	Courses for new employees by technology suppliers.	Annual refresher courses for machine operators.	Regular courses for optimal use of technology.	Increased employee knowledge level for process improvement.	Employees work with new advanced technologies.
2. Digital Factory	Connected floor	Machines function as standalone systems.	Some machines are connected to the company network.	Full connectivity within the company network.	All essential machines are interconnected with sensors.	Full data exchange and open connections.
2. Digital Factory	Cyber security	Individual security updates.	Complies with existing safety standards.	Protection with cybersecurity technology.	Comprehensive Security Information & Event Management.	Continuous risk analyses and threat detection.

2. Digital Factory	Digitally supported networks	The supply chain is not digitally connected.	Parts of the supply chain are digitally connected.	A major part of the supply chain is digitally supported.	The majority of the supply chain is digitally connected.	Fully digitally supported and dynamic supply chain.
3. Eco Factory	Material consumption	Measures for stepwise reduction.	Project-oriented improvements.	Specific goals and structured approach.	Use of best available technologies.	Systems for closing the material loop.
3. Eco Factory	Energy consumption	Various measures for improvement.	Project-oriented improvements for key processes.	Specific goals for reduced energy consumption.	Drawing from best technologies for energy reduction.	Investments in new technologies for energy consumption.
3. Eco Factory	Waste management	Implementation of measures that limit waste streams.	Project-oriented limitations of waste streams.	Methodical approach for waste stream management.	Application of best technology for limiting waste streams.	Investments in new methodologies for waste limitation.
3. Eco Factory	Regulations and standards	Compliance with existing regulations.	Compliance with regulations in the company and supply chain.	Integration of new regulations in products and processes.	A proactive approach to new regulations for competitive advantage.	Key stakeholder in shaping new regulations.

3. Eco Factory	KPIs and goals	No additional KPIs for environmental impact.	Basic measurements and communication for footprint reduction.	Implementation of benchmark and management systems.	Continuous improvement of internationally standardised goals.	Reduction of footprint within the entire value chain.
4. Integrated Engineering	Customer integration	Input from the sales department.	Integration of customer expectations in design specifications.	Active integration of customer requirements in design and production.	Systematic documentation and integration of customer requirements.	Continuously updated and applied customer requirements in all processes.
4. Integrated Engineering	Servitization	General customer service.	Design of services that add specific value.	Use of outcome-oriented services with products.	Services focused on functionality requested by customers.	Development of services that transcend product level.
4. Integrated Engineering	Customer-oriented Customisation	Limited variation in product dimensions.	Modular products are adaptable by the technical department.	Customers assemble their products from options.	Custom products are cost-effectively produced via the DFM methodology.	Full supply chain designed for custom products.

4. Integrated Engineering	Stakeholder collaboration and involvement	Part of the technical staff works on project-oriented methods. Process improvements initiated by managers.	Employees from different departments collaborate on the transition from product development to production phase.	Co-creation by individual employees and managers in new product and process developments.	Multidisciplinary project teams use digital tools for collaboration across multiple workstreams and datasets.	Use of centralised CAD, CAE, and PLM systems in the cloud for integration of teams and external stakeholders.
4. Integrated Engineering	Standards, tools, and approaches	The development process follows general technical standards and best practices.	At the start of a technical project, objectives and criteria are established.	Cross-departmental feedback loops for monitoring of design and engineering choices.	Defining, refining, and applying experience-based learning and knowledge to meet customer and production needs.	Optimisation of the overall technical process through anchored, optimised design rules.
4. Integrated Engineering	Quality and robustness management	Documentation of product or project information for	Monitoring and documentation of technical projects and specifications.	Maximum reliability and predictability of new base	Specific KPIs for new products, processes, and services are	Internal and external feedback translated into KPIs affecting both new

		scope and technical feasibility.		technologies and product development.	established and actively applied.	and existing products and processes.
4. Integrated Engineering	Continuous improvement	Collection of improvement ideas after project completion.	Active assessment of ongoing projects by multidisciplinary teams for improvements.	Application of lean methodologies and rapid prototyping to shorten feedback loops.	Multidisciplinary responsibility for the reliability and predictability of products and processes.	Development of a clear vision of product, production, and maintenance processes for greater predictability.
5. Human-Centred Organisation	Talent and competency development	Training determined by management, ad hoc reactive.	Managers determine development goals and ad hoc training.	Autonomous development goals by employees, formal program.	Teams and individuals set their own development goals.	Individual vision on sustainable employability, active support.
5. Human-Centred Organisation	Acquired knowledge and experience	Knowledge resides in the heads of employees, and ad hoc management.	Experiences discussed with managers.	Active learning; experiences stored and checked.	The team takes the lead in knowledge sharing and automated dissemination.	Teams lead processes independently, learning based on experience.

5. Human-Centred Organisation	Well-being and quality of work	Work mainly consists of routine tasks, with little influence from employees.	Variation in work, some independent scheduling.	A healthy mix of routine tasks and knowledge work, independent scheduling.	Independent activities and exchanges without guidance.	Challenging work that is self-scheduled, intensive team interaction.
5. Human-Centred Organisation	Planning and work scheduling	The top-down planning process, little input from employees.	Top-down with some feedback opportunities.	Planning is partly influenced by employees, input in execution.	Planning by operational teams, independent adjustments.	Teams manage their planning and KPIs, and flexible work scheduling.
5. Human-Centred Organisation	Goals and KPIs	Only management follows strategic objectives.	KPIs set by management and communicated.	The team knows and supports KPIs and daily updates	Teams set KPIs and actions in consultation, and own monitoring.	Teams develop and monitor KPIs continuously, autonomous improvement.
5. Human-Centred Organisation	Autonomy	The manager assigns tasks and oversees them.	Employees receive instructions and individual work.	Teams organise their activities, with high interdependence.	Self-directing teams with skills for self-organisation.	Teams are very flexible, self-scheduling and conflict resolution.

5. Human-Centred Organisation	Vision and Strategy	Management keeps employees annually informed of results and long-term vision without linking to daily work. Information is mainly one-way.	Management regularly updates on business results and vision, including reports on strategy and projects. Initiatives are set up to keep employees informed.	Management explains the vision and strategy and looks for connections between the vision, strategy, and the role of individual employees.	Management and teams discuss the vision and strategy together, emphasising how employees can contribute and what opportunities exist. Active encouragement and motivation by linking with the company vision.	Teams and individual employees discuss together how they can contribute to the future vision and strategy. There is an understanding of the interaction between different projects and the need for collaboration.
5. Human-Centred Organisation	Horizontal & Vertical Direction	No clearly defined leadership; management has full top-down responsibility.	Managerial tasks are integrated into hierarchical positions; middle management and executives	Part of the leadership tasks is distributed among self-directing teams. The highest management is responsible for the	Major leadership tasks are shared within self-directing teams. The highest management acts as a moral authority and	Responsibilities for tasks, employees, and changes are widely shared within the organisation based on a common vision. The highest management is an

			oversee performance and relationships.	realisation of the vision and strategy and initiates changes.	is primarily responsible for the vision and strategy.	example of moral authority and has broad responsibility.
5. Human-Centred Organisation	Professional Development Path	Individual employees feel involved in their roles and responsibilities. Focus on operational execution and contribution to the company.	Employees focus on adding value and involvement, encouraged to use skills for development.	Partnership between the company and employees for the development of skills and competencies. Collaboration on lifelong learning and professional paths.	Open discussions between employees and managers about ambitions and training opportunities, with agreements on development paths.	Intensive collaborations between companies and employees for career benefits, with early planning and appreciation for acquired expertise.
5. Human-Centred Organisation	Open Dialogue	Formal information exchange between management and employees, limited collaboration, mainly mandatory meetings.	Direct communication lines between employee representatives and management for ad hoc questions and project discussions.	Open communication lines for all employees with management, the opportunity to discuss both ad hoc issues and project problems.	All employees freely discuss with managers and management about vision, strategy, and projects. Open discussions where	Hierarchical boundaries in communication are removed; everyone works together as partners within the company. Joint strategy development and space for initiatives.

					employees are involved promptly.	
6. Smart Manufacturing	From stand-alone automation to flexible production	Machines function stand-alone without automation solutions.	Key machines and automation are combined in production cells, connected to a digital platform.	Machines can start simple/routine tasks digitally and autonomously.	Efficient, flexible automation, communication, and production planning based on intelligent use of real-time information.	Advanced, automated planning and control of digitally connected machines for maximum efficiency and flexibility.
6. Smart Manufacturing	Tasks on the shop floor	No automation or robot is present on the shop floor; operators manually perform routine tasks.	Specific routine and monotonous tasks are performed by automation and/or robotic systems.	Intelligent, automated machines, cobots and/or robots on the shop floor reduce the time employees spend on routine tasks and enable them to perform more complex tasks.	Intelligent, automated machines, cobots and/or robots perform both simple and some complex tasks, thus engaging employees more in value creation.	Intelligent machines, cobots, and robots work side by side with employees to create maximum value for both employees and customers.

6. Smart Manufacturing	Flexible & rapid response	Production according to the 'make-to-stock' principle with large batch sizes; minimal use of feedback to improve processes.	Production in small batches, largely 'make-to-stock'; manual planning system, limited use of feedback.	'Make to order' production; setup times between batches are minimised via a manual, digitally supported planning system; sometimes use of feedback for improvements.	Small batch sizes based on 'make to order', minimal setup times via an automatic planning system; active utilisation of feedback; deployment of data analysis and automated decision-making.	Automated production planning systems for 'make to order' production; integral utilisation of feedback for continuously improved processes; advanced data analysis and AI-driven decision-making.
6. Smart Manufacturing	First time right	Quality assurance per product by individual inspection.	Quality inspection and statistical models are used on a sample basis to improve quality.	Monitoring of key production processes to control and predict product quality.	Large-scale, real-time monitoring of production processes and automated feedback ensure	Application of knowledge and experience to explain relationships between production parameters and final product quality; fast setup times and quality

					production 'first time right'.	assurance at first production.
6. Smart Manufacturing	Visualisation and management of KPIs	KPIs are established ad hoc and not regularly monitored.	A basic set of KPIs is checked quarterly.	Intelligent KPIs for regular monitoring and evaluation of production processes.	Daily use of intelligent KPIs on the shop floor for monitoring and improvement of production processes; application of corrective measures.	Real-time calculated KPIs visualise results, quality, throughput, and efficiency on the shop floor; advanced management of production processes.
7. Networked Factory	Innovation culture	No structured innovation, accidental.	Innovations by limited groups at specific challenges.	Innovation plan and work meeting for idea collection.	The innovation process is supported by the management system.	Innovation supported by the whole organisation, long-term effects.
7. Networked Factory	Innovation based on partnerships	No collaborations.	Occasional collaborations at the opportunity.	Structural collaborations for sharing knowledge.	Extensive networks for access to external knowledge.	Leader in the international innovation network

						transcends own competencies.
7. Networked Factory	Supply chain management	Not set up for rapid changes.	Long-term adjustments are possible.	Adjustments at the project level in the supply chain.	Flexible, small supply chain, expandable with partners.	Dynamic network adjusted to service provision and demand.
7. Networked Factory	Beyond customer and supplier needs	Besides customers and suppliers, there are no other stakeholders actively approached by the company.	It is determined who the relevant groups of stakeholders are and they are approached now and then in a defensive, reactive manner.	It is determined who the individual stakeholders are and they are actively involved in specific activities.	Systematically taking into account the needs of a large number of stakeholders.	The company has developed a broad range of expertise and a large network for knowledge exchange/expanded with numerous proactively managed stakeholders.
7. Networked Factory	External knowledge is limited and not centrally stored.	Sporadic attempts to collect external knowledge.	First steps towards a management system for external knowledge.	Formal management system for active use of external knowledge.	Trend watching by all employees, knowledge sharing formal and informal.	All individual employees work as a kind of trend watchers intrinsically and independently on gathering external knowledge and passing this knowledge

						both formally and informally to colleagues.
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Annexe Two – Questions Delphi Round One

Table 4

Delphi round one - questions

Q1	Is the safety professional ready for the industry 4.0?
Q2	The current risk assessment models are sufficient to cope with the automatization and interactions between humans and automated robots
Q3	The safety professional should be a business partner rather than an advisor
Q4	OH&S policy should balance the goal conflicts between people, growth and operations. The policy should be based on normal work and envision making work more successful.
Q5	Safety professionals are aware of the latest developments in OH&S worldwide, including technology, social sciences and engineered controls. Safety professionals should use the knowledge to understand work done to improve the workplace.
Q6	The safety department is continually looking at risks and anticipating future operational scenarios to strengthen the resilience within the organisation.
Q7	Safety is an integrated part of the working methods. The feedback loop is closed by debriefings of high-risk work.
Q8	The organisation invests in risk reduction by allocating resources to create operational intelligence. There is a continuous focus on reliable safe operations.
Q9	The Safety department invests in the digitalisation of tools such as checklists, procedures and instructions. This data is combined with other safety-related data to make decisions based on the latest information.
Q10	Safety professionals ensure that compliance (legal and group) is an integrated part of the day-to-day work. There is competence building on every level with the integration of the day-to-day data.
Q11	Safety professionals function as partners between the frontline workforce and the management. Helping both to balance operational demands, learning and innovation.
Q12	OH&S policies are based and updated on the operational needs. The OH&S workers serve the operational teams by systematically collecting and processing the data from daily work.

Q13	The OH&S department is a partner in the company, understanding the challenges of those who do the day-to-day work. Safety is integrated from start to finish in projects as in daily work.
Q14	There is a monitoring plan that collects operational and planned data. The KPIs are built from big data, thick data (story/learning) and rich data (analytics). The sensitivity to the operations leads to proactively anticipate
Q15	Frontline workers are the main information of operational intelligence. The safety department supports the operational groups to create a shared view of risk that is constantly updated because of the new knowledge that is created.
Q16	Tiger teams are created to develop new methods of risk management and operational learning. These tiger teams are multi-disciplinary and exist out of the most knowledgeable persons on the subject with a high understanding of the complexity and operational challenges.
Q17	Safety is seen as a moral responsibility for all actors, the OH&S plan adapts to the needs of this responsibility in collaboration with all levels within the enterprise. All workers are expected to provide ideas that lead to a better workplace
Q18	The safety department fosters a culture of speaking up where all levels of the organisation can address issues. These issues can be reactive or proactive. The individual parts understand that the emergent property of the organisation supersedes their objectives.
Q19	Operational learning focuses on the interaction between humans and machines, providing error-tolerant operations. The boundaries of humans and machines are known to the organisation and work together to extend these boundaries.
Q20	The notion of coupling and interaction is known by all stakeholders in the organisation. Sense-making of situations is done from a holistic perspective, in-depth and in time
Q21	As failure is expected, the organisation invests in the resilience of the workforce as a process. The innovation to build resilience comes from all layers of the organisation.
Q22	The organisation invests in knowledge from internal and external sources. All departments actively work with external umbrella companies to solve complex issues and integrate that knowledge into their workgroups.

Q23	The safety department works intensively with external knowledge bodies such as universities, workgroups and interest groups to adapt to new knowledge.
Q24	OH&S policy should balance the goal conflicts between people, growth and operations. The policy should be based on normal work and envision making work more successful.
Q25	Safety professionals are aware of the latest developments in OH&S worldwide, including technology, social sciences and engineered controls. Safety professionals should use the knowledge to understand work done to improve the workplace.
Q26	the safety department is continually looking at risks and anticipating future operational scenarios to strengthen the resilience of the organisation.
Q27	Safety is an integrated part of the working methods. The feedback loop is closed by debriefings of high-risk work.
Q28	The organisation invest in risk reduction by allocating resources to create operational intelligence. There is a continuous focus on reliable safe operations.
Q29	The Safety department invests in the digitalisation of tools such as checklists, procedures and instructions. This data is combined with other safety-related data to make decisions based on the latest information.
Q30	Safety professionals ensure that compliance (legal and group) is an integrated part of the day-to-day work. There is competence building on every level with the integration of the day-to-day data.
Q31	Safety professionals function as partners between the frontline workforce and the management. Helping both to balance operational demands, learning and innovation. ²
Q32	OH&S policies are based and updated on the operational needs. The OH&S workers serve the operational teams by systematically collecting and processing the data from daily work.
Q33	The OH&S department is a partner in the company, understanding the challenges of those who do the day-to-day work. Safety is integrated from start to finish in projects as in daily work.
Q34	There is a monitoring plan that collects operational and planned data. The KPIs are built from big data, thick data (story/learning) and rich data (analytics). The sensitivity to the operations leads to proactively anticipate

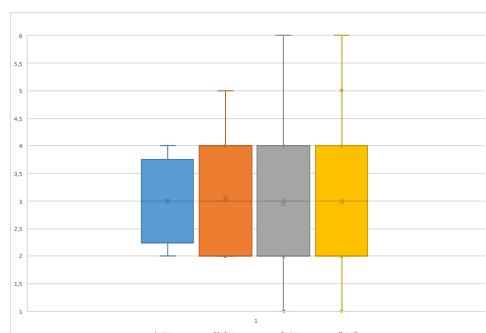
Q35	Frontline workers are the main information of operational intelligence. The safety department supports the operational groups to create a shared view of risk that is constantly updated because of the new knowledge that is created.
Q36	Tiger teams are created to develop new methods of risk management and operational learning. These tiger teams are multi-disciplinary and exist out of the most knowledgeable persons on the subject with a high understanding of the complexity and operational challenges.
Q37	Safety is seen as a moral responsibility for all actors, the OH&S plan adapts to the needs of this responsibility in collaboration with all levels within the enterprise. All workers are expected to provide ideas that lead to a better workplace
Q38	The safety department fosters a culture of speaking up where all levels of the organisation can address issues. These issues can be reactive or proactive. The individual parts understand that the emergent property of the organisation supersedes their objectives.
Q39	Operational learning focuses on the interaction between humans and machines, providing error-tolerant operations. The boundaries of humans and machines are known to the organisation and work together.
Q40	The notion of coupling and interaction is known by all stakeholders in the organisation. Sense-making of situations is done from a holistic perspective, in-depth and in time
Q41	As failure is expected, the organisation invests in the resilience of the workforce as a process. The innovation to build resilience comes from all layers of the organisation.
Q42	The organisation invests in knowledge from internal and external sources. All departments actively work with external umbrella companies to solve complex issues and integrate that knowledge into their workgroups.
Q43	The safety department works intensively with external knowledge bodies such as universities, workgroups and interest groups to adapt to new knowledge.
Open Q1	What is safety in your own words?
Open Q2	What is resilience in your own words?

Annexe Three – Results Delphi Round One

Q1: Is the safety professional ready for the industry 4.0?

Figure 1

Question 1 result



The average readiness scores indicate that, on average, Junior professionals perceive to be more for the future (result 3.00), Medior professionals score themselves 3.07, and Senior professionals score 2.95. The overall average readiness score is 2.98. This suggests a relatively consistent level of readiness across experience levels, with a slight increase in readiness from Junior to Medior professionals.

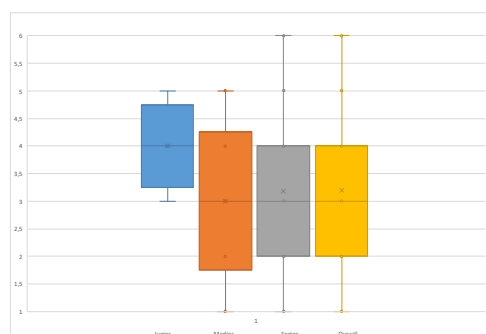
The IRQ values (0.5 for Junior, 2 for Medior, 2 for Senior) indicate that the scores are clustered closely around the median for each experience level. The data points are relatively concentrated within a narrow range, suggesting a degree of consensus among respondents within each group.

The small standard deviation (0.82 for Junior, 1 for Medior, 1.13 for Senior) values suggest a relatively low variability in scores within each experience level, indicating a degree of agreement among respondents.

Q2: The current risk assessment models are sufficient to cope with the automatisation and interactions between humans and automated robots.

Figure 2

Question 2 result

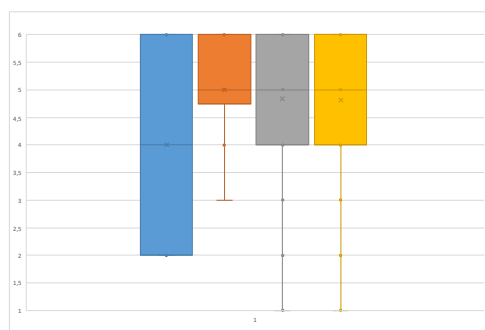


On average, the perception of the sufficiency of current risk assessment models is moderate, with an overall average score of 3.2. The scores indicate that, on average, Senior professionals tend to perceive the sufficiency of the models slightly higher (3.189) compared to Junior (4) and Medior (3) professionals. The IRQ values (0.5 for Junior, 2 for Medior, 2 for Senior) suggest that there is a degree of consensus or agreement within each experience level regarding the sufficiency of current risk assessment models. The relatively small IRQ values indicate that responses are clustered closely around the median within each group. The standard deviation values (0.82 for Junior, 1.47 for Medior, 1.39 for Senior) provide a measure of the variability or spread of scores around the mean. The standard deviation values suggest a higher variability in perceptions among Medior and Senior professionals compared to Junior professionals.

Q3: The safety professional should be a business partner rather than an advisor.

Figure 3

Question 3 result



On average, the perception is that safety professionals should act more as business partners, with an overall average score of 4.82. Medior professionals have the highest average score (5), indicating a strong belief in the idea that safety professionals should be business partners. Senior professionals also have a relatively high average score (4.84), while Junior professionals have a lower average score (4). The IRQ values (4 for Junior, 0.75 for Medior, 2 for Senior) suggest that there is a considerable difference in opinions within the Junior group, a relatively smaller difference within the Medior group, and a moderate difference within the Senior group. The larger IRQ for Junior professionals indicates a wider range of opinions compared to the other experience levels. The standard deviation values (2.31 for Junior, 0.88 for Medior, and 1.44 for Senior) provide a measure of the variability or spread of scores around the mean. The high standard deviation for Junior professionals suggests a higher variability in opinions within this group compared to Medior and Senior professionals.

Q4 & Q24: OH&S policy should balance the goal conflicts between people, growth, and operations. The policy should be based on normal work and envision making work more successful.

Figure 4

Question 4 result – future state

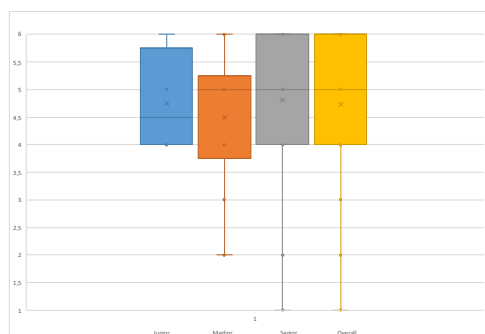
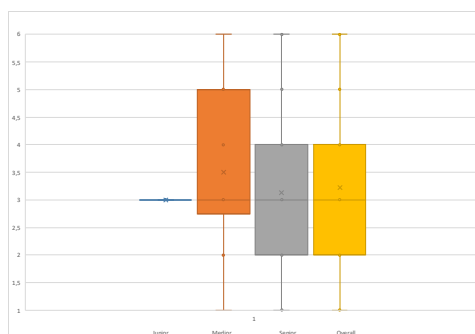


Figure 5

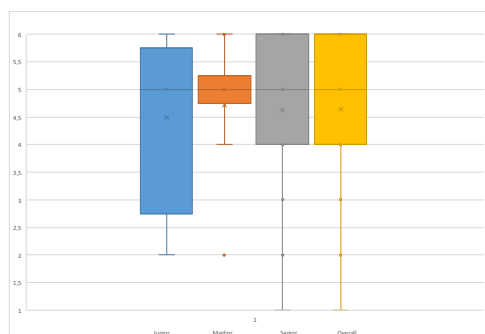
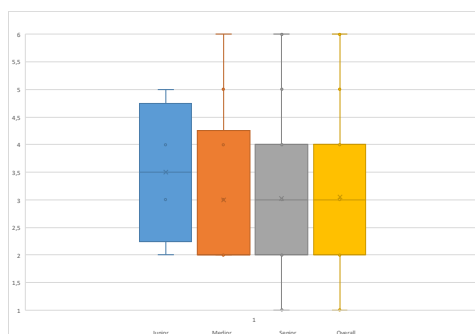
Question 24 result – current state



The ideal state average scores indicate a positive perception overall, with an average score of 4.73. The current state indicates a less positive perception, with an overall average score of 3.22. Senior professionals have the highest average score in the ideal state (4.81), indicating a strong belief that OH&S policies should balance goal conflicts effectively.

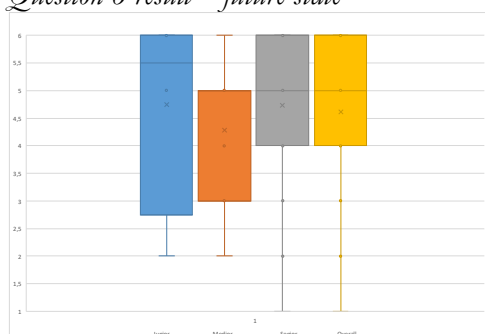
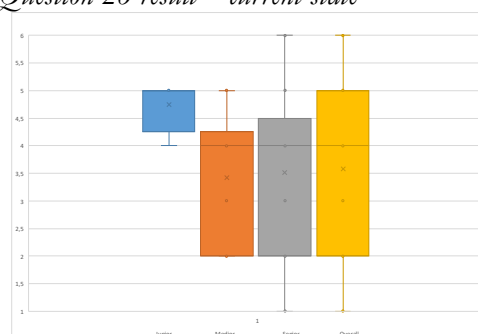
The IRQ values (1.25 for Junior, 1 for Medior, 2 for Senior) suggest that there is a notable difference in opinions within each experience level for the ideal state, as in the current state (0 for Junior, 1.75 for Medior, 2 for Senior). The standard deviation values (0.96 for Junior, 1.34 for Medior, 1.29 for Senior) suggest a moderate variability in perceptions within each experience level for the ideal state and in the current state (0 for Junior, 1.40 for Medior, 1.57 for Senior).

Q5 & Q25: Safety professionals are aware of the latest developments in OH&S worldwide, including technology, social sciences and engineered controls. Safety professionals should use the knowledge to understand work as done to improve the workplace.

Figure 6*Question 5 result – future state***Figure 7***Question 25 result – current state*

The ideal state average scores indicate a positive perception overall, with an average score of 4.64, whilst the current state indicates a less positive perception, with an overall average score of 3.11. Medior professionals have the highest average score (4.71), followed closely by Senior professionals (4.62). IRQ values for the ideal state (1 for Junior, 0 for Medior, 2 for Senior) and current state (1.5 for Junior, 1.75 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the ideal (1.73 for Junior, 1.27 for Medior, 1.44 for Senior) and current state (1.5 for Junior, 1.75 for Medior, 2 for Senior) suggest a moderate variability in perceptions within each experience level.

Q6 & Q26: the safety department is continually looking at risks and anticipating future operational scenarios to strengthen organisational resilience.

Figure 8*Question 6 result – future state***Figure 9***Question 26 result – current state*

The ideal state average scores indicate a positive perception overall, with an average score of 4.62. The average scores for the current state indicate a less positive perception, with an overall average score of 3.58. The IRQ values for the ideal state (1.75 for Junior, 1.75 for Medior, and 2 for Senior) suggest some variability in opinions within each experience level. For the

current state, the IRQ values (0.25 for Junior, 2 for Medior, and 2 for Senior) suggest a notable difference in opinions within each experience level. The standard deviation values of the ideal (1.89 for Junior, 1.14 for Medior, 1.33 for Senior) and current state (0.5 for Junior, 1.22 for Medior, 1.45 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q7 & Q27: Safety is an integrated part of the working methods. The feedback loop is closed by debriefings of high-risk work.

Figure 10
Question 7 result – future state

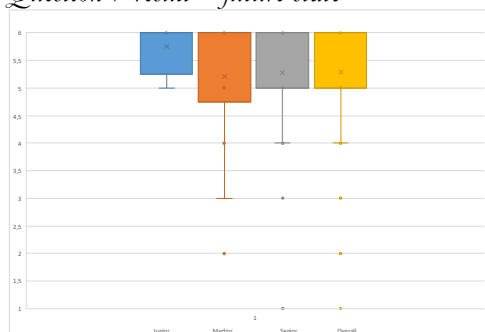
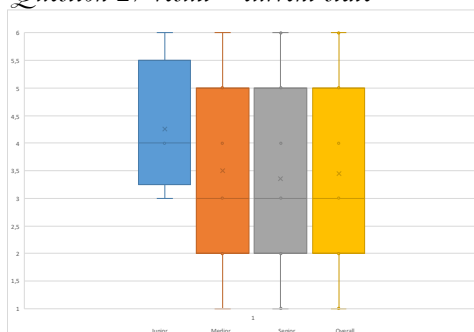


Figure 11
Question 27 result – current state



The ideal state average scores indicate a positive perception overall, with an average score of 5.29. The average scores for the current state indicate a less positive perception, with an overall average score of 3.45. The IRQ values for the ideal (0.25 for Junior, 1 for Medior, 1 for Senior) and current state (0.75 for Junior, 2.75 for Medior, 3 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the ideal state (0.5 for Junior, 1.31 for Medior, 1.12 for Senior) suggest a moderate variability in perceptions within each experience level. The standard deviation values of the current state (1.26 for Junior, 1.51 for Medior, 1.62 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q8 & Q28: The organisation invests in risk reduction by allocating resources to create operational intelligence. There is a continuous focus on reliable safe operations.

Figure 12

Question 8 result – future state

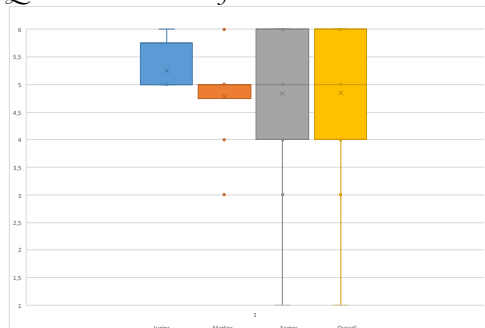
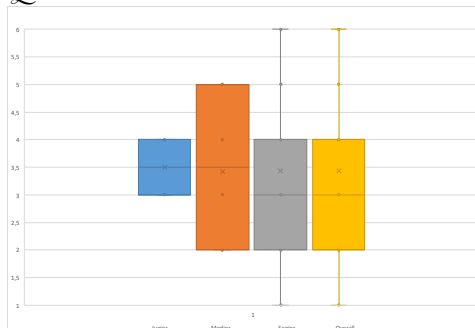


Figure 13

Question 28 result – current state



The ideal state average scores indicate a positive perception overall, with an average score of 4.85. The average scores for the current state indicate a less positive perception, with an overall average score of 3.44. The IRQ values for the ideal (0.25 for Junior, 0 for Medior, 2 for Senior) and current state (1 for Junior, 2.75 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the future (0.5 for Junior, 0.70 for Medior, 1.26 for Senior) and current state (0.58 for Junior, 1.28 for Medior, 1.37 for Senior) suggest a low to moderate variability in perceptions within each experience level.

Q09 & Q29: The Safety department invests in the digitalisation of tools such as checklists, procedures and instructions. This data is combined with other safety-related data to make decisions based on the latest information.

Figure 14

Question 9 result – future state

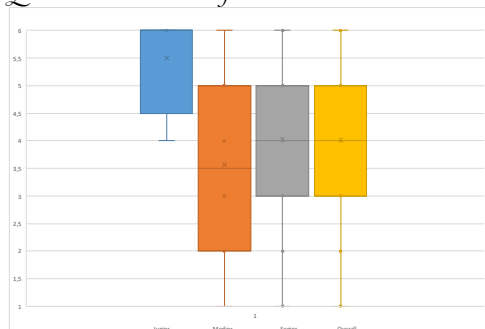
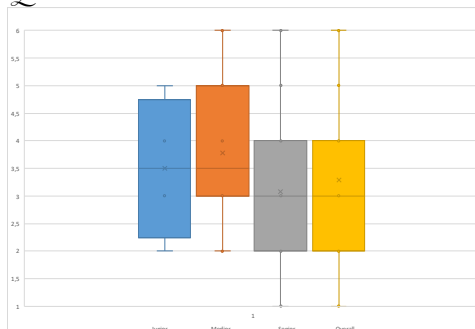


Figure 15

Question 29 result – current state



The ideal state average scores indicate a positive perception overall, with an average score of 4.02. The average scores for the current state indicate a less positive perception, with an

overall average score of 3.29. The IRQ values of the future (0.5 for Junior, 2.75 for Medior, 2 for Senior) and current state (1.5 for Junior, 1.75 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values of the future (1 for Junior, 1.50 for Medior, 1.52 for Senior) and current state (1.29 for Junior, 1.31 for Medior, 1.52 for Senior) suggest a moderate variability in perceptions within each experience level.

Q10 & Q30: Safety professionals ensure that compliance (legal and group) is an integrated part of the day-to-day work. There is competence building on every level with the integration of the day-to-day data.

Figure 16

Question 10 result – future state

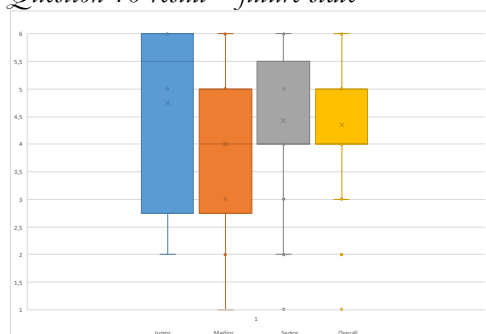
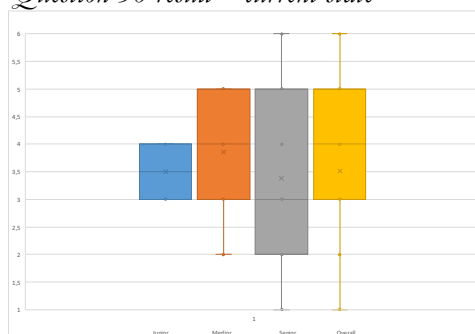


Figure 17

Question 30 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.35. The average scores for the current state indicate a less positive perception, with an overall average score of 3.51. The IRQ values of the future state (1.75 for Junior, 1.75 for Medior, 1 for Senior) suggest some variability in opinions within each experience level. The IRQ of the current state (1 for Junior, 1.5 for Medior, 3 for Senior) suggest a notable difference in opinions within each experience level. The standard deviation values of the future (1.89 for Junior, 1.52 for Medior, 1.28 for Senior) and current state (0.58 for Junior, 1.03 for Medior, 1.55 for Senior) suggest a moderate variability in perceptions within each experience level.

Q11 & Q31: safety professionals function as partners between the frontline workforce and the management. Helping both to balance operational demands, learning and innovation.

Figure 18

Question 11 result – future state

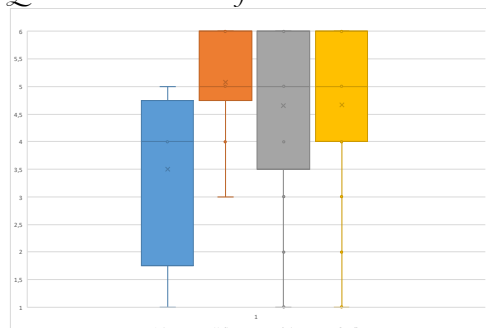
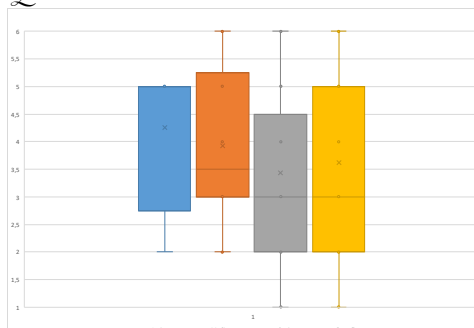


Figure 19

Question 31 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.67. The IRQ values (1 for Junior, 1 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values (1.73 for Junior, 0.92 for Medior, 1.55 for Senior) suggest a moderate variability in perceptions within each experience level. The average scores for the current state indicate a less positive perception, with an overall average score of 3.62. The IRQ values (0.75 for Junior, 2 for Medior, and 2 for Senior) suggest a notable difference in opinions within each experience level. The standard deviation values (1.5 for Junior, 1.44 for Medior, 1.54 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q12 & Q32: OH&S policies are based and updated on the operational needs. The OH&S workers serve the operational teams by systematically collecting and processing the data from daily work.

Figure 20

Question 12 result – future state

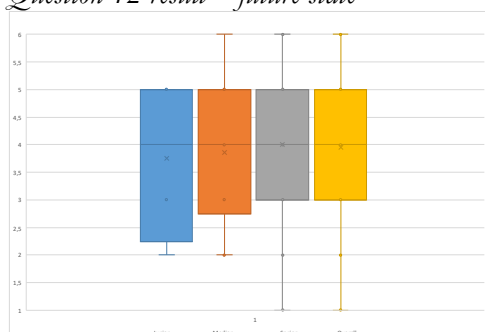
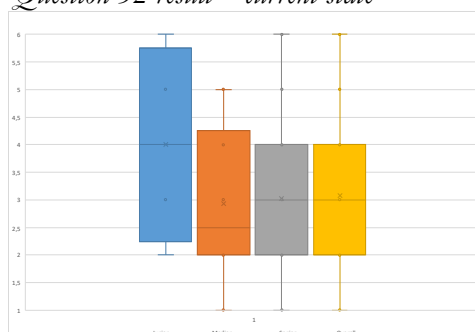


Figure 21

Question 32 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.67. The average scores for the current state indicate a less positive perception, with an overall average score of 3.62. The IRQ values of the future (1 for Junior, 1 for Medior, 2 for Senior) and current state (0.75 for Junior, 2 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the future state (1.73 for Junior, 0.92 for Medior, 1.55 for Senior) suggest a moderate variability in perceptions within each experience level. The standard deviation values (1.5 for Junior, 1.44 for Medior, 1.54 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q13 & Q33: The OH&S department is a partner in the company, understanding the challenges of those who do the day-to-day work. Safety is integrated from start to finish in projects as in daily work.

Figure 22

Question 13 result – future state

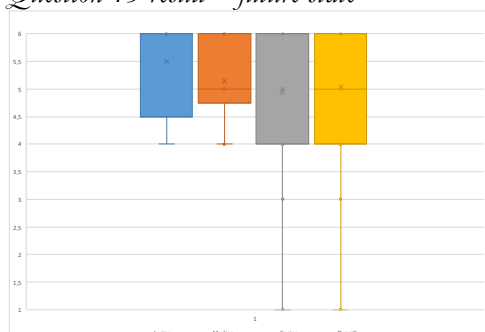
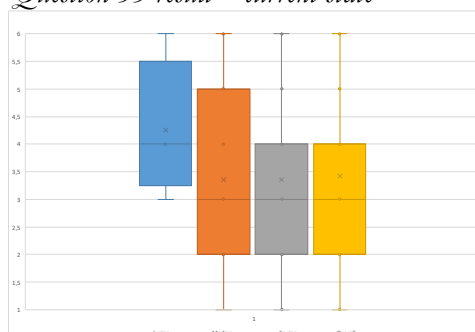


Figure 23

Question 33 result – current state



The future state average scores indicate a highly positive perception overall, with an average score of 5.04. The average scores for the current state indicate a moderate perception, with an overall average score of 3.42. The IRQ values for the future (0.5 for Junior, 1 for Medior, 2 for Senior) and current state (0.75 for Junior, 2.75 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values of the future state (1 for Junior, 0.77 for Medior, 1.39 for Senior) suggest a moderate variability in perceptions within each experience level. The standard deviation values of the current state (1.26 for Junior, 1.60 for Medior, 1.60 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q14 & Q34: There is a monitoring plan that collects operational and planned data. The KPIs are built from big data, thick data (story/learning) and rich data (analytics). The sensitivity to the operations leads to proactively anticipate.

Figure 24

Question 14 result – future state

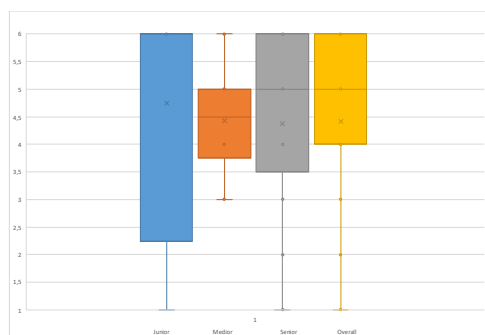
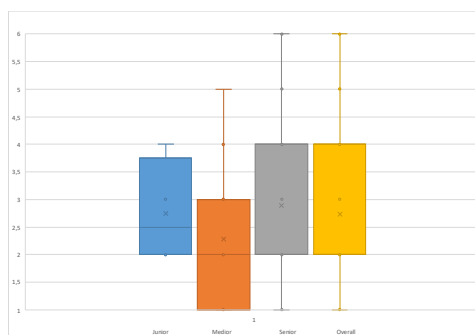


Figure 25

Question 34 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.42. The average scores for the current state indicate a less positive perception, with an overall average score of 2.73. The IRQ values of the future (1.25 for Junior, 1 for Medior, 2 for Senior) and current state (1.25 for Junior, 1.75 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the future (2.5 for Junior, 1.02 for Medior, 1.53 for Senior) and (0.96 for Junior, 1.20 for Medior, 1.68 for Senior) suggest a high variability in perceptions within each experience level.

Q15 & Q35: Frontline workers are the main information of operational intelligence.

The safety department supports the operational groups to create a shared view of risk that is constantly updated because of the new knowledge that is created.

Figure 26

Question 15 result – future state

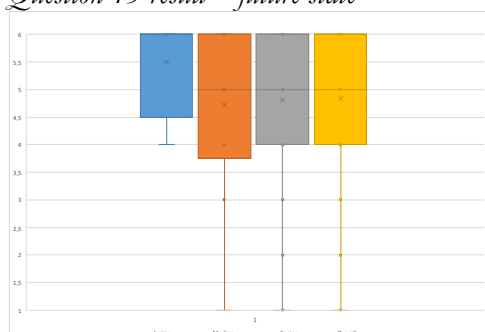
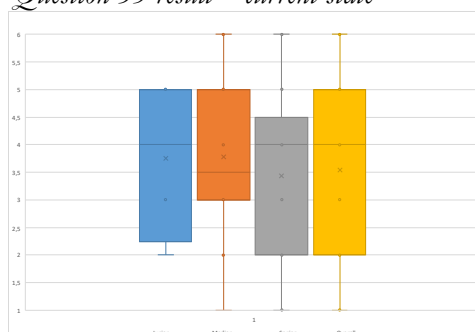


Figure 27

Question 35 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.84. The average scores for the current state indicate a positive perception, with an overall average score of 3.55. The IRQ values for the future (0.5 for Junior, 2 for Medior, 2 for Senior) and current state (2.25 for Junior, 2 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values for the future (1 for Junior, 1.54 for Medior, 1.49 for Senior) and current state (1.5 for Junior, 1.48 for Medior, 1.59 for Senior) suggest a moderate variability in perceptions within each experience level.

Q16 & Q36: Tiger teams are created to develop new methods of risk management and operational learning. These tiger teams are multi-disciplinary and exist out of the most knowledgeable persons on the subject with a high understanding of the complexity and operational challenges.

Figure 28

Question 16 result – future state

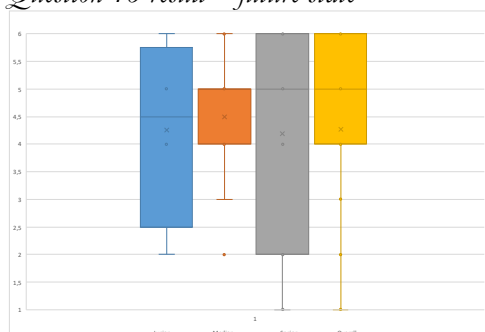
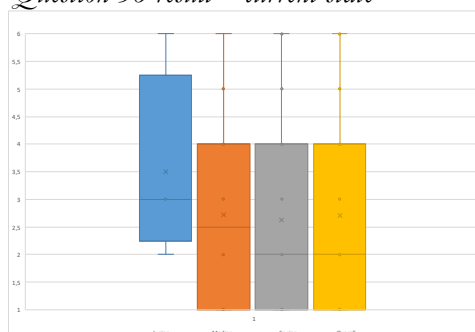


Figure 29

Question 36 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.84, and the current state has an overall average score of 3.55. The IRQ values of the future (0.5 for Junior, 2 for Medior, 2 for Senior) and current state (2.25 for Junior, 2 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values of the future state (1 for Junior, 1.54 for Medior, 1.49 for Senior) suggest a moderate variability in perceptions within each experience level. The standard deviation values of the current (1.5 for Junior, 1.48 for Medior, 1.59 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q17 & Q37: Safety is seen as a moral responsibility for all actors, the OH&S plan adapts to the needs of this responsibility in collaboration with all levels within the enterprise. All workers are expected to provide ideas that lead to a better workplace.

Figure 30
Question 17 result – future state

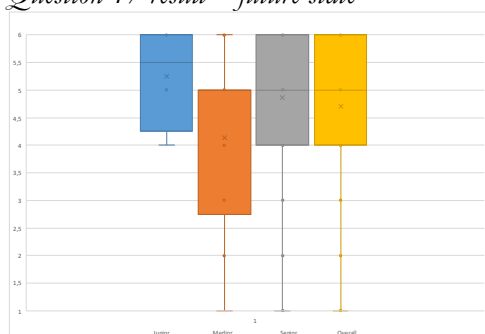
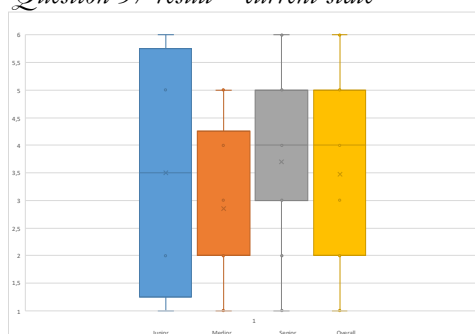


Figure 31
Question 37 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.71. The average scores for the current state indicate a less positive perception, with an overall average score of 3.47. The IRQ values of the future (1.25 for Junior, 1.75 for Medior, 2 for Senior) and current state (3.5 for Junior, 2 for Medior, 2 for Senior) suggest some variability in opinions within each experience level. The standard deviation values of the future state (0.96 for Junior, 1.56 for Medior, 1.42 for Senior) suggest a moderate variability in perceptions within each experience level. The standard deviation values of the current state (2.38 for Junior, 1.46 for Medior, 1.33 for Senior) suggest a moderate to high variability in perceptions within each experience level.

Q18 & Q38: The safety department fosters a culture of speaking up where all levels of the organisation can address issues. These issues can be reactive or proactive. The individual parts understand that the emergent property of the organisation supersedes their objectives.

Figure 32

Question 18 result – future state

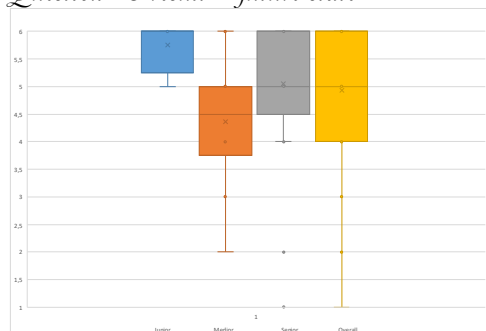
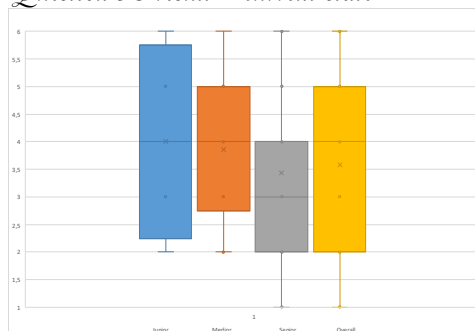


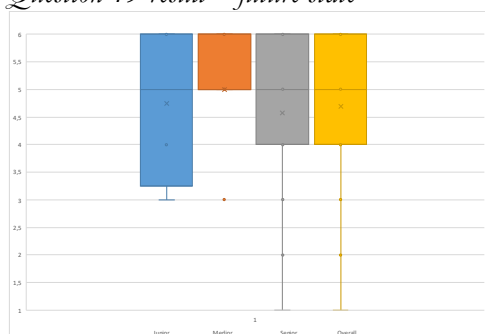
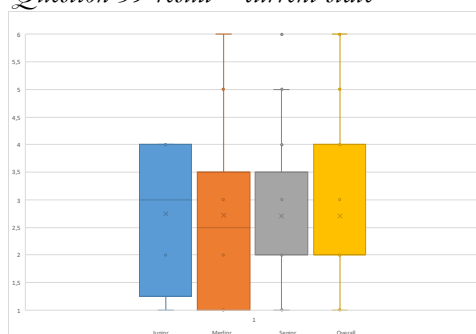
Figure 33

Question 38 result – current state



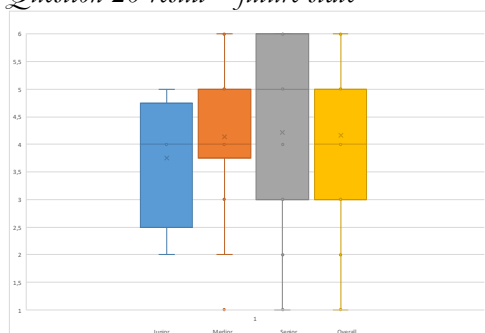
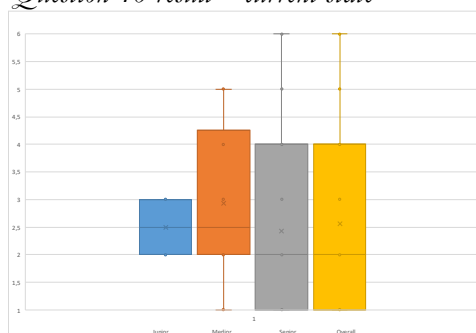
The future state average scores indicate a positive perception overall, with an average score of 4.93. The average scores for the current state indicate a less positive perception, with an overall average score of 3.58. The IRQ values of the future state (0.25 for Junior, 1 for Medior, 1 for Senior) suggest minimal variability in opinions within each experience level. Whilst the IRQ values of the current state (2.5 for Junior, 1.5 for Medior, 2 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values of the future state (0.5 for Junior, 1.15 for Medior, 1.27 for Senior) suggest low to moderate variability in perceptions within each experience level. The standard deviation values of the current state (1.83 for Junior, 1.23 for Medior, 1.46 for Senior) suggest moderate variability in perceptions within each experience level.

Q19 & Q39: Operational learning focuses on the interaction between humans and machines, providing error-tolerant operations. The boundaries of humans and machines are known to the organisation and work together to extend these boundaries.

Figure 34*Question 19 result – future state***Figure 35***Question 39 result – current state*

The future state average scores indicate a positive perception overall, with an average score of 4.69. The IRQ values of the future (2.25 for Junior, 0.75 for Medior, 2 for Senior) and current state (2.25 for Junior, 1.75 for Medior, 1 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values for the future (1.5 for Junior, 0.96 for Medior, 1.46 for Senior) and current state (1.5 for Junior, 1.64 for Medior, 1.37 for Senior) suggest moderate variability in perceptions within each experience level.

Q20 & Q40: the notion of coupling and interaction is known by all stakeholders in the organisation. Sensemaking of situations is done from a holistic perspective, in-depth and in time.

Figure 36*Question 20 result – future state***Figure 37***Question 40 result – current state*

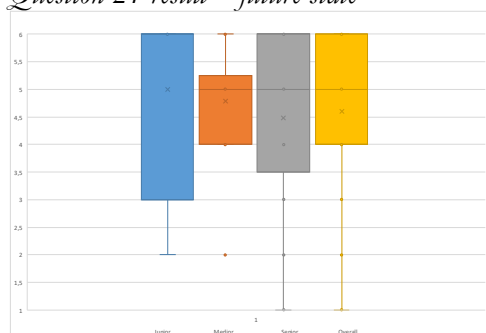
The future state average scores indicate a moderately positive perception overall, with an average score of 4.16. The IRQ values (0.75 for Junior, 1 for Medior, and 3 for Senior) suggest variability in opinions within each experience level. The standard deviation values (1.26 for Junior, 1.41 for Medior, 1.67 for Senior) suggest moderate to high variability in perceptions within each experience level. The average scores for the current state indicate a moderately

positive perception, with an overall average score of 2.56. The IRQ values (1 for Junior, 2 for Medior, and 3 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values (0.58 for Junior, 1.44 for Medior, and 1.46 for Senior) suggest low to moderate variability in perceptions within each experience level.

Q21 & Q41: As failure is expected, the organisation invests in the resilience of the workforce and the process. The innovation to build resilience comes from all layers of the organisation.

Figure 38

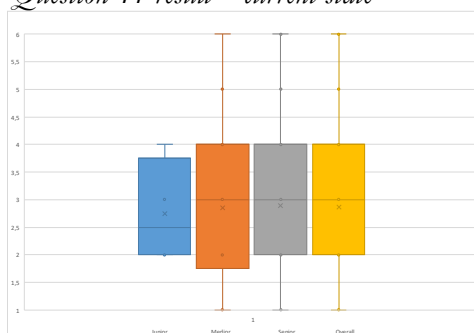
Question 21 result – future state



The future state average scores indicate a positive perception overall, with an average score of 4.6. The IRQ values (1 for Junior, 0.75 for Medior, and 2 for Senior) suggest variability in opinions within each experience level. The standard deviation values (2 for Junior, 1.05 for Medior, 1.61 for Senior) suggest moderate to high variability in perceptions within each experience level.

Figure 39

Question 41 result – current state



The average scores for the current state indicate a less positive perception, with an overall average score of 2.87. The IRQ values (1.25 for Junior, 1.75 for Medior, and 2 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values (0.96 for Junior, 1.51 for Medior, and 1.51 for Senior) suggest moderate to high variability in perceptions within each experience level.

Q22 & Q42: The organisation invests in knowledge from internal and external sources.

All departments actively work with external umbrella companies to solve complex issues and integrate that knowledge into their workgroups.

Figure 40

Question 22 result – future state

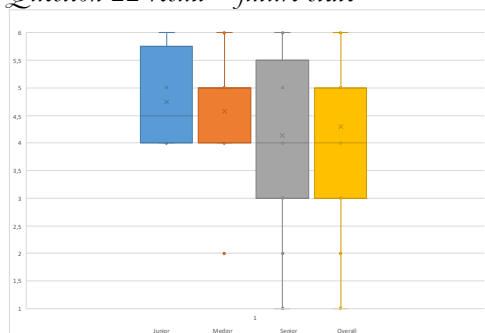
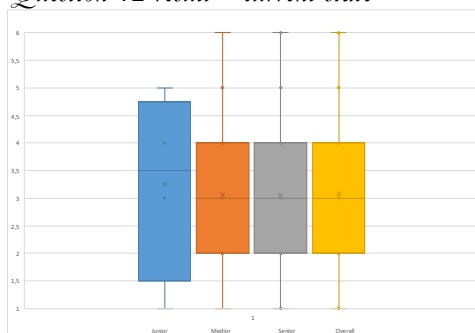


Figure 41

Question 42 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.29. The average scores for the current state indicate a moderately positive perception, with an overall average score of 3.07. The IRQ values of the future state (1.25 for Junior, 0.75 for Medior, and 2 for Senior) suggest variability in opinions within each experience level. The IRQ values of the current state (1.75 for Junior, 2 for Medior, and 2 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values for the future state (0.96 for Junior, 1.22 for Medior, 1.46 for Senior) suggest moderate variability in perceptions within each experience level. The standard deviation values for the current state (1.71 for Junior, 1.38 for Medior, 1.49 for Senior) suggest moderate to high variability in perceptions within each experience level.

Q23 & Q43: The safety department works intensively with external knowledge bodies such as universities, workgroups and interest groups to adapt to new knowledge.

Figure 42

Question 23 result – future state

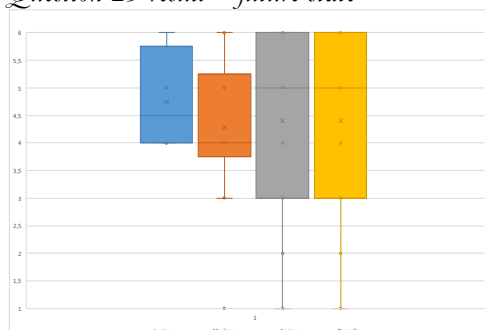
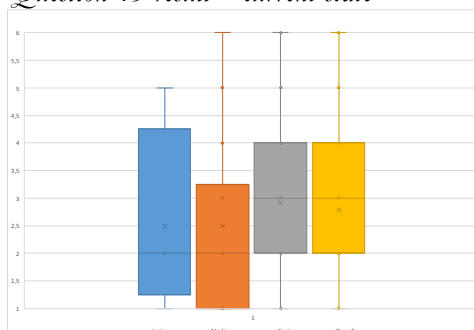


Figure 43

Question 43 result – current state



The future state average scores indicate a positive perception overall, with an overall average score of 4.4. The IRQ values (1.25 for Junior, 1 for Medior, and 3 for Senior) suggest variability in opinions within each experience level. The standard deviation values (0.96 for Junior, 1.38 for Medior, and 1.61 for Senior) suggest moderate to high variability in perceptions within each experience level. The average scores for the current state indicate a moderately positive perception, with an overall average score of 2.78. The IRQ values (1 for Junior, 1.75 for Medior, and 2 for Senior) suggest notable variability in opinions within each experience level. The standard deviation values (1.73 for Junior, 1.56 for Medior, 1.5 for Senior) suggest moderate to high variability in perceptions within each experience level.

Annexe Four – Open Question: What Is Safety?

Table 5

What is safety in your own words (open question, no response = “no answer given”)

nr	How many years of experience do you have?	What is safety in your own words?
1	Medior (5 =< 15 years)	No answer given
2	Senior (>15 years)	No answer given
3	Medior (5 =< 15 years)	The safe way of working is percipience to be the easiest and most logical way of working.
4	Medior (5 =< 15 years)	In organisational settings, safety is often a core value and a top priority. It involves implementing measures and protocols to prevent accidents, injuries, and adverse incidents. This may include creating a safe work environment, providing necessary training, adhering to industry standards, and establishing emergency procedures.
5	Senior (>15 years)	Ensuring success, not preventing incidents and accidents. Safety is not an outcome; safety is a process that is embedded in everything you do. Safety is inherent in all aspects of business operations, from the design of the organisation, processes, products, and workplaces, through operational control to continuous learning and improvement. Safety is about feeling secure and being safe.
6	Medior (5 =< 15 years)	We'll try to get everybody home safely at the end of the day.
7	Senior (>15 years)	Sound operational competence resulting from proper hiring and onboarding. Controls are integrated within procedures that are followed by the workers who carry them out, participate in the procedure creation, and actively update. Park front-line management actively sets expectations about risk tolerance while continually communicating what is a priority, so

		workers do not let to succumb to inundation and self-imposed time pressures
8	Senior (>15 years)	The reliable execution of work activities that otherwise could involve hazardous energies or unmanned risks harming people or the environment.
9	Medior (5 =< 15 years)	Safety, for me, refers to the condition of being free from harm, danger, or risk. It encompasses both physical and psychological well-being, ensuring that individuals and their environment are protected from potential hazards or adverse events. Safety is a fundamental human need and a critical aspect of maintaining a secure and stable society.
10	Senior (>15 years)	Safety is a holistic approach to work, aiming to execute it as optimally as possible with minimal collateral damage.
11	Senior (>15 years)	Manage the variability of performance to make work succeed
12	Senior (>15 years)	people relation
13	Senior (>15 years)	The organisational capacities to assess risks and respond to hazards & threats.
14	Senior (>15 years)	Presence of capacity and active barrier management
15	Senior (>15 years)	Absence of harm
16	Medior (5 =< 15 years)	Looking with a multi-disciplinary team to day-to-day operations to understand how we can work in a safe operation.
17	Senior (>15 years)	Everyone goes home every day unharmed by the business operations. As more technology is introduced, digitalisation of systems with AI

		checking of outputs/results, the human error element is being reduced, and better controlled.
18	Senior (>15 years)	presence of capacity
19	Medior (5 =< 15 years)	When you are trying to figure out in advance a safe way to act or operate and where the environment/surroundings are allowing you to do so.
20	Senior (>15 years)	This extends to the use of controls
21	Junior (= < 5 years)	Being able to fail at your task in a way you are not hurt and able to recover the work quickly.
22	Senior (>15 years)	The continuous and open discussion on how to maintain the welfare of everyone within a company (including contractors) and help each other to participate accordingly.
23	Senior (>15 years)	The presence of capacity, developing good controls, expecting error and working with teams on ways to fail safely.
24	Senior (>15 years)	In my perspective, safety is the state of being shielded from harm, risk, or injury. It's not merely about the absence of accidents or incidents but is a proactive process of identifying potential hazards, assessing risks, and taking preventative actions. Within the context of our normal operations, safety is a fundamental principle that underlies every procedure and decision. It involves fostering a culture where every member is not just adhering to safety regulations but actively participating in the continuous improvement of our safety measures. We perceive safety as a shared responsibility - it's an integral part of our daily tasks and long-term goals.
25	Junior (= < 5 years)	Safety is a part of the job

26	Senior (>15 years)	Personal awareness of possible consequences through dissecting and understanding tasks and associated risks - establishing a working methodology for low-risk execution. continuous monitoring and adjusting where necessary
27	Medior (5 =< 15 years)	Safety is the degree of absence of potential causes of a hazardous (losses) situation or the degree of presence of protective measures against every type of Loss: unplanned cost (e.g., safety, process safety, reliability, environmental, regulatory, equipment & property damage, product quality, etc.)
28	Medior (5 =< 15 years)	Safety is the degree of absence of potential causes of a hazardous (losses) situation or the degree of presence of protective measures against every type of Loss: unplanned cost (e.g., safety, process safety, reliability, environmental, regulatory, equipment & property damage, product quality, etc.)
29	Senior (>15 years)	Too complex to answer within the 20 minutes allocated for this questionnaire.
30	Senior (>15 years)	Hard question. Not as the absence of accidents, but more about capacities (and the willingness, ...) to respond and (pro-) actively adapt/act on dynamic and changing risks.
31	Senior (>15 years)	being able to do the work that you want to do in a way that has the least amount of unwanted effects, given the knowledge that you have at that moment and within the circumstances that you are at that moment.
32	Senior (>15 years)	Safety is an emergent property of a sociotechnical complex system - like efficiency, accidents, quality, and cost-benefit.

33	Senior (>15 years)	As you come, you can leave the workplace with; the same health; by continuously keeping in mind that safe operations are a priority for everyone.
34	Senior (>15 years)	Enabling continuous acceptable levels of system risk throughout the system and adverse progression life cycles via continuous validation and verification of risk controls; while noting the inclusive system and not fixating on OSH risk, with the consideration of system assurance risks.
35	Senior (>15 years)	Safety is as much as possible going right, no one feels pain as a result of work (theirs or others)
36	Senior (>15 years)	Be aware of risks and know to react appropriately and take action
37	Senior (>15 years)	Safety is part of the daily business. I think we have very much focus on safety.
38	Junior (= < 5 years)	Safety exists when there is an allowance for things to go wrong/people to be wrong.
39	Senior (>15 years)	impact positively people, assets and the environment by fostering/guaranteeing processes that improve health, safety and security.
40	Senior (>15 years)	a warm blanket leading to freedom.
41	Medior (5 =< 15 years)	Safety is a needed layer of any activity, but often looked upon as an "extra" barrier to getting things done.
42	Medior (5 =< 15 years)	Safety is a mix of intuition, learned and trained behaviour to protect the integrity of people, machines, structures and organisations from unwanted events. To act safely, one must be able to determine risks and dangers and act in a way to minimise them.
43	Senior (>15 years)	Food for thought for philosophers ;-) Safety is much more than the absence of accidents. Continuous learning to do better. Clear link with other departments (operations, HR, etc.).

44	Medior (5 =< 15 years)	Safety is the presence of capacity to complete work and meet operational needs even as variability in task completion arises.
45	Senior (>15 years)	no answer given
46	Senior (>15 years)	You can't define safety in a sentence - it is a system of many sentences
47	Senior (>15 years)	What do we need to know & do to get the job done successfully
48	Senior (>15 years)	Safety is the shared wish to avoid incidents.
49	Junior (=< 5 years)	The work and actions of employees have a positive outcome. Employees care about it and there is a culture of speaking up and thinking about the tasks.
50	Senior (>15 years)	Safety is to develop a work environment where people can spend their time growing as human beings in a culture of well-being.
51	Medior (5 =< 15 years)	Work that is done in a manner that all stakeholders agree
52	Senior (>15 years)	Safety is an organisational capability to organise work in a way that Risks are managed, and the organisation is resilient to adapt to changes
53	Senior (>15 years)	100% transparency on all operational ins and outs and safety outcomes! Quantitative data like nr of LTA, number of absence days, nr of incidents, nr of training... need to be monitored, but are mostly indicative! What matters is: what conclusions are drawn? Which actions are taken? How transparent is this process? How qualitative is it? So for me, it's all about transparency and the will to continuously improve.
54	Medior (5 =< 15 years)	the process of getting in control of the hazards related to any activity, complying with Rules and Regulations as a bare minimum, which is often even hard to realise.
55	Senior (>15 years)	avoiding incidents/accidents, trying to prevent risks from coming into the organisation
56	Senior (>15 years)	Do the right thing for the right reason to protect workers.

57	Senior (>15 years)	It is an integral part of day-to-day operations.
58	Junior (=< 5 years)	The notion is to know where the risks are and how to prevent them from causing any harm.
59	Medior (5 =< 15 years)	Safety is a challenge and a balance. Safety can be a daily routine but also a factor easily forgotten or removed. Safety needs to be for everyone and not a slogan for a company. Eventually, Safety is there to help people perform safe operations, learn from mistakes, grow, and help each other. But Safety can't be the word to confirm a company has focused on an empty box, it needs to be a balance within business performance and culture imbedded in everything we do like quality is often seen in processes, documents, procedures, work, etc.

Annexe Five – Open Question: What Is Resilience?

Table 6

What is resilience in your own words (open question, no response = “no answer given”)

ID	years of experience	What is resilience in your own words?
1	Medior (5 =< 15 years)	no answer given
2	Senior (>15 years)	no answer given
3	Medior (5 =< 15 years)	Resilience lies in how innovative ideas can be expressed.
4	Medior (5 =< 15 years)	Resilience is not something fixed; it can be developed and strengthened over time. Through experiences and coping with difficulties, individuals and organisations can learn valuable lessons and build resilience for the future
5	Senior (>15 years)	The ability to deal with adversity while business as usual continues. Resilience consists of four capabilities: detecting and bouncing back when things threaten to go wrong (early warnings, weak signals, openness), being able to gain time when things go wrong by building buffers and margins into business operations, the ability to adapt when necessary in unexpected events (being able and allowed to deviate from procedures to ensure a successful operation), and the ability to anchor learning from the three aforementioned capabilities in business operations.

6	Medior (5 =< 15 years)	We don't have "go for zero" slogans as we don't believe in them. Learning from every (near)miss is far more important to us. We judge people on how they cope with incidents, not in having them.
7	Senior (>15 years)	Communication of investigation of incidents and normal work by the people who most closely engage in this. The safety department is the conduit through which this information should flow. And this interplay creates reliance through education.
8	Senior (>15 years)	The ability to perform reliably under varying conditions or involving different people and pressures
9	Medior (5 =< 15 years)	Resilience to me, is the ability of an individual or a system to bounce back, adapt, and recover effectively from challenging situations. It involves the capacity to withstand adversity, setbacks, or stressors and to maintain a sense of stability and well-being despite facing adversity.
10	Senior (>15 years)	Resilience is the ability to independently prevent/minimise damage without external assistance and ultimately be able to restart when an unexpected situation arises.
11	Senior (>15 years)	As above, but taking into account the changing conditions
12	Senior (>15 years)	anticipate
13	Senior (>15 years)	How an organisation monitors, anticipates, learns, responds, adapts, and recovers in managing normal variability for reliable outcomes
14	Senior (>15 years)	The ability to bounce back after failure

15	Senior (>15 years)	Agility to cope with situations outside of the norm and bounce back
16	Medior (5 =< 15 years)	Resilience is the way how a setback is digested and how people grow from that setback.
17	Senior (>15 years)	When a business is stressed, safety is still maintained.
18	Senior (>15 years)	Adaptive capabilities that are known and get used as a tool to continually improve work or design
19	Medior (5 =< 15 years)	The ability to adapt to changes and recover and learn.
20	Senior (>15 years)	The capacity to adjust the behaviour to actual constant circumstances
21	Junior (=< 5 years)	Being able to carry out normal work in a normal work where safeguards create “safety nets” for when things go south. Can be technical measures, PPE or CPE.
22	Senior (>15 years)	Mistakes happen, so know how to act when they are made.
23	Senior (>15 years)	Building capacity, anticipating, and building robust safeguards with the people who do the work.

24	Senior (>15 years)	Resilience, to me, is the capacity to recover quickly and efficiently from difficulties or changes, be they unexpected challenges, setbacks, or shifts in the operational environment. In our everyday operations, resilience is the robustness of our systems, processes, and people, enabling us to bounce back from adverse situations and learn from them to enhance our future response. It is also about adaptability - our ability to change course when necessary and innovate to meet new challenges. In a broader sense, resilience involves contingency planning, continuous learning, and flexibility.
25	Junior (= \leq 5 years)	Resilience is bad teamwork
26	Senior (>15 years)	opposition from any stakeholder during a change process.
27	Medior (5 = \leq 15 years)	Resilience is the ability to continue to function well in unexpected situations and afterwards. The organisation allows employees to act quickly and resiliently in unforeseen situations, and teams in companies can continue to work safely, even in situations where things go slightly differently than expected.
28	Medior (5 = \leq 15 years)	Resilience is the ability to continue to function well in unexpected situations and afterwards. The organisation allows employees to act quickly and resiliently in unforeseen situations, and teams in companies can continue to work safely, even in situations where things go slightly differently than expected.
29	Senior (>15 years)	I always liked Woods' 4 views.

30	Senior (>15 years)	The adaptability to respond and deal with 'stress' (on people, organisations and technology) before it 'breaks'.
31	Senior (>15 years)	being able to adapt to the circumstances, and change the working methods quickly and wisely, in other words: not freeze when something doesn't go as planned
32	Senior (>15 years)	Resilience is the organisational capability to anticipate, adapt, act, and recover from unexpected scenarios.
33	Senior (>15 years)	Setbacks happen. Do not let them lead but always stay sharp on safe operations.
34	Senior (>15 years)	While understanding system dynamics and life cycle risks conduct the above efforts with contingency analyses and continuous risk assessment. Climb out of your boxes with buzzword safety attempts to prevent harm and do your job!
35	Senior (>15 years)	The ability to adapt to the normal variability of the operational context
36	Senior (>15 years)	Be aware of risks and have the processes in place to reach an acceptable level of safety
37	Senior (>15 years)	Good training, tools for reporting and routines make good resilience, but it can be better with more resources.
38	Junior (= \leq 5 years)	The ability to handle varying circumstances. The ability to withstand them, to recover from them.
39	Senior (>15 years)	the capacity of an organisation to recover and continue business after a major/phenomenal - negative - event. business can continue in the same way or another one.

40	Senior (>15 years)	being capable of adaptation, being able to deal with changes, being strong
41	Medior (5 =< 15 years)	The way a group of individuals can stand up again after a failure and use this experience for future situations.
42	Medior (5 =< 15 years)	Resilience is the ability to adapt to a new situation and overcome obstacles, crises, or emergencies without losing all previous progress. One can train or build people, organisations, and protocols to prepare for unwanted events and their outcomes to be more resilient.
43	Senior (>15 years)	Who dares wins
44	Medior (5 =< 15 years)	Resilience is when there is enough capacity designed in a system to effectively absorb variability I.e. not brittle or fragile.
45	Senior (>15 years)	no answer given
46	Senior (>15 years)	As above
47	Senior (>15 years)	Mistakes will always happen, and things will always go wrong, what things have we put in place to allow the mistakes/ things to happen but limit the degree of consequence or effect
48	Senior (>15 years)	Resilience is the ability to handle changes.
49	Junior (=< 5 years)	The ability of the workforce or organisation to adapt to changing circumstances.
50	Senior (>15 years)	no answer given

51	Medior (5 =< 15 years)	Power to adapt to change to keep going
52	Senior (>15 years)	To operate well under different conditions, to be able to recognise changes and take action for people to make mistakes in their work without severe consequences to their health, the environment
53	Senior (>15 years)	A massively overrated, theoretical and vague concept! Operational workers will always need a dedicated mix of training, instructions, and SOPs... to carry out hazardous work. Resilience, interpreted as adaptability in decision-making, to me, is a very individual trait: some excel at it, some utterly fail and the rest is in between ;-). It's important to know how work is done as in possible opposition to the SOPs, but that doesn't mean WaD should never be corrected.
54	Medior (5 =< 15 years)	The ability to act upon deviations from the expected on both micro and macro levels within the company influence
55	Senior (>15 years)	the fact that everyone thinks they are safety specialists, that the law needs to be followed by the letter and not by the spirit.
56	Senior (>15 years)	Do the right thing for the right reason to protect workers. EVERY TIME.
57	Senior (>15 years)	Resilience is not giving up.
58	Junior (=< 5 years)	by solving the problems and adapting to them. not be an ostrich hiding in the ground.
59	Medior (5 =< 15 years)	Resilience is managing certain elements to an extent that if there is an impact on people, the environment or equipment the damage will be

		limited, and we properly learn from mistakes without blaming the frontline of our operations.
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Annexe Six – Questions Delphi Round Two

Table 7

Questions Delphi round two

Q44	The OH&S professional should be mindful of the different goal conflicts between time and resources on the one side and safety and human reliability on the other hand.
Q45	The OH&S professional should be part of the work preparation to educate frontline supervisors and workers on the trade-offs between efficiency and thoroughness.
Q46	Risk assessment is to be done with the involvement of operational parties. The future OH&S professional's task is to coach and understand the complexity of these tasks
Q47	Risk assessments should recognise that frontline workers will make decisions based on their expertise, and experience and recognise that most situations show incomplete, dynamically changing conditions and competing goal structures.
Q48	Risk assessments should begin by observing the work and understanding how work is done. With that understanding a mutual decision can be made to make a risk assessment that describes the work, rather than the theoretical view of the work.
Q49	A job safety analysis is not a separate document, but safety and environmental concerns are integrated into the standard operating procedures. These standard operating procedures are a result of the work of multiple stakeholders.
Q50	After a task, routine or non-routine, is done there is a discussion (feedback loop) where frontline workers give input on what did work as planned, what deviated from the plan and where workers were surprised. This intelligence is used to create lessons learned and to optimise the standard operating procedures.
Q51	Workers are to be given time to conduct a last-eight-minute meeting after a task where they can evaluate how the work went. This last-eight-minute meeting is facilitated by operations and OH&S professionals

Q52	The operational plan has to foresee time for pre- and post-mortems. Discussions should focus on how workers can be safe and productive. The pre- and post-mortem discussions are a tool to educate the entire workforce, from managers to frontline workers.
Q53	Competence building has to differentiate between education of skill and education of knowledge. The education of knowledge can be done by slideshows and e-learning, whilst the education of skills is to be done in on-the-job training or workshops.
Q54	Education of the workforce should include the latest insights of regulations, company requirements and technological trends. Therefore, education is to be updated regularly with input from the workforce.
Q55	The OH&S professional has to invest in the relationships with frontline workers. This can be done by appointing OH&S champions at the frontline who are coached diligently and understand how human performance works to gather better intelligence from work as done.
Q56	The OH&S professional's main task within the leadership team is to communicate the intelligence from the workforce together with the operational managers.
Q57	Frontline workers and OH&S professionals are included in the design of new equipment to ensure that the gap between work as done and work as imagined is identified in the early stage of a project. The OH&S professional acts as a bridge between the project team and the frontline.
Q58	Cross-functional teams (operations, maintenance, OH&S, finance, project,...) are assembled every time some projects impact the organisation on multiple levels. Projects such as permit-to-work can benefit from operational knowledge and the understanding of how contracts with subcontractors are set up to have a realistic as
Q59	Risk assessment techniques are tailored to the needs of the work. Rather than making an arbitrary choice on risk ranking, the focus is on how the work is done and interconnected with other steps in the process.

Q60	The OH&S plan should not be a separate yearly safety plan of the OH&S department but is a collective document to improve the company where OH&S is part of every department's plan. The OH&S plan should be the improvement plan of the OH&S department as a part of the company improvement plan.
Q61	The OH&S professional should be mindful of the different goal conflicts between time and resources on the one side and safety and human reliability on the other hand.
Q62	The OH&S professional should be part of the work preparation to educate frontline supervisors and workers on the trade-offs between efficiency and thoroughness.
Q63	Risk assessment is to be done with the involvement of operational parties. The future OH&S professional's task is to coach and understand the complexity of these tasks
Q64	Risk assessments should recognise that frontline workers will make decisions based on their expertise, and experience and recognise that most situations show incomplete, dynamically changing conditions and competing goal structures.
Q65	Risk assessments should begin by observing the work and understanding how work is done. With that understanding a mutual decision can be made to make a risk assessment that describes the work, rather than the theoretical view of the work.
Q66	A job safety analysis is not a separate document, but safety and environmental concerns are integrated into the standard operating procedures. These standard operating procedures are a result of the work of multiple stakeholders.
Q67	After a task, routine or non-routine, is done there is a discussion (feedback loop) where frontline workers give input on what did work as planned, what deviated from the plan and where workers were surprised. This intelligence is used to create lessons learned and to optimise the standard operating procedures.
Q68	Workers are to be given time to conduct a last-eight-minute meeting after a task where they can evaluate how the work went. This last-eight-minute meeting is facilitated by operations and OH&S professionals

Q69	The operational plan has to foresee time for pre- and post-mortems. Discussions should focus on how workers can be safe and productive. The pre- and post-mortem discussions are a tool to educate the entire workforce, from managers to frontline workers.
Q70	Competence building has to differentiate between education of skill and education of knowledge. The education of knowledge can be done by slideshows and e-learning, whilst the education of skills is to be done in on-the-job training or workshops.
Q71	Education of the workforce should include the latest insights of regulations, company requirements and technological trends. Therefore, education is to be updated regularly with input from the workforce.
Q72	The OH&S professional has to invest in the relationships with frontline workers. This can be done by appointing OH&S champions at the frontline who are coached diligently and understand how human performance works to gather better intelligence from work as done.
Q73	The OH&S professional's main task within the leadership team is to communicate the intelligence from the workforce together with the operational managers.
Q74	Frontline workers and OH&S professionals are included in the design of new equipment to ensure that the gap between work as done and work as imagined is identified in the early stage of a project. The OH&S professional acts as a bridge between the project team and the frontline.
Q75	Cross-functional teams (operations, maintenance, OH&S, finance, project,...) are assembled every time some projects impact the organisation on multiple levels. Projects such as permit-to-work can benefit from operational knowledge and the understanding of how contracts with subcontractors are set up to have a realistic as
Q76	Risk assessment techniques are tailored to the needs of the work. Rather than making an arbitrary choice on risk ranking, the focus is on how the work is done and interconnected with other steps in the process.

Q77

The OH&S plan should not be a separate yearly safety plan of the OH&S department but is a collective document to improve the company where OH&S is part of every department's plan. The OH&S plan should be the improvement plan of the OH&S department as a part of the company improvement plan.

Annexe Seven – Results Delphi Round Two

Q44 & Q62: The OH&S professional should be mindful of the different goal conflicts between time and resources on the one side and safety and human reliability on the other hand.

Figure 44

Question 44 result – future state

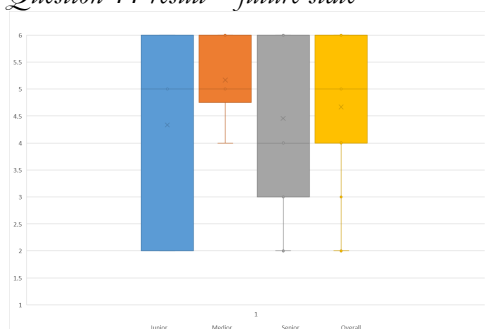
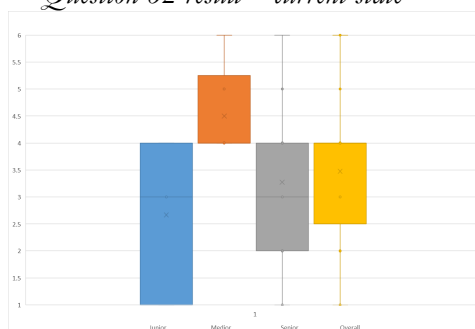


Figure 45

Question 62 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.84. Junior professionals have the highest average score (5.5), followed by Senior professionals (4.81). The IRQ values (0.5 for Junior, 2 for Medior, and 2 for Senior) suggest some variability in opinions within each experience level. The small IRQ values for Junior indicate a relatively narrow range of opinions within this group. This can be due to the low response rate in this group. The standard deviation values (1 for Junior, 1.54 for Medior, 1.49 for Senior) suggest a moderate variability in perceptions within each experience level.

Q45 & Q63: The OH&S professional should be part of the work preparation in order to educate frontline supervisors and workers on the trade-offs between efficiency and thoroughness.

Figure 46

Question 45 result – future state

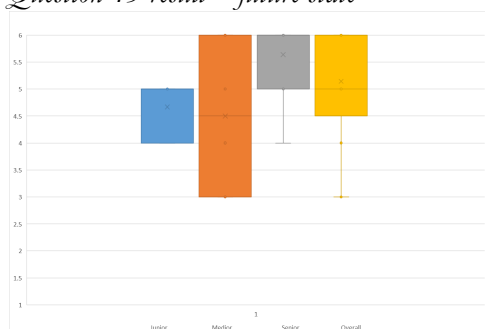
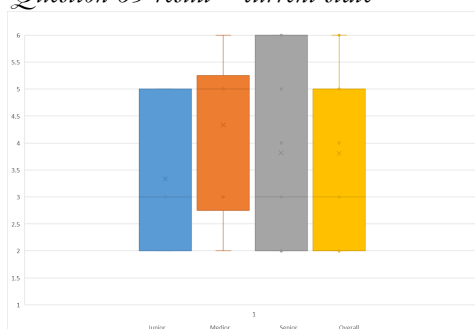


Figure 47

Question 63 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.14. Junior professionals have the highest average score (4.67), indicating a positive perception.

The IRQ values (0.5 for Junior, 2.5 for Medior, 0.5 for Senior) suggest variability in opinions within each experience level. The larger IRQ values indicate a wider range of opinions among Medior professionals. The standard deviation values (0.58 for Junior, 1.38 for Medior, and 0.67 for Senior) suggest low to moderate variability in perceptions within each experience level.

Q46 & Q64: Risk assessment is to be done with the involvement of operational parties.

The future OH&S professional's task is to coach and understand the complexity of these tasks.

Figure 48

Question 46 result – future state

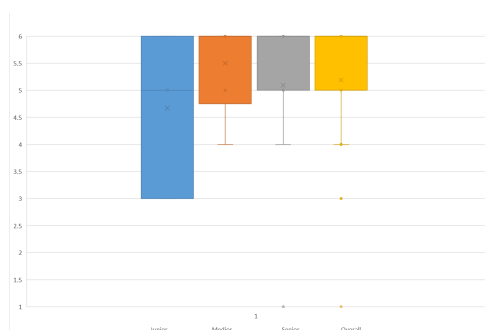
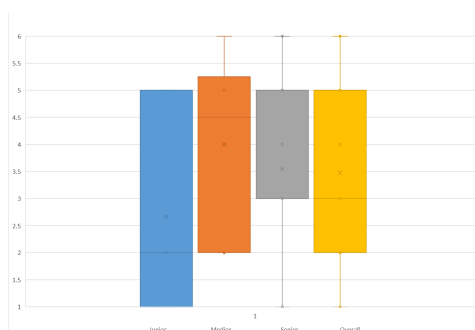


Figure 49

Question 64 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.19. Junior professionals have a positive perception with an average score of 4.67, while Senior professionals have the highest average score of 5.09. The IRQ value (1 for Junior, 0.75 for Medior, 1 for Senior) suggests variability in opinions within each experience level. The larger IRQ values indicate a wider range of opinions among Junior and Senior professionals. The standard deviation values (1.53 for Junior, 0.84 for Medior, and 1.51 for Senior) suggest moderate variability in perceptions within each experience level.

Q47 & Q65: Risk assessments should recognise that frontline workers will make decisions based on their expertise, and experience and recognise that most situations show incomplete, dynamically changing conditions and competing goal structures.

Figure 50

Question 47 result – future state

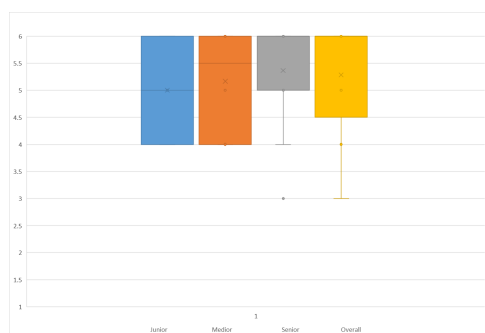


Figure 51

Question 65 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.29. Junior professionals have a positive perception with an average score of 5.00, while Senior professionals have the highest average score of 5.36. The IRQ value (1 for Junior, 1.75 for Medior, 1 for Senior) suggests variability in opinions within each experience level. The larger IRQ values indicate a wider range of opinions among Medior professionals. The standard deviation values (1.00 for Junior, 0.98 for Medior, 1.03 for Senior) suggest moderate variability in perceptions within each experience level.

Q48 & Q66: Risk assessments should begin by observing the work and understanding how work is done. With that understanding a mutual decision can be made to make a risk assessment that describes the work, rather than the theoretical view of the work.

Figure 52

Question 48 result – future state

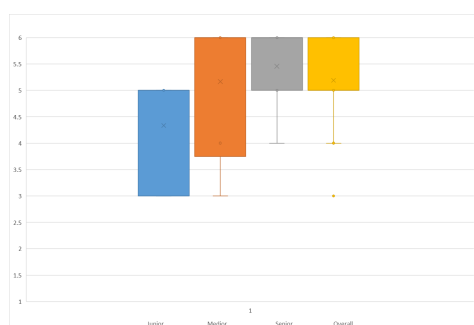
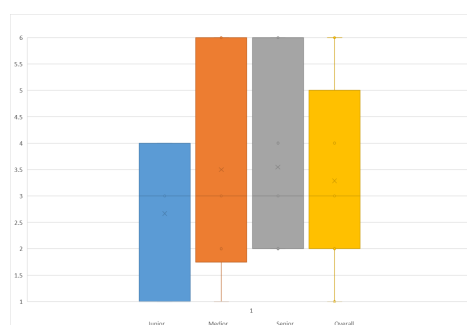


Figure 53

Question 66 result – current state



The future state average scores indicate a positive perception overall, with an average score of 4.27. Medior professionals have the highest average score (4.5), followed by Junior professionals (4.25). The IRQ values (1.75 for Junior, 1 for Medior, and 4 for Senior) suggest some variability in opinions within each experience level. The small IRQ values for Junior and Medior professionals indicate a relatively narrow range of opinions within these groups. The standard deviation values (1.71 for Junior, 1.09 for Medior, 1.76 for Senior) suggest a moderate variability in perceptions within each experience level.

Q49 & Q67: A job safety analysis is not a separate document, but safety and environmental concerns are integrated into the standard operating procedures. These standard operating procedures are a result of the work of multiple stakeholders.

Figure 54

Question 49 result – future state

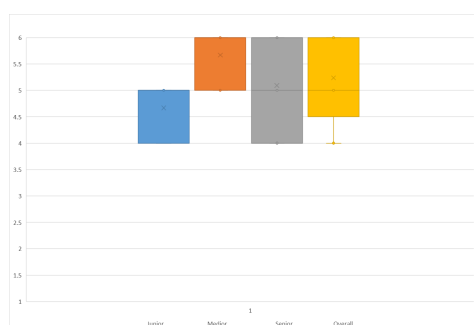
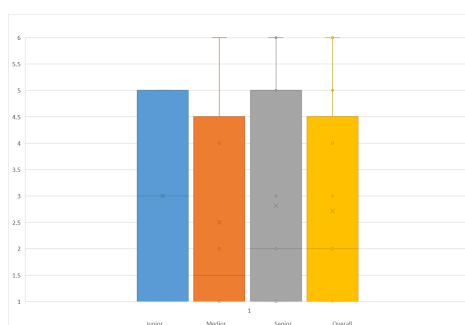


Figure 55

Question 67 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.24. Junior professionals have a positive perception with an average score of 4.67, while Senior professionals have the highest average score of 5.09. The IRQ value (0.5 for Junior, 0.75 for Medior, 2 for Senior) suggests limited variability in opinions within Junior and Medior professionals, while there is wider variability among Senior professionals. The standard deviation values (0.58 for Junior, 0.52 for Medior, 0.94 for Senior) suggest relatively low to moderate variability in perceptions within each experience level.

Q50 & Q68: After a task, routine or non-routine, is done there is a discussion (feedback loop) where frontline workers give input on what did work as planned, what deviated from the plan and where workers were surprised. This intelligence is used to create lessons learned and to optimise the standard operating procedures.

Figure 56

Question 50 result – future state

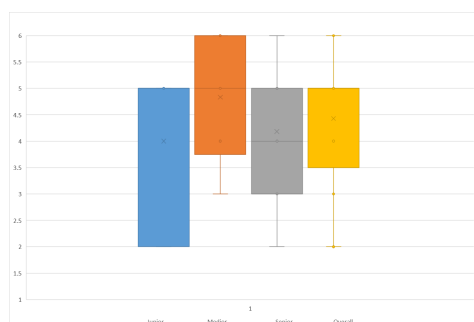
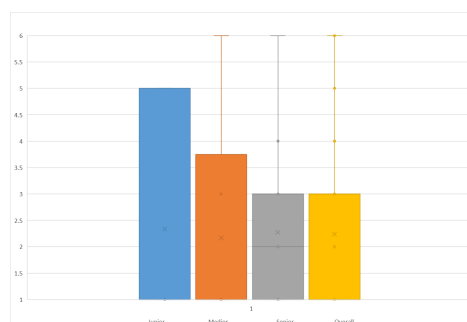


Figure 57

Question 68 result – current state



The overall average score indicates a positive perception, with an overall average score of 4.43. Medior professionals have the highest average score at 4.83, indicating a more positive perception of the feedback loop. The IRQ value (1 for Junior, 1.5 for Medior and Senior) suggests moderate variability in opinions within each experience level.

The standard deviation values (1.73 for Junior, 1.17 for Medior, 1.17 for Senior) indicate moderate variability in perceptions within Junior professionals and relatively lower variability in perceptions within Medior and Senior professionals.

Q51 & Q69: Workers are to be given time to conduct a last-eight-minute meeting after a task where they can evaluate how the work went. This last-eight-minute meeting is facilitated by operations and OH&S professionals

Figure 58

Question 51 result – future state

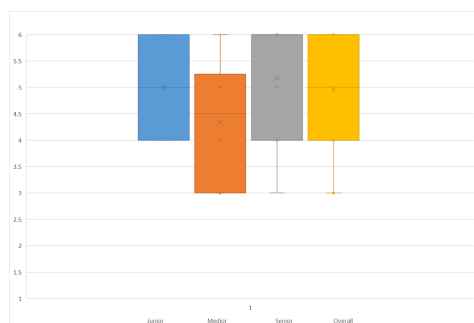
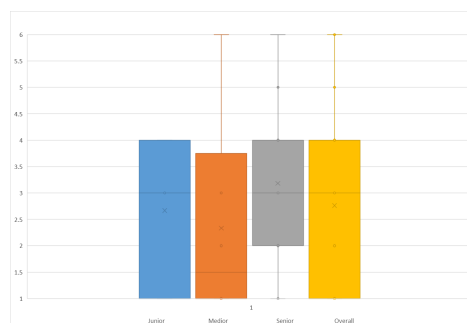


Figure 59

Question 69 result – current state



The overall average score indicates a positive perception, with an overall average score of 4.95. Senior professionals have the highest average score at 5.18, indicating a more positive perception of the last-eight-minute meeting. The IRQ value (1.5 for Junior, 1.75 for Medior, 1.5 for Senior) suggests moderate variability in opinions within each experience level. The standard deviation values (1.00 for Junior, 1.21 for Medior, 1.08 for Senior) indicate moderate variability in perceptions within each experience level.

Q52 & Q70: The operational plan has to foresee time for pre- and post-mortems. Discussions should focus on how workers can be safe and productive. The pre- and post-mortem discussions are a tool to educate the entire workforce, from managers to frontline workers.

Figure 60

Question 52 result – future state

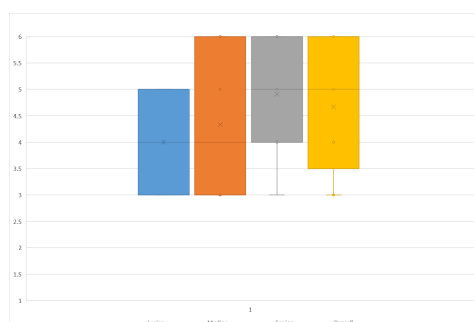
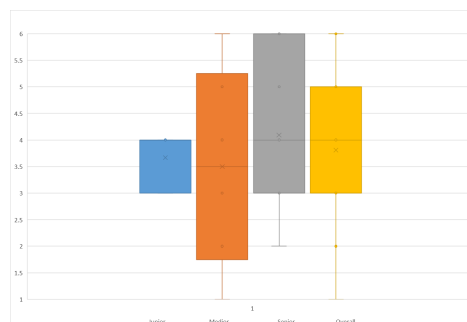


Figure 61

Question 70 result – current state



The overall average score indicates a positive perception, with an overall average score of 4.67. Senior professionals have the highest average score at 4.91, suggesting a more positive perception of the effectiveness of these discussions. The IRQ value (2 for Junior, 2.75 for Medior, and 2 for Senior) suggests a moderate to high variability in opinions within each experience level. The standard deviation values (1.00 for Junior, 1.51 for Medior, 1.04 for Senior) indicate moderate to high variability in perceptions within each experience level.

Q53 & Q71: Competence building has to differentiate between education of skill and education of knowledge. The education of knowledge can be done by slideshows and e-learnings, whilst the education of skills is to be done in on-the-job training or workshops.

Figure 62

Question 53 result – future state

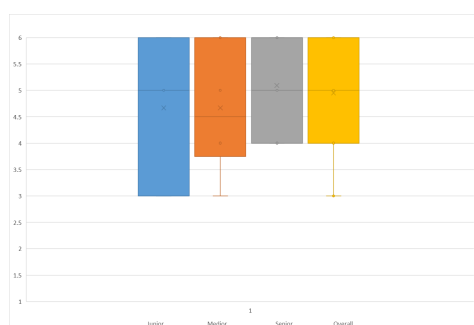
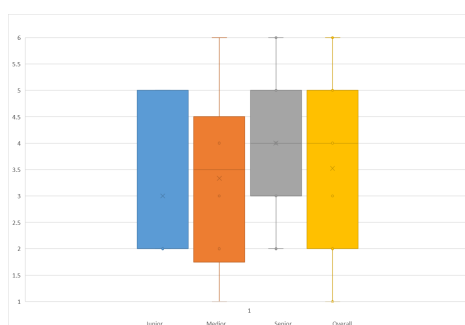


Figure 63

Question 71 result – current state



The overall average score indicates a positive perception, with an overall average score of 4.95. Senior professionals have the highest average score at 5.09, suggesting a more positive perception of the competence-building process. The IRQ value (1.5 for Junior, 1.75 for Medior, 2 for Senior) suggests a moderate to high variability in opinions within each experience level. The standard deviation values (1.53 for Junior, 1.21 for Medior, 0.94 for Senior) indicate moderate to high variability in perceptions within each experience level.

Q54 & Q72: Education of the workforce should include the latest insights into regulations, company requirements and technological trends. Therefore, education is to be updated on a regular basis with input from the workforce.

Figure 64

Question 54 result – future state

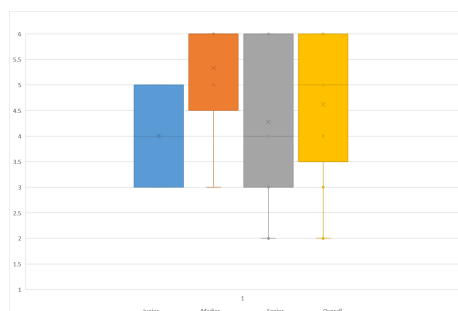
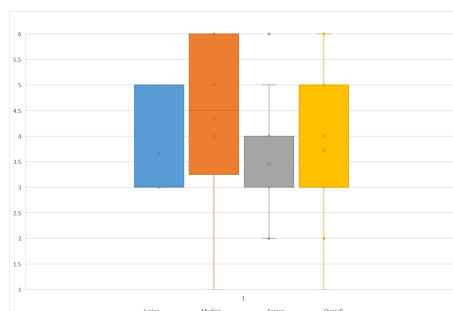


Figure 65

Question 72 result – current state



The overall average score indicates a positive perception, with an overall average score of 4.95. Senior professionals have the highest average score at 5.09, suggesting a more positive perception of the competence building process. The IRQ value (1.5 for Junior, 1.75 for Medior, 2 for Senior) suggests a moderate to high variability in opinions within each experience level. The standard deviation values (1.53 for Junior, 1.21 for Medior, 0.94 for Senior) indicate moderate to high variability in perceptions within each experience level.

Q55 & Q73: The OH&S professional must invest in the relationships with frontline workers. This can be done by appointing OH&S champions at the frontline who are coached diligently and understand how human performance works in order to gather better intelligence from work as done.

Figure 66

Question 55 result – future state

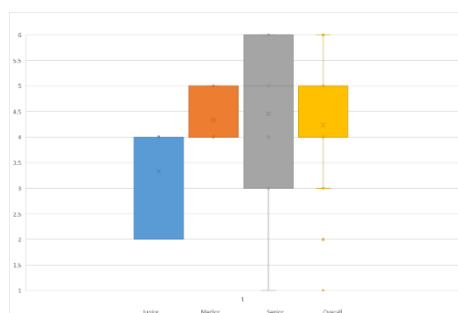
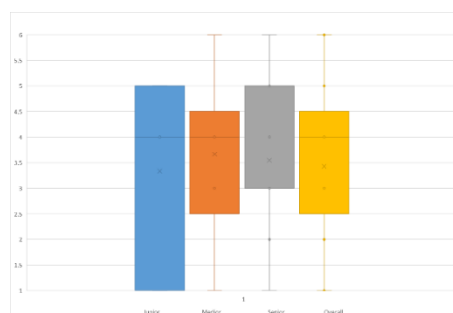


Figure 67

Question 73 result – current state



The overall average score suggests a positive perception, with an overall average score of 4.24. Medior professionals have the highest average score at 4.33, indicating a more positive perception of the investment in relationships. The IRQ value (1 for Junior, 0.75 for Medior, 2.5 for Senior) suggests a moderate to high variability in opinions within each experience level. The standard deviation values (1.15 for Junior, 0.52 for Medior, 1.63 for Senior) indicate moderate to high variability in perceptions within each experience level.

Q56 & Q74: The OH&S professional's main task within the leadership team is to communicate the intelligence from the workforce together with the operational managers.

Figure 68

Question 68 result – future state

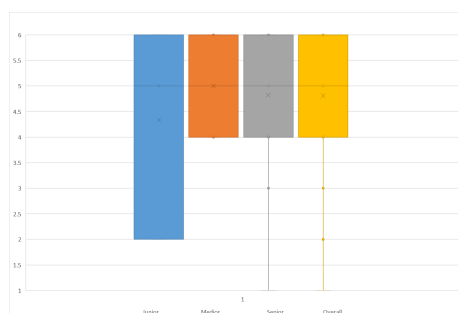
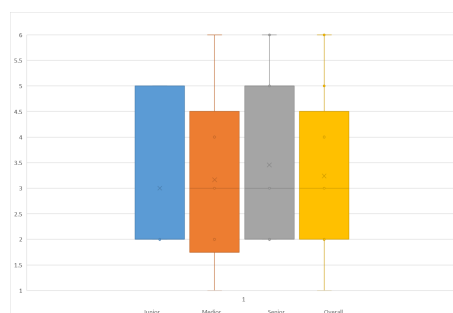


Figure 69

Question 74 result – current state



The overall average score suggests a positive perception, with an overall average score of 4.81. Medior professionals have the highest average score at 5.00, indicating a more positive perception of the OH&S professional's role in communication within the leadership team. The IRQ value (2 for Junior, 1.5 for Medior, 1.5 for Senior) suggests a moderate variability in opinions within each experience level. The standard deviation values (2.08 for Junior, 0.89 for Medior, 1.60 for Senior) indicate moderate to high variability in perceptions within each experience level.

Q57 & Q75: Frontline workers and OH&S professionals are included in the design of new equipment to ensure that the gap between work as done and work as imagined is identified in the early stage of a project. The OH&S professional acts as a bridge between the project team and the frontline.

Figure 70
Question 57 result – future state

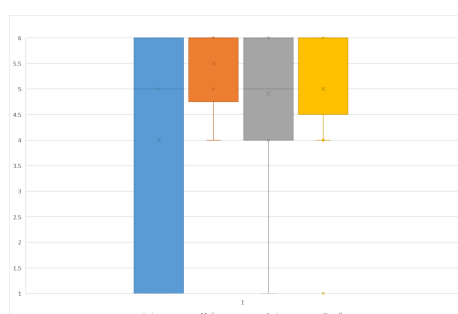
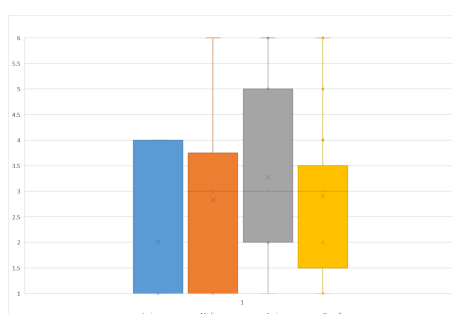


Figure 71
Question 75 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.00. Medior professionals have the highest average score at 5.50, reflecting a more positive perception of their involvement in design. The IRQ value (2.5 for Junior, 0.75 for Medior, 1.5 for Senior) suggests a substantial variability in opinions within each experience level. The standard deviation values (2.65 for Junior, 0.84 for Medior, 1.51 for Senior) indicate high variability in perceptions within each experience level.

Q58 & Q75: Cross-functional teams (operations, maintenance, OH&S, finance, project,...) are assembled every time there are projects that impact the organisation on multiple

levels. Projects such as permit-to-work can benefit from operational knowledge and the understanding of how contracts with subcontractors are set up in order to have a realistic ask.

Figure 72

Question 58 result – future state

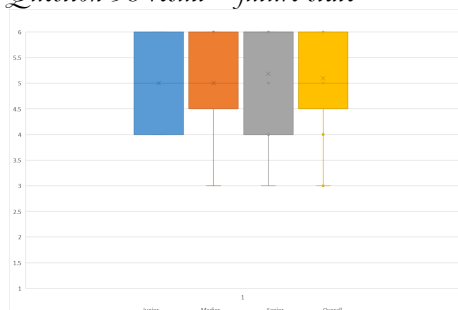
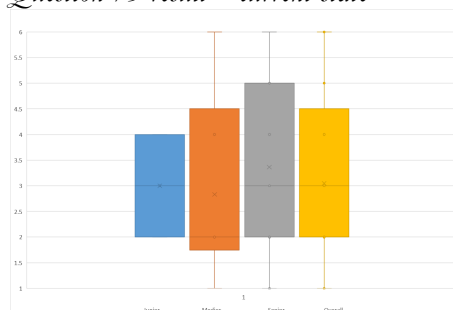


Figure 73

Question 75 result – current state



The overall average score indicates a positive perception, with an overall average score of 5.10. Both Junior and Medior professionals have an average score of 5.00, while Senior professionals have a slightly higher average score of 5.18. The IRQ value (1.0 for Junior, 0.75 for Medior, 1.5 for Senior) suggests variability in opinions within each experience level. The standard deviation values (1.00 for Junior, 1.10 for Medior, 1.08 for Senior) indicate moderate variability in perceptions within each experience level.

Q59 & Q76: Risk assessment techniques are tailored to the needs of the work. Rather than making an arbitrary choice on risk ranking, the focus is on how the work is done and interconnected with other steps in the process.

Figure 74

Question 59 result – future state

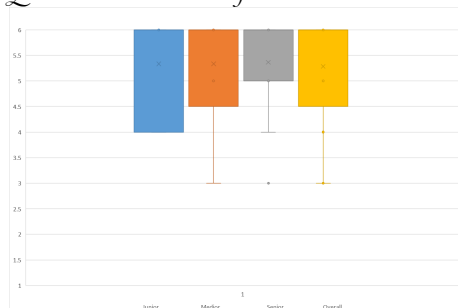
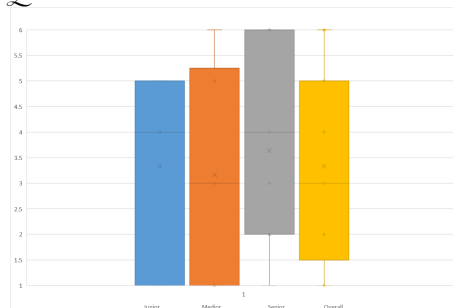


Figure 75

Question 75 result – current state



The overall average score is high, indicating a positive perception, with an average score of 5.29. The scores are consistent across Junior (5.33), Medior (5.33), and Senior (5.36)

professionals. The IRQ value (1.0 for Junior, 0.75 for Medior, 1.0 for Senior) suggests some variability in opinions within each experience level. The standard deviation values (1.15 for Junior, 1.21 for Medior, 1.03 for Senior) indicate moderate variability in perceptions within each experience level.

Q60 & Q77: The OH&S plan should not be a separate yearly safety plan of the OH&S department but is a collective document to improve the company where OH&S is part of every department's plan. The OH&S plan should be the improvement plan of the OH&S department as a part of the company improvement plan.

Figure 76

Question 60 result – future state

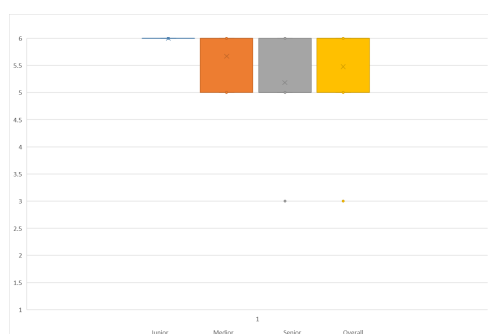
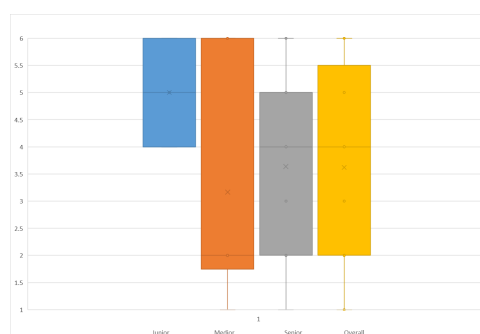


Figure 77

Question 77 result – current state



The overall average score indicates a strong positive perception, with an overall average score of 5.48. The integration of the OH&S plan is perceived positively across all experience levels. The IRQ value is low, suggesting minimal variability in opinions within each experience level. The standard deviation values are low, indicating a high level of agreement within each experience level.

Annexe Eight: Future State

Instead of working by themes, the process of how the work of safety is done, has to be the guide.

Competence Building

Understanding Risk Assessments Involving Operations

- Introduction to Risk Management Principles
- Hazard Identification Techniques
- Risk Assessment Methods and Tools
- Risk Communication Strategies
- Case Studies and Real-life Applications

This module is to include Perrow's quadrant on coupling and complexity to ensure that the united consequences of risk assessments are recognised. Mapping of daily work can be done by Hollnagel's FRAM and the distinguishment between risk-important and critical tasks can be derived from Tony Mushara's Critical Step method.

Academic papers that can be used to build the criteria are: Resilience Engineering Perspectives: Remaining Sensitive to the Possibility of Failure (Hollnagel & Woods, 2006), Hazard Identification Techniques in the Process Industries: A Critical Review and Comparison by Amyotte & El-Halwagi (2001), Patient Safety: A Case Study in Teamwork and Communication by Horak et al (2011) and Interdependence Analysis in collaborative robot applications from a joint cognitive functional perspective by Adriaensen et al (2022).

Recognition Of Frontline Expertise In Evolving Scenarios

- Importance of Frontline Input in Risk Assessment
- Engaging Frontline Workers in Safety Decision-making
- Scenario Planning and Adaptability
- Effective Communication Channels
- Continuous Improvement Strategies

This module is to include the relationship factor in safety leadership by Rosa Antonia Carrillo, humble inquiry by Edgard Schein, Work as done – work as imagined and the resilience analyses grid by Erik Hollnagel.

The following papers can be reviewed: The Influence of Supervisor Safety Support and Safety Climate on Non-Safety Outcomes (Carrillo et al, 2017), Algoe & Haidt (2009) Witnessing Excellence in Action: the ‘other-praising’ emotions of elevation, gratitude, and admiration and Smith (2001) The role of tacit and explicit knowledge in the workplace.

Occupational Health And Safety (OH&S) As A Business Partner

- Integration of OH&S with Organisational Goals
- Strategic Planning for Occupational Health and Safety
- Collaboration with Business Units
- Demonstrating Value through OH&S Metrics
- Stakeholder Engagement Techniques

This module is a management model that will benefit from works such as If You Can’t Measure It by Carsten Busch, The Tyranny of Metrics by Jerry Muller and The Art of Strategy by Avinash Dixit and Barry Nalebuff.

Operational Learning for OH&S Professionals

- Continuous Professional Development in OH&S
- Action Learning Techniques
- Reflective Practice in Safety Management
- Learning Review and Lessons Learned
- Implementing Feedback Mechanisms

Learning in OH&S can benefit from the works of Pupulidy and Vessel; Human & Organisation Potential. Todd Conklin's pre-accident investigations and Sidney Dekker's the field guide. To understand how incidents occur, Scott Snook's Friendly Fire is to be included.

Acquiring New Insights: Sociology And Technology

- Sociological Perspectives on Safety Culture
- Technology Trends in Occupational Safety
- Human Factors and Ergonomics in Safety Design
- Implications of Digital Transformation on OH&S
- Ethical Considerations in Technology Adoption

For this module, Nancy Leveson's Engineering a safer world: Systems thinking applied to safety is a work that needs to have a central place. Also Hogg and Vaughan's work, social psychology contains a basis for understanding social psychology basics better. Edgar Schein's organisational culture and leadership bring insights in how behaviors reflect deeper artefacts within the organisation.

Compliance Capability Building

- Regulatory Frameworks and Standards
- Compliance Auditing Techniques
- Ethical and Legal Obligations
- Proactive Compliance Strategies

This module will be more traditional as the compliance part will remain an important topic. Meaningful compliance though should be the basis where all companies thrive for, but the goal is to consciously improve. Here is where organisations can share best practices that are not necessarily compliance but rather a way to meet the moral responsibility of a company to continuously improve for better worker care.

Education Of Workforce

- Training Needs Analysis
- Designing Effective Training Programs
- Delivery Methods and Techniques
- Assessing Training Effectiveness
- Promoting a Culture of Learning Training

Where traditionally training is a one size fits all, the safety professional of the future can build on a skill and knowledge-based trainings. Where one ensure the audience know what is required, the other ensures that the right steps can be taken in practice. Experiment with technology and work methods. Another distinguishment that can be made, is the multi-level approach on capability building. Where one subject can require that an operator has a notion of the subject, another will require that the same operator is an expert. Dividing what workers of all levels need to know on a topic, can help to determine what the right education is for a certain role in the organisation.

The second stage of the curriculum is task mapping, where tasks are reviewed and mapped out, this builds further on the previous module understanding risks.

Task Mapping

Coupling And Interaction Between Components

- Systems Thinking in Safety Management
- Understanding Complex Systems Interactions
- Interdependencies Between Safety Components
- Risk Amplification and Mitigation in Interconnected Systems
- Dynamic Systems Modeling for Safety Analysis

Also here, two books will be central; Nancy Leveson's Engineering a safer world: Systems thinking applied to safety and FRAM by Erik Hollnagel. For the interdependencies between

safety components, Charel Perrow's Normal Accident Theory and Post-normal accident by Jean-Christophe Le Coze can be used as references. Another view, the gradient model by Jens Rasmussen helps to understand the macro interdependencies. Other books are, Safety-I and Safety-II: The Past and Future of Safety Management by Erik Hollnagel, Complex Adaptive Systems: An Introduction to Computational Models of Social Life by John H. Miller and Scott E. Page and System Dynamics by Jay W. Forrester.

Partnerships Between Frontline And Occupational Health And Safety (OH&S)

- Collaborative Decision-making Processes
- Empowering Frontline Workers in Safety Initiatives
- Communication Strategies for Partnership Building
- Shared Responsibility for Risk Identification and Mitigation
- Case Studies on Successful Frontline-OH&S Partnerships

This module will exist out of interactions with all different actors. Not only front-line workers are addressed in this module. How to get buy-in from management or how to interact with external stakeholders. In this module, Collaborative Intelligence: Thinking with People Who Think Differently by Dawna Markova and Angie McArthur will be the fundament. Drive: by Daniel Pink will help to motivate the different stakeholders in an approach that is based on the social needs of autonomy, mastery and purpose. Getting to Yes by Roger Fisher, William Ury, and Bruce Patton will help the future OH&S professional to make better arguments. The Wisdom of Crowds by James Surowiecki will enlighten the need to value all voices.

Integration Of all Aspects in Risk Assessment: Pivotal Role for OH&S

- Holistic Approach to Risk Assessment
- Incorporating Environmental, Health, and Safety Factors
- OH&S Professional as Facilitator in Risk Integration
- Balancing Technical and Human Factors in Risk Analysis
- Continuous Improvement in Risk Assessment Practices

In this module, Mushara's book critical steps will be central, a practical approach to the different aspects of safety. Human Error by James Reason and Behind Human Error by Dekker et al. will shine a light on the human within the system. Facilitative Leadership in Risk Management: A Practical Guide by Michael Hogan is a guide to set theory into practice.

Including Work Routines In Safety Protocols

- Observational Techniques for Work Routine Analysis
- Identifying Safety Gaps in Work Processes
- Designing Safety Protocols Aligned with Work Routines
- Implementing Safety Checks and Balances within Workflows
- Cultivating a Culture of Safety-Conscious Work Practices

For this module, Todd Conklin's five principles of human performance will be central. This book will requestion the fundamental ideas on human behaviour. Work as done, work as imagined by Erik Hollnagel, as well as the Field Guide to Safety Professional Practice by David Provan is to be used. Safety Leadership by Robert De Boer gives good insights into practical approaches.

Task analyses

Tailoring the Risk Assessment to Work Methods

- Adapting Risk Assessment Techniques to Different Work Environments
- Customising Risk Assessment Tools for Specific Industries
- Integrating Work Methodologies into Risk Assessment Processes
- Assessing and Mitigating Risks Associated with Work Methods

Safety Management Systems by Shane Bush will be the centrepiece of this module together with Risk Management by Carl Pritchard. Also, this module will dive deeper into risk assessment and start to practically define the tools one can use. Here the focus will be on how artificial intelligence can help safety professionals to work smarter, rather than harder.

Involvement In Work Preparation

- Understanding the Pre-Work Planning Process
- Role of Safety Professionals in Work Preparation
- Collaborative Work Preparation Practices
- Identifying and Addressing Safety Concerns in Pre-Work Activities

This module will focus on the work preparation together with the stakeholders. Here *Turn the Ship Around* by David Marquet will play a pivotal role in understanding where the expertise lies. It will also give a good view of where the safety professional's role is. *The Handbook of Collaborative Management* by Julian Birkinshaw and Martine Haas will provide further education on how the company can benefit from a collaborative approach.

Fostering Innovation On Every Level

- Promoting a Culture of Innovation in Safety Management
- Encouraging Creativity in Safety Solutions
- Recognising and Rewarding Innovative Safety Practices
- Engaging Frontline Workers in Innovation Processes
- Implementing Innovation in Occupational Safety Policies and Procedures

The Innovator's DNA by Jeff Dyer, Hal Gregersen, and Clayton M. Christensen will guide this part of the curriculum. The focus will be on innovation and micro-experimentation. The key is to safely try new methods and approaches. It is also looking to other industries and see where innovation can take place.

Work methods

More Standard Approach In Environmental And Safety Standards

- Overview of Environmental and Safety Standards (ISO 14001 and ISO 45001)
- Importance of Standardisation in Safety Management Systems
- Implementation Strategies for Environmental and Safety Standards

This part of the curriculum will be designed around the ISO management systems. To work more efficiently, an internationally recognised standard is more effective than a company-created standard. ISO 14001 Environmental Systems Handbook by Ken Whitelaw and ISO 45001:2018 Occupational Health and Safety Management Systems" by David Smith will be the basis of this module, providing a practical approach to the implementation of management systems.

Involvement of Workforce in Design

- Participatory Design Principles in Safety Management
- Engaging Employees in Safety Program Development
- Integrating Worker Input into Safety Protocols and Procedures
- Collaborative Decision-making for Safety Enhancements
- Empowering Workers to Identify and Address Safety Issues

This module has to be as practice as possible. The Human Factors and Ergonomics by Steve Shorrock and Claire Williams is the go-to guide for human factors-related topics. Also, Usability Engineering by Mary Beth Rosson and John M. Carrol is to be included.

Balanced Approach Between Regular Work and Overall Effectiveness

- Understanding the Relationship Between Productivity and Safety
- Strategies for Balancing Safety Protocols with Operational Efficiency
- Integrating Safety Goals into Performance Metrics
- Optimising Work Processes for Both Safety and Productivity

The Performance Appraisal Tool Kit by Paul Falcone can be used as the basis of this module, coupling to the book of Shane Bush earlier in the course. Adding the knowledge of other books in the course, a good case can be built on safety goals that count what counts, rather than what can be counted.

Reducing Human Error by Using AI

- Introduction to Artificial Intelligence (AI) Applications in Safety Management
- AI Tools for Predictive Safety Analytics
- Automation for Hazard Detection and Risk Assessment
- AI-driven Decision Support Systems for Safety Professionals
- Ethical Considerations and Challenges in AI Implementation for Safety

Artificial Intelligence: A Guide for Thinking Humans by Melanie Mitchell will be the starting point of this module. The module is not to create AI programmers but rather to see what is possible within automating a task so the safety professional can spend time on tasks that matter. A second book is about the ethics of automated systems; The Ethics of Invention: Technology and the Human Future by Sheila Jasanoff. This book helps the future safety professional to look with an ethical lens to the fast-changing technology.

Safety is the Easiest and Most Logical Way to Do Work

- Principles of Safety Integration into Work Processes
- Importance of Safety as a Core Value in Organisational Culture
- Embedding Safety into Standard Operating Procedures

This module brings it all together. Here no additional books are required but rather a work group session with the students and in a company to see how the safety of work and the work of safety can help to get to safe operations.

Observations

In this module, we dive deeper into the part that was also touched on in task mapping. Understanding better how work is done, by observing and interacting, will lead to more operational intelligence.

Human Interactions for Frontline Supervisors

- Communication Skills for Safety Leadership
- Conflict Resolution Techniques
- Building Trust and Rapport with Frontline Workers
- Active Listening and Empathy in Safety Conversations
- Motivating and Engaging Teams Towards Safety Goals

The Leadership Challenge: How to Make Extraordinary Things Happen in Organisation by Kouzes and Posner will be the heart of this module. Together with the relationship factor in safety leadership by Rosa Antonia Carrillo, this module will go more into depth on how to solve conflicts, bring bad news and act with integrity.

Goal Conflicts: Understanding and Improving

- Recognising and Addressing Conflicting Goals in Safety Management
- Strategies for Alignment of Safety Goals with Operational Objectives
- Collaborative Decision-making to Resolve Goal Conflicts

Reason's Human error and Sidney Dekker's drift into failure will lay the fundamentals of this module. Here the future safety professional will get both views on human error and the consequences, encouraging critical thinking.

Occupational Health and Safety (OH&S) Coaching on the Floor

- Techniques for On-the-Job Safety Coaching
- Providing Constructive Feedback on Safety Performance
- Coaching for Safety Behaviors and Mindset
- Addressing Safety Concerns in Real-Time Situations

On conversations, the book Crucial Conversations by Johan Roels is a textbook example of how coaching, theory and practice can be combined. For this module, Roels' book and De

Boer's safety leadership are the fundamentals. Also *The Checklist Manifesto: How to Get Things Right* by Atul Gawande needs to be addressed, to critically rethink the checklist approach.

Work as Done vs. Work as Imagined

- Understanding the Gap Between Planned and Actual Work Practices
- Importance of Resilience Engineering in Safety Management
- Bridging the Work-As-Done and Work-As-Imagined Divide
- Learning from Variability in Work Processes
- Implementing Adjustments in Safety Protocols Based on Real-World Observations

The basis of this module is Hollnagel's *Safety-II in Practice: Developing the Resilience Potentials*. With the foundations in the previous modules, it will be possible to understand how the gap between work as done and work as imagined should be perceived.

Investing in Relationships (Champions)

- Identifying and Cultivating Safety Champions
- Leveraging Influence Networks for Safety Improvement
- Empowering Champions to Drive Safety Culture Change

Here the book by David Marquet will provide a sufficient basis to further develop a culture where OH&S advocates won't be the ones in the office, but rather those who work on the sharp end.

Gathering Operational Intelligence

- Techniques for Collecting Data on Operational Safety
- Importance of Near Miss Reporting and Incident Investigation
- Utilising Technology for Real-Time Data Collection

In the last module, the safety professionals of the future will gather all the knowledge they have and work on a model that can give meaningful data.

Post mortems.

The post-mortem, after-action reporting, will provide intelligence to close the loop. The information that is gathered from these pre- and post-mortems creates intelligence for the capability part as well as for the other modules. The safety professional of the future will never stop learning and educating.

Anticipation of Risks and Future Scenarios

- Forecasting Emerging Risks in Safety Management
- Scenario Planning Techniques for Safety Professionals
- Trend Analysis and Predictive Modeling in Risk Assessment
- Strategic Foresight Methods for Anticipating Future Safety Challenges
- Incorporating Risk Resilience in Business Continuity Planning

The Black Swan: The Impact of the Highly Improbable by Nassim Nicholas Taleb and Risk Intelligence: How to Live with Uncertainty by Dylan Evan are two fundamental books that thrive in this module. Thriving at the Edge of Chaos by Jonathan Sapir will guide the students into planning and creating buffers, whilst Minding the Weather: How Expert Forecasters Think by Hoffman et al, gives a good insight into how forecasting can look like.

Feedback Loops for Non-routine and Routine Tasks

- Implementing Feedback Mechanisms for Non-routine Tasks
- Developing Standardised Feedback Processes for Routine Tasks
- Importance of Timely and Constructive Feedback in Safety Improvement
- Continuous Improvement through Iterative Feedback Loops

Organisational Learning II: Theory, method, and Practice by Argyris & Schön gives a good basis for how professional inquiry happens and what positives and negatives are around it. Cynefin - Weaving Sense-Making into the Fabric of Our World by Snowden gives the safety professional of the future a model where micro feedback can be used to steer better decisions.

Post and Pre-mortems in Operating Plans

- Conducting Post-Incident Reviews (Post-mortems) for Learning
- Proactive Pre-Incident Planning (pre-mortems) for Risk Mitigation
- Facilitating Post and pre-mortem Sessions Effectively
- Incorporating Lessons Learned into Future Operating Plans
- Creating a Culture of Continuous Improvement through Mortem Analysis

Critical thinking for strategic intelligence of Katherine and Randolph Pherson is used as the basis, where Red Teaming by Bruce Hoffman helps to create a playground where ideas are challenged in a safe environment.

Communicating Workforce Intelligence

- Techniques for Gathering and Analysing Workforce Data
- Effective Communication Strategies for Sharing Intelligence
- Utilising Data Visualisation Tools for Clear Communication
- Fostering a Culture of Open Dialogue and Information Sharing
- Leveraging Workforce Intelligence for Decision-making and Strategy Development

John Armstrong's Principles of Forecasting: A handbook for researchers and practitioners brings practice and theory together. Together with The Power of People: Learn How Successful Organisations Use Workforce Analytics to Improve Business Performance by Nigel Guenole it makes this module a practical tool to use.

Communication of Work-As-Done (WAD) and Incident Investigation

- Importance of WAD Communication for Understanding Safety Practices
- Conducting Effective Incident Investigations
- Communicating Incident Findings and Recommendations to Stakeholders
- Strategies for Transparent Communication of WAD and Incident Data
- Promoting a Learning Culture Through WAD and Incident Communication

This module brings multiple previous modules together. Books from Dekker, Hollnagel and Conklin are the basis of this module. Moving further with the learning organisation, *The Fifth Discipline: The Art & Practice of The Learning Organisation* by Peter Senge fits in this module.

Safety's Ability to Respond, Be Prepared, and Adopt

- Developing Emergency Response Plans and Procedures
- Building Organisational Resilience in Safety Management
- Implementing Adaptive Safety Strategies for Rapid Response
- Training and Preparedness Exercises for Safety Teams
- Embracing Change and Innovation in Safety Practices

This module must be centered around high-reliability organisations, *High-Reliability Management: Operating on the Edge* by William G. Ouchi, and *Managing the Unexpected: Resilient Performance in an Age of Uncertainty* by Karl E. Weick and Kathleen M. Sutcliffe are the two must-reads. Here the underlying idea is to give a counterweight to Perrow's classic.

Improving Operational Learning, Collaboration, and Interaction Quality

- Creating Opportunities for Cross-functional Collaboration
- Implementing Knowledge Management Systems for Operational Learning
- Fostering Communities of Practice for Continuous Learning
- Enhancing Communication Channels for Quality Interaction
- Promoting a Culture of Shared Learning and Best Practice Sharing

Edmondson's *Teaming: How Organisations Learn, innovate, and Compete in the Knowledge Economy* and *The New Edge in Knowledge: How Knowledge Management Is Changing the Way We Do Business* by Carla O'Dell and Cindy Hubert will end the curriculum. These books will help the safety professionals of the future create a safe environment where relationships with other departments are as important as their relationships with their peers.

Annexe Nine: Current State

The current state of the general basic curriculum (Codex, book II, Title 4, annexe II.4-2) exists out of the following pillars:

Skills:

- Being able to work in interdisciplinary teams.
- Being able to direct, coach, communicate and negotiate.
- Being able to collect and process science-based information
- Being able to integrate welfare into the daily tasks of others
- Being able to put knowledge into practice

Knowledge:

- Introduction: sorts of prevention and intervention, methods of discovering, analysis and diagnostics, multi- and interdisciplinary, the legal framework of welfare at work
- Basic principles: human and social human and social aspects, organisation of work, employability, organisation, and communication cultures, human anatomy, physiology, and psychology, legal and economic aspects, understanding tasks and responsibilities, and other aspects that can impact the employees' welfare.
- Risks: participative and global approach, analysis techniques, epidemiology, job analysis, occupational accidents and diseases, and data collection.
- Prevention principles: industrial hygiene and medicine, environmental risks, biological agents, ergonomics, anthropometry, psychosocial, tools, fire and electrical risks
- Policy: structures, dynamic risk management system, information, first aid, coordination of prevention, basic tasks, reporting and meeting, partnering with different stakeholders

Level one safety advisors (Codex book II, Title 4, annexe II.4-3) need to be able to master the following during the specialisation module:

Skills:

- Ability to identify the hazards and risk factors in high-risk industries, and propose necessary measures to eliminate the risks as much as possible.
- Ability to analyse workplace accidents, determine their causes and develop the main principles of the well-being policy to propose an effective and efficient dynamic risk management system.
- Ability to monitor the safety level of installations throughout their life cycle and consequently conduct an analysis of any existing installation.
- Ability to integrate elements of occupational health and safety into quality assurance systems and other management systems of the company.
- Ability to develop and organise the technical and administrative management of the well-being policy, particularly concerning the Committee.

Knowledge:

- General knowledge of occupational hygiene, ergonomics, and psychosocial aspects of work.
- Knowledge of strategies for risk assessment and management.
- Familiarity with relevant regulations, legislation, and safety standards.
- Understanding of the logistical aspects of well-being policies: management of the prevention service, procurement, commissioning, etc.
- Knowledge of strategies related to training, information, and communication.
- Understanding of safety and health management systems and basic knowledge of quality assurance.
- Basic knowledge of international and European well-being policies.

Domains:

- Knowledge of specific risk analysis techniques.
- Understanding of mechanical risks, machinery directives, and new technologies.
- Knowledge of electrical risks.

- Understanding of chemical agents (storage, transportation, handling, labelling, waste).
- Awareness of physical agents (noise, vibrations, heat/cold, etc.).
- Familiarity with high-risk situations and emergency planning.
- Understanding of safety in the process industry.
- Knowledge of fire prevention and explosion hazards.
- Understanding of safety in construction, construction sites, and temporary or mobile construction sites.
- Knowledge of building safety (security).

For the level, two safety advisor (Codex book II, Title 4, annexe II.4-4), the specialisation module contains the following requirements:

Skills:

- Ability to identify the hazards and risk factors in lower-risk industries.
- Ability to analyse workplace accidents determine their causes to develop the main principles of the well-being policy, and propose an effective and efficient dynamic risk management system.
- Ability to monitor the safety level of installations throughout their life cycle, and consequently, capable of analysing any existing installation.
- Ability to develop and organise the technical and administrative management of the well-being policy, particularly concerning the Committee.

Knowledge:

- General knowledge of occupational hygiene, ergonomics, and psychosocial aspects of work.
- Understanding of strategies for risk assessment and management.
- Familiarity with applicable regulations, legislation, and safety standards.
- Understanding of the logistical aspects of well-being policies: management of the prevention service, procurement, commissioning, etc.

- Knowledge of strategies related to training, information, and communication.
- Basic knowledge of safety and health management systems and quality assurance.

Specific domains:

- Knowledge of mechanical risks, machinery directives, and new technologies.
- Knowledge of electrical risks.
- Understanding of hazardous substances (storage, transportation, handling, labelling, waste).
- Basic knowledge of high-risk situations and emergency planning.
- Basic knowledge of safety in the process industry.
- Knowledge of fire prevention and explosion hazards.
- Knowledge of safety in construction sites.
- Understanding of temporary or mobile construction sites.
- Basic knowledge of building safety (security).