UNIVERSITY OF TURKU

Strategic Foresight and -Analysis

Merging foresight and intelligence through probabilistic futures

Future Studies
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Master of Science in Social Sciences Thesis

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The thesis explores the potential integration of strategic foresight and strategic intelligence analysis through the perspective of probabilistic futures. By combining practically elements from both domains, the resulting information aims to provide enhanced value and accuracy, serving as a more effective tool to support strategic decision-making process in foresight.

The study incorporates risk management through numeric evaluation through future events, introducing the static rigor to the assessment. This adjustment allows the transformation of qualitative data into the quantitative format, thereby accelerating the process through data process of prototype formulas. Combination of Analysis of Competing Hypotheses and Delphi method are a basis of methodological elements of this study.

These structural frameworks of intelligence and foresight are the building blocks of the thesis alongside human cognition included in them. Strategic design structure gathers around design thinking and lean philosophy. Resulting tool Foresight & Analysis (F&A) is a beneficial, yet raw tool for organizational strategic aid providing most likely scenarios and future events scenarios includes.

The combination of different future study and intelligence methods and approaches crystalizes into developing a fast and easy to use study method and potential development of a tool into a test prototype. Potential development of the tool with artificial intelligence and good human user interference, probabilistic are possible to utilize in rapid pace in strategic decisions. The tool accelerates the data collection process, which prevents the information to outdate in the changing informative society we live in. Monitoring of future events gives more profound insight to scenarios, which aids operative actions.

The thesis recombines strategic foresight with a new tool that transforms data into actionable insights, empowering organizations to outpace uncertainty and shape the future.

Keywords: intelligence, foresight, strategy, analysis, decision-making, risk management

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“To shape the future, we must first understand it.”

-Herman Kahn

Abbreviations

ACH	Analysis of Competing Hypothesis
AI	Artificial Intelligence
BI	Business Intelligence
CI	Competitive Intelligence
F&A	Foresight and Analysis
FE	Future Event
GFPF	Generic Foresight Process Framework
GEOINT	Geospatial Intelligence
HUMINT	Human Source Intelligence
KM	Knowledge Management
MASINT	Measurement and Signature Intelligence
MI	Military Intelligence
OI	Operational Intelligence
OSINT	Open-Source Intelligence
QAI	Quantum Artificial Intelligence
RFI	Request For Information
SI	Strategic Intelligence
SIGINT	Signals Intelligence
STRATINT	Strategic Intelligence
TI	Tactical Intelligence
UI	User Interface
UX	User Experience

1 Introduction

The pace of knowledge production and transmission is accelerating at an unpredicted rate in the information society today. Especially the paradigm shift with artificial intelligence will be changing knowledge management. Resilience in general has become critical for organizations to not only survive but thrive, requiring a proactive approach to the future knowledge. However, the process involved in acquiring and applying future-oriented information are often time-consuming, risking obsolescence by the time the information reaches the decision makers.

By merging strategic foresight and strategic intelligence analysis, this study emerges the elements from intelligence studies and future science. As the global order shifts from state-centric systems to a landscape of blended power between states and corporations (Stone 2007), there is a growing need to draw upon both military and intelligence and corporate foresight tools. The increasing complexity of today's operational environments calls for innovative thinking and tools can expedite the decision-making processes.
By classification of future events through development of risk management formulas, incorporating with ACH intelligence analysis base and leveraging with Delphi-panel new method was refined from the existing knowledge.

This thesis explores the acceleration of these processes through the application of strategic design thinking and lean philosophy. The goal is to determine whether future-oriented information can be engineered to produce more precise insights with a less time-consuming frame. A key driver of this study is the pursuit of competitive advantages, focusing on whether managing biases in data collection and developing new tools to address emerging challenges.

1.1 Aim

The main purpose of the work is to explore whether strategic foresight and intelligence analysis can be combined into unified tool to accelerate the process of gather intelligence information from the future and increase so the understanding of the probabilistic future. This is achieved by designing a new tool that converts qualitative data into quantitative insights, addressing the need for faster information processing.

1.1.1 Research question

This research focuses on blending existing elements with practical testing to answer the central question:

> ***How can strategic foresight and intelligence analysis tools to be combined as a single, effective tool?***

This research question arises from the need to address costly and time-consuming foresight and analysis process. Tool development is guided by three key requirements:

1. **Accelerated Process:**
   Traditional panel-based information gathering is slow, often rendering insights outdated by the time they are finalized. Information technology and artificial intelligence (AI) are accelerating the pace of decision making, so tools should adapt the process.

2. **Numeric Evaluation of Future Events:**
   The absence of quantitative metrics hampers the comparison and timeliness of process. Classification of future events brings traceability to the evaluation.

3. **Bias recognition:**
   Enhancing the reliability of insights by identifying and mitigating biases thereby reducing information noise in the final output.

These requirements shape the foundation of the tool's development to address these challenges effectively. The overlapping nature of all three points binds them together forming a cohesive red thread that runs through the core of this research.

1.1.2 Hypothesis

Building on the elements described in the initial study settings, the hypothesis is formed through the design process shaped through the lean philosophy (Mangaroo-Pillay & Coetzee 2021). This approach integrated the research question and its background to establish a foundation for the study. The hypothesis proposes that:

> ***The generation of future knowledge can be accelerated by classification of future events, converting qualitative data to quantitative form with merging the tools from foresight and intelligence.***

Figuratively, this hypothesis envisions filtering data from an information pool is acting like a catalyst minimizing the waste of the process. Slow processes can be automated with interaction of technical aids and human cognition, a combination deemed essential for the organizational future success and ability to thrive.

2 Theoretical framework

This functional thesis merges multiple disciplines, combining frameworks from strategic intelligence and strategic foresight. Both have a common origin after aftermath of World Wars and were somewhat rooted in the famous think tank RAND Corporation, where from the differentiation and specification of both started to emerge. Both strategic foresight and intelligence analysis are merged with a focus on future probabilities while risk management related numeric evaluation acts as a binding element by translating qualitative data into quantitative evaluation. This integration follows the research questions read thread woven into the strategic design process. To fully grasp this approach, it's essential to understand these two central concepts: *foresight* and *intelligence* in strategic perspective.

When intelligence specialized in collecting and analysing data, whereas foresight is focused on anticipating future. Cognition plays a critical role across both fields, influencing how data in interpreted and future possibilities are evaluated. Recognizing cognitive biases is particularly important, as reducing biases enhances the reliability and accuracy of predictions. AI also contributes to mitigating biases further improving the outcomes. The multidisciplinary approach supported by future sciences (WFSF) enable cross-disciplinary processes that draw from various fields of the study.

Both foresight and intelligence operate with strategic aims as their foundation. In military contexts, the strategic level sits between political goals and operational planning, with tactics forming the foundation level below. beyond the military, strategic planning is equally relevant in business management and politics (Kuosa 2012, 45-48). The strategic perspective underpins all areas of these frameworks, ensuring that each element contributes to achieving overarching strategic objectives.

2.1 Intelligence

Intelligence as its origin serves security needs of nations, no matter was in political or military-based approach. Nevertheless, intelligence serves commercial business sector in its increasing ways. For example, casual business benchmarking can be seen as a form of intelligence, as it focuses to analyse the competitor's performance (Lankford 2002, 57).
Corporate intelligence can be divided into sections by its focus: *competitive intelligence* and *business intelligence*, both focusing on commercial objectives. In contrast, military- and political intelligence remains cantered on security-based focus (Kuosa 2012, 50-51). A common thread across both security and corporate intelligence is the concept of competition (Levine et al. 2414) or more broadly; thriving in in challenging and dynamic operational field.

While competition is undeniably central to intelligence, limiting its scope to competitive dynamics alone risks overlooking other critical perspectives and objectives. A wider view ensures that intelligence remains a comprehensive tool for the decision-making across diverse contexts.

2.1.1 Security intelligence

Security intelligence can be evaluated through dual lenses of *security* and *safety*, where security focuses on aims to protect against threats and safety address hazards and disasters. Security focuses on protection against maleficent actions to different targets, as safety's focus is on non-maleficent actions such as accidents, risks and surprises (Jore 2019, 171). Security intelligence has evolved alongside the strategic intelligence, particularly in response to the power dynamics shaped by warfare. Consequently, the military perspective remains essential to consider the developing intelligence methods in a rapidly changing world.

A key feature in security-based intelligence is its reliance on clandestine and covert actions, which introduces the concept of visibility. While visibility may not always be necessary, traceability becomes crucial. Traceability serves as the foundation of scientific rigor, especially in data collection (Gerhold et al. 2022, 70-71) and is an indispensable component of foresight-related work. By ensuring traceability, intelligence methods can maintain reliability and accountability even in scenarios where full transparency s not feasible option,

RAND corporation

The origin of first futurists can be traced back to the RAND Corporation, a U.S. based think tank. This military rooted, yet civilian brain power leveraging organization was established in the aftermath or the World Wars (RAND). Why this institution is worth of mentioning, is through many of analytical methods developed at the RAND do bridge both corporate foresight and military foresight applications. From its inception, RAND recognized the need for computational assistance in data analysis, a trend that continues in the field of data management and knowledge processing.

What sends RAND apart is its unique ability to cross boundaries between military and civilian objectives. While the historical paths of future science and military intelligence diverges from the RAND, its early focus on deterrence during Cold War and nuclear arms race later shifter towards addressing modern challenges such as sustainability and societal well-being (RAND). Despite these shifts, RAND continues to conduct significant research on technological advancements and intelligence studies maintaining its relevance (Menthe & Sullivan 2008).

The enduring strength of RAND lies in its multidisciplinary approaches, avoiding so silos and fostering collaboration across the diverse fields. This adaptability allows the RAND to remain a force for shaping both strategic foresight and state based national security initiatives.

Military Intelligence

History of intelligence used in military purposes reaches as far as there have been warfare, but actual Military Intelligence (MI) has been established in 1960's during the aftermath of World Wars. World Wars accelerated the development of intelligence in military uses, as aerial photography, cryptography, radar and radio intelligence were used. There were technologies, as well-advanced atomic technology in a form of a-bomb were heavily involved in intelligence development. (Bigelow 2012, 1-28).

As MI is an activity to support policy-making and military activities (Oxford Reference), it has classification needs and rights. For data classification MI is having structured approach, where data is given a value according to its reliability and credibility. Access to information is acknowledged, which is aided through classification. This taxonomy makes knowledge more arrangeable, controlled and usable, than it could be just without it. Taxonomy gives approach how to protect the data yet does not directly indicate how it should be protected. (Newhouse et al. 2023, 1-7).

Besides the actual data classification is widely used in MI, the collection of data has logic structure. Framework for intelligence data collection can be seen through OODA (Observe, Orient, Decide, Act) -loop (figure 1), which emphasises agile decision making for gaining competitive advantage (Richards 2020, 143-144). In future development the automation in

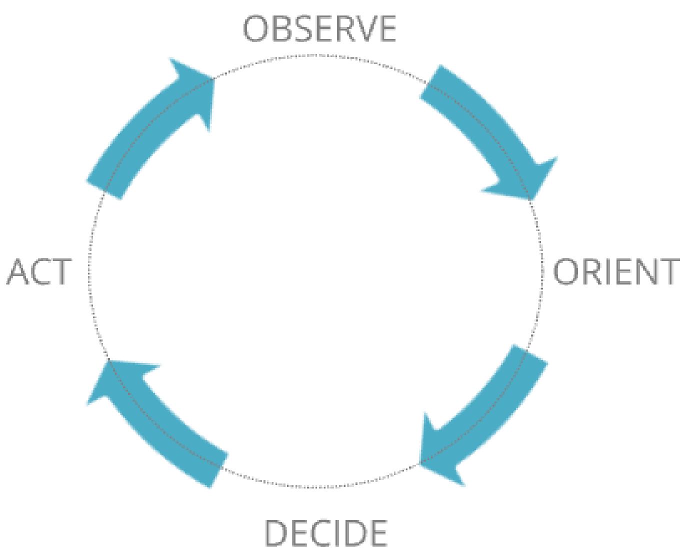

Figure 1:OODA-loop (Richards 2020, 144).

OODA-loop will have transformative role, yet understanding the human-machine interaction needs further study, especially in warfare (Johnson 2023, 60).

Observation in OODA-loop can be seen as collection of intelligence data. The ways of data collection in intelligence are described through five disciplines:

1. Human Intelligence (HUMINT)
2. Open-Source Intelligence (OSINT)
3. Signal Intelligence (SIGINT)
4. Geospatial Intelligence (GEOINT)
5. Measurement and Signature Intelligence (MASINT)

   (Lowenthal & Clark 2016, 1-4).

Imagery Intelligence (IMINT) is sometimes differentiated from GEOINT. With the evolution of information society, data collection methods have also advanced. While these disciplines are traditionally associated with MI, they are being increasingly utilized in foresight data collection as well. All these collection methods are employed in MI, which encompasses various forms of intelligence including:

- Operational Intelligence (OI)
- Tactical Intelligence (TI)
- Technical Intelligence (TI)
- Strategic Intelligence (SI)

  (Total Military Insight; Heidenrich 2007, 2).

Strategic Intelligence

Among of all the various forms of intelligence described above, strategic perspective aims to gather intelligence knowledge for usage in strategy, policy and military plans (Heidenrich 2007, 2). Strategic Intelligence (STRATINT) is described to be art of planning for desired outcome (Maccoby 2015, 19).

One of the key factors behind strategic intelligence is how data is handled and processes into knowledge. Often this is referred through knowledge pyramid (DIKW-pyramid), where collected data is processed as information, information to knowledge, and at the end knowledge to wisdom (Frické 2022). DIKW pyramid is used especially for strategic means, but there is criticism towards this data refining framework.

Wisdom building is not so straight forward complicated system, but instead complex combination of elements (Peters et al. 2024, 7) such as learning, analysis and sense-making affecting to the pyramid (Jennex 2017, 72-73). In this revised knowledge pyramid relations between data are acknowledged from through new elements brought by development of information: Big Data, IoT-sensors are added to the bottom of the pyramid, and actionable intelligence is added to the top of it. (Jennex 2017, 74-77).

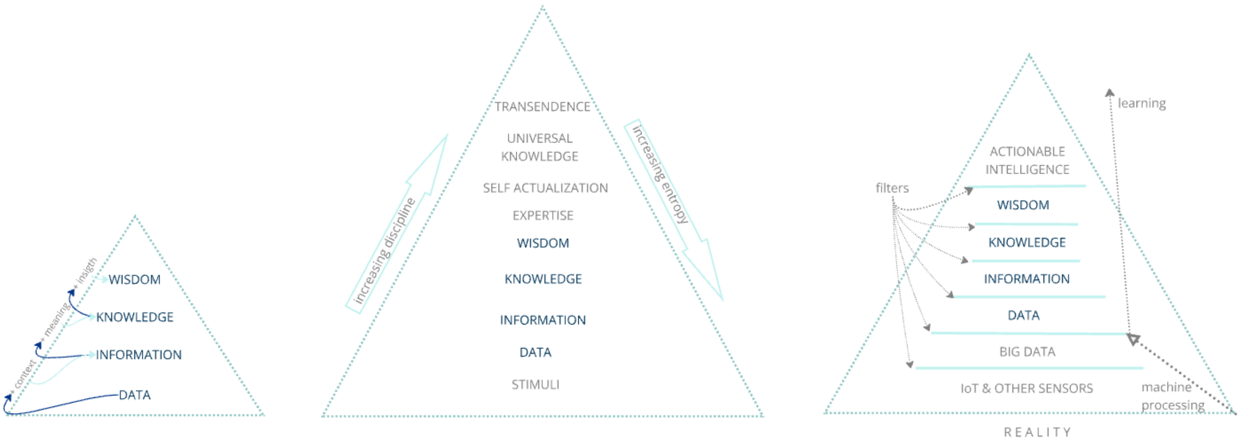

Figure 2:Comparison of DIKW framework (Frické 2022; Drigas & Pappas, 2017; Jennex 2017)

A common criticism of the DIKW pyramid framework is its inadequacy in representing the complexities of knowledge development. The actual shape of pyramid is argued to be insufficient, as complex systems need more accurate visualization for the framework (Van Meter 2020, 9). Intuition, experience and emotions are not included in traditional view of the pyramid, which neglects expertise knowledge and all encrypted data in emotions and intuition processes (Peters et al. 2024, 2-3). Consciousness is a crucial part, that is not seen in pyramid basic model, neither are different cognition intelligence types (Drigas & Pappas 2017, 19). AI will be implemented to the wisdom building process, as it excels in datasets, economics, risk

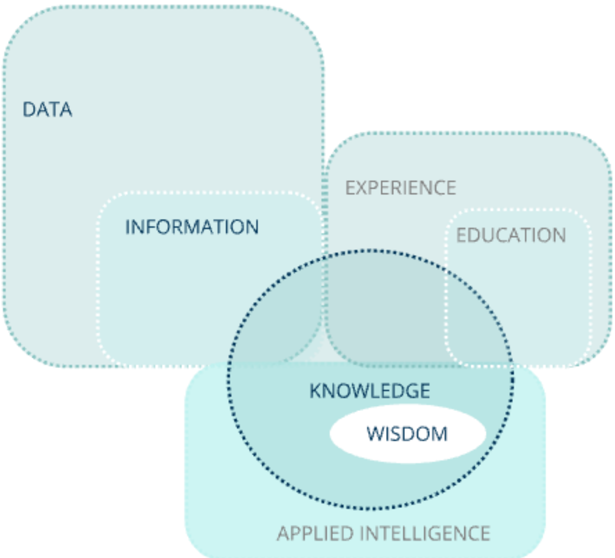

Figure 3: Revised DIKW (Van Meter 2020).

management and so on, yet it does need human thinking besides it. Empathy, emotional connectivity and ability to inspire other are elements of leadership, as well something AI doesn't possess. Hence, AI development needs to have human cognition besides it for not to leading to implications that are unwanted and harmful. (Peters et al. 2024, 5-8).

Overall, DIKW-framework is initial part of strategic intelligence, which cumulates through the generations. Keeping in mind, that youngest generations do have the most processed knowledge as a data in the big picture, underestimating the age does not serve the strategic intelligence means.

2.1.2 Corporate intelligence

The other perspective of intelligence focuses on corporate applications. As in state-based security intelligence, power dynamics are also a central element in the corporate intelligence. State-based power balance has been shifted also from some parts to multinational corporates, which not only do global business but research and education initiatives of their own. One main distinction yet is that states do have defence body in the form of national defence, which corporates are not able to possess of their own. State based legislation governs corporations is highly complex due global nature of multinational corporations. Corporate intelligence can be seen in divisions of two main areas regarding to scope: Competitive- and Business intelligence.

Competitive Intelligence

Competitive intelligence (CI) is not espionage nor similar activities. Instead, it has been referred to sports due it's nature of preparedness, learning for the opponent weaknesses and strengths to build winning strategy (Liebowitz 2006, 57). Operations means of CI are under legal legislation and is not to aim to harm none, but to boost organizational success. Aims and tools for beneficial competitive intelligence have been argued to use aggressive enough means, mapping early warnings, valuing creative thinking besides analytics, good planning just to mention few (Liebowitz 2006, 58-59).

CI has important role in strategy generation among other corporate intelligence forms. When classification of intelligence forms, means and tools are known and understood, strategy comes more traceably and it's easier to justify for employees, stakeholders and clients. Traceability brings trust not only to scientific work (Gerhold et al. 2022, 69), but also to strategy. Transparency instead is not always a correspondent with trust as traceability can be seen. Transparency comes issue when lacking the trust (Van der Steen & Van der Duin 2012, 491). This can be argued accordingly in the perspective of CI in strategy building: Traceability builds up value in a form of trust, which alleviates from the burden of transparency. Too wide transparency in CI tends to turn against the core meaning of CI – competitive advantage.

CI life cycle works in loops, which is quite similar in all intelligence forms (Pythian 2013, 9-10). It's somewhat based on OODA-loop, where through it's possible to understand the

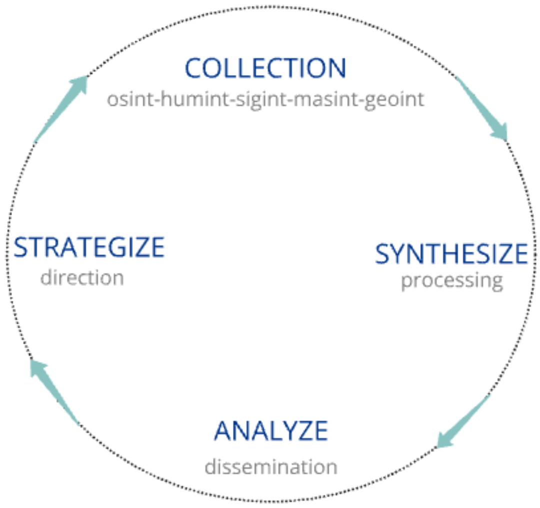

Figure 4: The collection (Pythian 2013, 58; Liebowitz 2006, 63; Lowenthal & Clark 2016, 1-4).

collection as a process: Intelligence is not straight forward a to b linear project, it's an iterative loop. In the intelligence means, the loop reveals early warnings (Pythian 2013, 14), which have somewhat similar elements as weak signals in future studies.

CI is useless without proper Knowledge management (KM), when the collected information is in use. Mentioned use in strategy building is an important one, but KM may be led to information distribution inside the organization as well. Organizations have found different means to conduct knowledge distribution. Gap Gemini Ernst & Young and Harris Government Communications rewards employees for sharing common agenda and knowledge they're holding (Haesebrouck et al. 2021, 1-2; Liebowitz 2006, 67). Value of the organization grows through incentives in KM means. Understanding that knowledge is an asset, is a part of all intelligence aspects, and it applies to both internal and external CI.

Previous examples of employees' knowledge are internal CI, when in other hand benchmarking is a way to gather information from external competitors or actors and can be seen as a way of corporate intelligence. Benchmarking, or better to frame competitor benchmarking, is a form of study about competitors in the same area or field and find information as much as possible to evaluate how they are approaching the same matters as evaluator is comparing the data for. To be precise, benchmarking, competitor benchmarking and competitor analysis (Adom et al. 2016, 116) are all external CI forms, yet they are not the same thing.

Business Intelligence

The fine line between Business Intelligence (BI) and CI is their approach. Despite the fact that CI knowledge management can be gathered internally as well, the main focus of CI is external. BI instead, focuses into gather internal information and aims to discover hidden aspect for decision-making (Liebowitz 2016, 19) and strategy itself. BI gathers the internal data together, and KM processes the data to decision make knowledge. Traditionally BI has been implemented to be marketing or financial analyst field, yet it has developed to be a part of strategic evaluation and important tool in strategic intelligence (Jiménez-Partearroyo & Medina-Lopéz 2024, 21). When gathering information through human resources, regulation and protection of data are involved through general data protection regulation (GDPR) (European Commission 2024a), Data Protection Act (Gov.uk) and American Data Privacy and Protection Act (Congress.gov) for instance.

BI is not only a management toolbox to thrive through business as usual. It has significant potential to produce data for strategic foresight, support organizational mission and vision, and achieve competitive advantage. There are BI tools for extrapolating future from vast datasets in the aims for future sight (Jiménez-Partearroyo & Medina-Lopéz 2024, 18-20), yet most important one is KM when it comes to how to use BI data in strategic means (Hijazin et al. 2023, 13).

AI development in data set processing is arising, as is security features in overall data protection and governance. As a special feature in AI as data processing tool, all data that can inserted into AI, can be derived out as well. In the perspective of feeding organizational data into AI, exposing the data to possibility to mine it out needs to be considered via security means. AI is in fast developmental pace at the time, which means not all possibilities and threats BI datasets combined to AI usage are not revealed yet.

2.1.3 Analysing tools

Intelligence has a variety of analytic tools specifically designed on certain needs. Visualization tool's main goal is to build knowledge from data (Jern 1999, 3). In general means for business data visualization there are Microsoft Power BI, Tableau and Qlik among others (Coursera 2024). For the OSINT there are software tools to analyse information for public sources such as social media, webpages, records and statistics. Companies such as Black Swan data harness information from social media to evaluate future events to offer for companies to use in development and marketing (Wiggers 2022). This brings organisational new competitive aspect to all operations. OSINT nature has changed crucially in late decades and it's essential for CI, cybersecurity and law enforcement just to mention few. Analysis of Competing Hypotheses is an intelligence tool to study the most likely event to occur, and it's widely used tool in military, corporate and in academic world when error of reasoning is present. Analysis of Competing Hypotheses is one of focus means in this thesis.

Scenario tools

In strategic intelligence analysis several frameworks are used to understand complex environments and support so decision-making. Among these, PMSII, DIMEFIL, and ASCOPE stand out for their focuses and applications. Each framework provides distinct perspectives on operational and strategic planning, making them essential tools for analysing military challenges.

PMSII (Political, Military, Economic, Social, Information, Infrastructure) offers holistic approach to analysing an operational environment. It examined the interrelationships between systemic factors to reveal how they influence the area of interests. While its comprehensive nature is a strength, the broad scope can demand substantial resources and data collection. This applies especially in time-sensitive scenarios. (Abaianiţi 2018, 45)
DIMEFIL (Diplomatic, Information, Military, Economic, Financial, Intelligence, Law enforcement) focuses on national powers. It emphasizes actionable strategies, which makes it a beneficial strategic tool. This framework is particularly suited for geopolitical analysis and policymaking, offering insights to state-centric power dynamics.
ASCOPE (Areas, Structures, Capabilities, Organizations, People, Events) provides detailed understanding of civil and societal status. It's useful to mapping of human terrain, identifying cultural dynamics, and understanding local influences. ASCOPE provides micro-level factors, which often makes it a complementary tool for broader frameworks, such as PMESII or DIMEFIL (Saressalo & Huhtinen 2022, 43).
Choice of scenario tools depends on scale and nature of the scope and can be combined in different ways. Organisations such as NATO, UN, EU apply these frameworks in comprehensive scenario work (Abaianiţi 2018, 46). Frameworks are sometimes integrated through matrices, while in other cases separate tools were employed and the data is subsequently combined.

Analysis of Competing Hypothesis

There are several methods in intelligence, that are built on minimizing biases. Strategic tool of Analysis of Competing Hypothesis (ACH) has been developed among intelligence community

(Dhami et al., 1085) and is sometimes too said to be the simplest one (Heuer 1999, 108). It has been used widely in military purposes in governmental intelligence, as it's structural 8-step technique, that analytical views aim to overcome human biases (Heuer 1999, 95).
Technique itself makes it used to identify reasonable scenarios; in this case they're named as hypotheses.
Steps are conducted shortly by following steps:

1. identifying hypotheses
2. evidence generation
3. matrix preparation
4. refining matrix
5. Tentative conclusions of likelihood
6. Sensitivity analysis
7. Reporting
8. Milestone identifying (Heuer 1999, 97).

As a highly simplified example ACH matrix may look like this considering Request For Information (RFI): "Where are the keys?"

H1: Keys are dropped out.
H2: Dog ate them.
H3: Keys are at home.
H4: Keys are stolen.

Evidence	H1	H2	H3	H4
E1: Dog is tiny and cannot eat big keys.	+	-	+	0
E2: Keys are not in my bag.	+	-	+	+
E3: I haven't called home yet.	0	-	+	-
E4: I didn't hear them dropping.	-	0	+	+
E5: All doors have been locked all the time.	-	0	+	-
Most likely scenario:			5 x +	

Here + indicates that certain evidence supports the hypothesis, - indicates the opposite: it does not support the hypothesis and 0 is N/A, no weight for this hypothesis. There are several variations with different emphasis on, as well as different indications markings and ways.

Matrix is always a part of ACH, where from the most likely hypothesis is possible to find out, as well as backing up evidence in the need of trace work.
In some work there are added the classification system for information secrecy, credibility and relevance. There is variance with this depending on institute and/or organization and its needs. For example, according to ISO standards for information security gives classification accesses from confidential, restricted, internal and public information (ISO/IEC 27001:2022).

There has been criticism towards is ACH beneficial with bias recognition, especially confirmation bias. Discussion has been going back and forth and study has been conducted. Through there are still some deficiencies in the methodology as it is, it could be improved by implementing other methodologies (Dhami et al. 2019).
Criticism has evolved for one analyst using the method, when there is risk of “falling in love” with favourite hypothesis, or so-called confirmation bias (Kappes et al. 2020, 134), which enables imperceptibly to work towards proving favourite hypothesis (Heuer 1999, 96). One important aspect in evidence search, is to be trying to disprove each hypothesis, which helps overcome or at least minimize this bias. As in use, there are indication that analyst seem to jump over different steps of the analysis, and often one analysis is behind one analyst itself (Dhami et al. 2019, 1085).
As overall conclusion as an analysis process, ACH gives the traceability when needed, is systematic with data classification and leads over the basic bias pitfalls (Heuer 1999, 109) yet has it weak links as well.

2.2 Foresight

Foresight is the systematic understanding of the future. While the future cannot be precisely predicted, it can be evaluated though probabilities and scenarios (Kuosa 2014, 5-6). Like intelligence in this study, foresight is examined from both security and corporate perspectives. Strategic insights gained in the foresight processes are informative tools of the decision-making.

2.2.1 Security foresight

Anticipating and preparing for potential threats and opportunities in the nation and global safety and security contexts is the core of security foresight. Organizations like Defence Advanced Research Projects Agency (DARPA), North Atlantic Treaty Organization (NATO), Research and Development Corporation (RAND), People’s Liberation Army (PLA) plays critical roles in shaping security foresight, each leveraging unique strategies and frameworks to address emerging challenges to each perspective.

DARPA is U.S. based organization that focuses on innovations to maintain technological superiority. Intelligence, cybersecurity, advanced defence systems are few of the aspects to serve U.S. national security focus with foresight aims. PLA is a national organization of China, that applies strategic planning in cybersecurity, space operations, AI and other modern capabilities to serve Chinas broader ambitions. Besides these two nation-based security-based foresight example organizations, there are multinational power coalitions such as NATO, that promotes collective defence among its member nations. Foresight activities in NATO involves analysing the geopolitical trends, emerging threats like cyber- and hybrid warfare and evolving and escalating nature of global conflicts to ensure stability for its members. RAND is in the other hand is a think tank analysing all previously mentioned and originally was based on U.S. army needs (RAND). Today it works with global matters.

In the perspective of security-based foresight, risk management is an area to highlight in this study. It is integral to the operations of all the major organizations mentioned as example earlier, and it does it in every level. This highlights the importance of the security-based foresight and the critical role of risk management in its applications.

Risk Management

Risk management has developed after World War II, especially study of it (Dionne 2013, 147). Even though start of modern risk management can be evaluated to mid-1950's when it became a form of a science, the concept of risk has been known for from the time of antique: Risk semantics flow from Latin word *risicare*, "to dare" (Capocchi 2023). Risk can be seen as a future event with potentiality when considering will it happen (Mohun 2016, 30).

Presence of risks can be seen through *Fishpond* concept, where negative events such as risks and threats are seen present together, and mitigated through "*fisherman*" actions. Fisherman represents for example an organisation, intelligence agency, authorities or a state. Each of them use their best knowledge to get a fish, which may be a element of risk management, foresight technique for negative elemets or intelligence analysis. Actual "*fishes*" are different types of information, such as secret information, wild card and phenomenons. They all are viewed in the perspective of intention and target. (Kuosa 2014, 53-56).

Figure 5: Fish Pond (Kuosa 2014, 56-57)

As risk represents somewhat uncertainty, knowing the matters related uncertainity are described as levels of knowledge. In Ralph Gomory approach it is divided to known, unknown and unknowable. First describes known uncertainity, second unknown uncertainity that exists and last fully unknown situation of uncertainity existense (Ahteensivu et al. 2018, 16-18).
Levels of knowledges can be seen through metacognition as well: Unknown unknowns, made famous by Secretary of Defence of the United States - Donald Rumsfeld, are a expression of metacognition levels of events or matters we're not able to recognize (Hampton et al. 2011, 1-2). In Rumsfield Matrix (figure 6) is a bit wider in comparison of levels of knowledges: *Known knows* represents things you do know, that you know. *Known unknowns* are thinks you know, that you don't know as in other hand *unknown knowns* are things you don't know, you actually

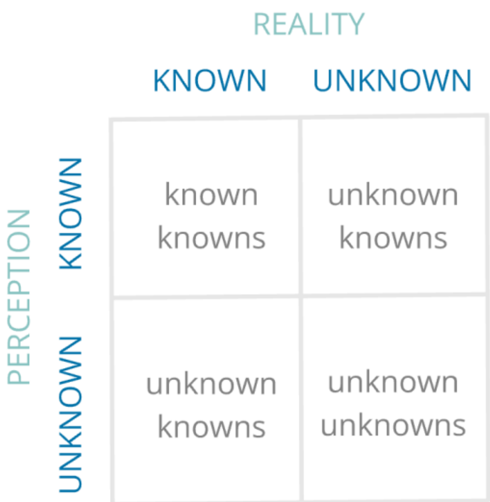

Figure 6: Rumsfield Matrix (Sandhu & Andrade, 2023).

know. Famous *unknown unknowns* are things you don't know, you don't know (Sandhu & Andrare 2023). Cognition plays a significant role in riks recognitions and -management.
Risks or events one are unaware that one don't even know, are called as black swans. They do differ from wild cards as a future event. Wild cards have a known factor, like unknown knowns. Likelihood for them is small, yet impact is vast. Black Swans are again from the whole another ideal world (Taleb 2007, 33-34), yet in the focus on many organizations prepaderness plan. Through ongoing development with computational power and artifical intelligence in the information society, algorithms detecting black swans are evolving as well.
Quantum computational algorithms do bring a new dimension to detecting future events such as black swans (NSA 2023). Development around deep learning neural networks and black swans (Wabartha et al. 2021, 2140-2145) is bringing new aspects to oragizational strategic views. Bayesian reasoning combined with deep operational neural networks is a one approach to black swan detetction without vast data history (Pickering et al. 2022, 1; Choi 2023).
Algorithmic black swans are a another perspective to the same matter: When we have algorithms to detect future events such as risks and black swans, they may create such ones too (Kolt 2023, 68).

Risk-models do evolve through growing computational power development of understanding different risks and governing understanding of organizational need for them. For instance, in the view of propabilities of extreme outcomes, new models are needed for more robust evaluation. (Johnston & Djurić 2011).
There are approaches, where risk management has been weaved into foresight scenario planning, especially delphi based scenario planning (Zio et al. 2024, 2-3). Direction of combining risk management and foresight more of both future estimation tools, is welcomed path to foresight, as foresight scenarios itself generates risks (Zio et al. 2024, 8).
As previously risk managemet has been seen subliminal for foresight, today there are opposite approaches when risk management has been reinforced with foresight, especially in disaster management. The foresight ability to shape future has been seen as an aid to construct better risk management (Aubrecht et al. 2011). Also, shaping of foresight in the very basis of ISO 31000 standard is a combining persective to bring qualitative and quantitative methods together (Meyer-Nieberg et al. 2015, 1-7). Fusing together risk management and foresight is not new, quite the opposite. Both serve the same purpose, gaining future knowledge, but only in complemenatry means towards each other. Especially the risk evaluation brings the ability to assess impact and likelihoods to foresight (Luís et al. 2021). Therefore, risk management placing under security foresight is relevant.

2.2.2 Corporate foresight

Anticipation serves as foundational building block on foresight focusing on the immediate act of predicting future events, whereas foresight is more analytical and often aligned with strategic objectives. Understanding the anticipation as a concept enhances the value of corporate foresight and foresight in general. Recognized as one of the six main pillars of future thinking (Inayatullah 2008), anticipation includes and understanding of causality which is critical for effective future planning.
The European Commission utilizes strategic foresight as a tool of preparedness, anticipating future events, and actively shaping the future (European Commission 2024b). Strategic foresight is a powerful tool across the fields enabling the users to influence and mold future outcomes and especially in corporate perspective. This view aligns the with the border idea that

> "*If we don't have the tools to imagine futures, we easily end up living the future of others*." Freely translated (Aalto et al. 2022, 335).

Corporate foresight has evolved from its early quantitative roots, where predicting corporate futures relied on numerical data. Around the 1950's two main approaches to corporate foresight emerged: the French Prospective school, which focused on collaborative systems thinking, and RAND Strategic Foresight school emphasizing in analytical and strategic methodologies (Marinković et al. 2022, 290).

Nevertheless, corporate foresight today integrates variety of the tools and techniques to map potential futures. Technology plays a significant role in the corporate foresight, as systems and innovations not only mapped in foresight aims but used in the foresight processes (Marinković et al. 2022, 291).
Development can be traced through significant milestones. Scenario generation became prominent during the 1970's with Shell's anticipation of the oil crisis standing out as notable example. In the 1980's roadmapping techniques gained popularity. By the 21st century, enterprises such Nokia, Siemens and Phillips had begun to integrate foresight into their managerial and strategical processes.
Key concepts in corporate foresight revolve around knowledge generation including how information is utilised within an enterprise, the sophistication of methods employed, the translation of insights into actionable strategies, and the integration of foresight not organizational processes. (Rohrbeck et al. 2015, 4).
Generic Foresight Process Framework (GFPF) exemplifies a structured, reactive approach to strategy via corporate foresight (Voros 2003, 15). Foresight includes in this process phases such

as analysis, interpretation and prospection, which can be cross-impact analysis, causal layered analysis, scenarios or backcasts for instance. This segment of foresight is fed with input, which can be strategic intelligence or Delphi for example. From foresight segment strategy is generated though output is reports (figure 7).

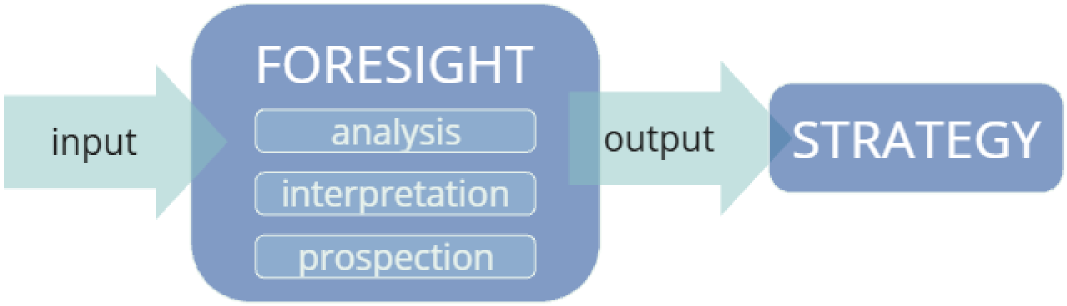

Figure 7: Foresight framework (Voros 2003, 15).

2.2.3 Foresight tools

In the evolving field of foresight techniques, a variety of methods and tools are used to gather the future-oriented knowledge. Some of these methods trace their origins back to the golden era of RAND corporation rooted in military application, while others have emerged more recently. While these tools can be used independently, they are often blended with other methods and frameworks in foresight practices to enhance accuracy.

Risk Matrix

Evaluation in risk management traditionally relies on possible risk event's likelihood and potential impact of it (Ahteensivu et al. 2018, 77). On the very basis, future events are observed by this mean to be risks in all bases, and this equation is calculated the risk rate from severe to mild according to its results by following equation:

$$Risk = likelihood\ x\ impact^2$$

Likelihood and impact are typically rated on a scale of 1-3 for example, whit the resulting risk value categorized accordingly. Generally, risks are evaluated through this equation, but when margin of dispersion error is reduced, impact is raised to the second power (Ilmonen et al. 2022, 97). In practice risk equations can be more complex incorporating statistical models, depending on the subject equation is used for. Risk matrix is a widely used tool used within the context or likelihood and impact (Acebes et al. 2024, 4).

IMPACT LIKELIHOOD	**Neglible**	**Minor**	**Moderate**	**Significant**	**Severe**
Very likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Table 1: Risk Matrix (Acebes et al. 2024, 4).

Risk ratios offer a mathematical evaluation of the risk outcomes, measuring the magnitude of odds and differences. As a tool, they evaluate the end situation with variable risk outcomes, even though they are seen more intuitive than accurate (Holmberg & Andersen 2020). Risk ratio (figure 8) aims to answer how many times higher the risk is between variables (Dattani 2023).

$$\frac{\left(\frac{A}{A+B}\right)}{\left(\frac{C}{C+D}\right)}$$

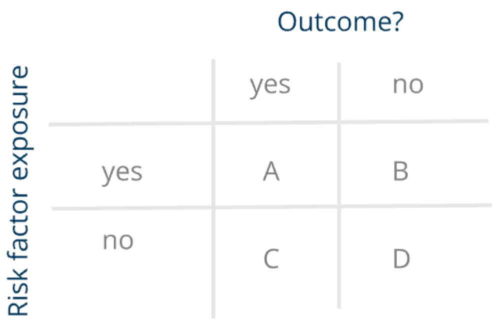

Figure 8: Risk Ratio (Dattani 2023).

Risk classification varies between organizations (Rousku 2017, 27), even though there are existing risk management standard ISO 31000:2018. Risk management, as well as the evaluation of the risk events have been evolving since the method has been adapted to organizational processes. Even semantics of risk itself, has been varying withing time (Li et al. 2020). Evaluation variables considered are a number resulting of equation's changing parameters. For example, risk factor maximum in certain time-period is often under evaluation, where to maximum distribution are calculated with different approaches and connotations (Johnston & Djurić 2011). Financial risk management and insurance sectors frequently use statistical methods for computational risk evaluation, relying on complex algorithms rather than basic formulas. Paradoxally, risk evaluation it self contains risks, such as computational or algorithm included risks (Glau et al. 2013, 305-307) .

The scope of risk management has been expanding beyond addressing negative risks to include positive opportunities. If risks are shown as a negative value event on the x-axis, positive events are placed on positive side of the same axis and are seen as opportunities (ISO 31000:2018). For instance, Wärtsilä integrates this dual perspective in its management systems through “Risks & opportunities management” framework (Wärtsilä 2024).

Future Cone

Earlies description of a concept of future cone (figure 9) has been mapped back to 1993, where from different versions of it have been evolving out. It has been seen as a foresight tool, and one of the versions by has been used by British intelligence around 2010. (Gall et al. 2022, 6-7)
What is common to all future cone variations, is linearity and widening range of possibilities as well as understanding the likelihood of events (Gall et al. 2022, 9-11). The framework it provides gives a visual perspective to scan the operational horizon, scenarios, and events in the scenario. It also provides perspectives to map the route towards preferrable scenario or backcasting of the event, which makes it a useful strategic tool. (Gall et al. 2022, 10-12)

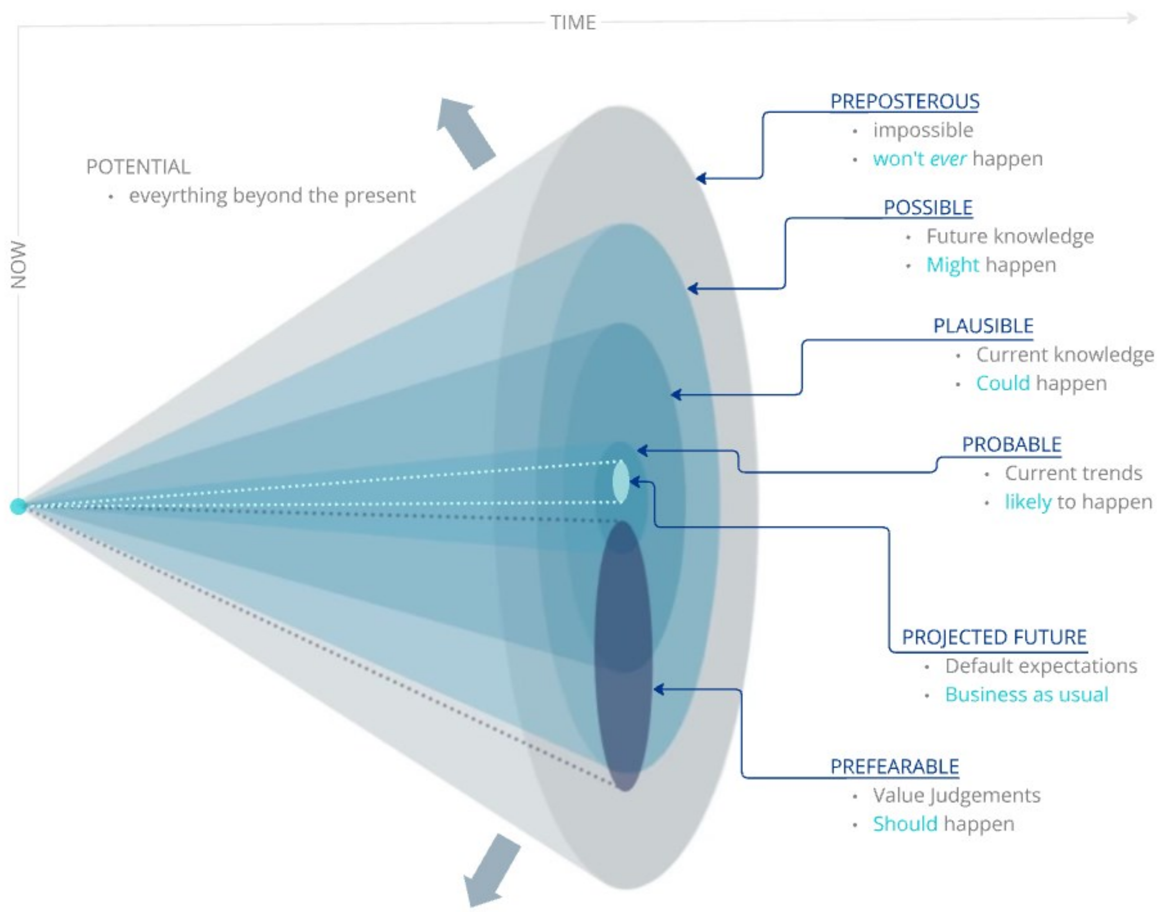

Figure 9: Future Cone (Voros 2003, 16; Voros 2017).

As a visual tool, future cone categorizes futures into possible, plausible, probable and preferable future scenarios, offering a structures way to explore the range of outcomes for given situation. The cone widens as it moves forward in time, representing the increased uncertainty and variability of the future. This model helps decision-maker to understand the diversity of potential paths and focus on shaping the desirable outcomes while preparing for uncertainties. It’s a foundational tool in futures thinking fostering both creativity and strategic planning. (Christophilopoulos 2021, 83-87).

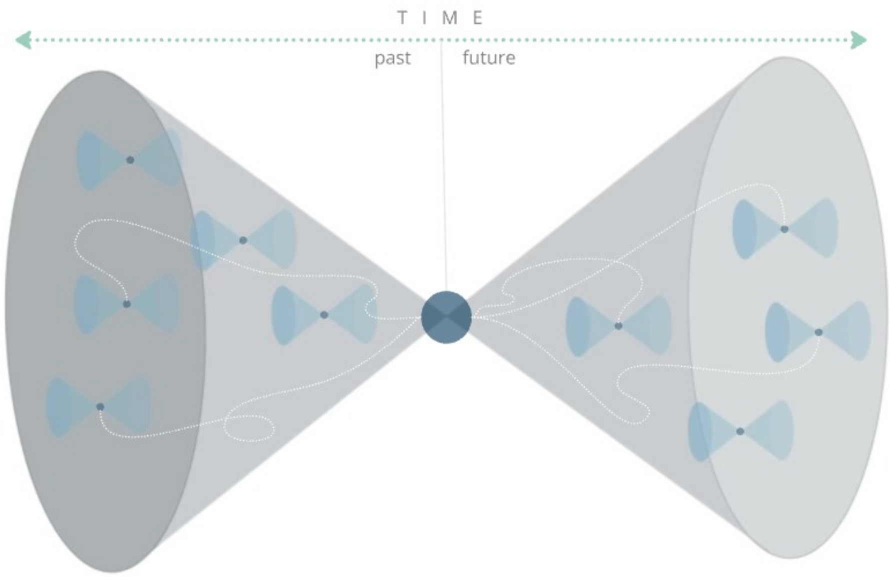

Figure 10: Cone of everything (Christophilopulos 2021).

Further studies around future cone has explored its relationship with theory of relativity, particularly incorporating the perspective of the past. Traditionally, the Future Cone does not explicitly address what lies outside its boundaries (Christophilopoulos 2021, 88). However, this study argues that beyond the Future Cone exists the unknown unknowns -unpredictable events such as black swans- representing future occurrences for which no information is currently available. Time is a variable also in the context of the Future Cone, yet the concept of time is observed in the next chapter of this study.

Delphi-panel

As a tool for foresight knowledge, Delphi-panel and variations of it recognize cognitive biases among creation of future knowledge (Bonaccorsi et al. 2020, 1-2). Widely known tool has variations and been adapted to other methodologies due its ability to anonymize participant. Background history of the tool lies in RAND Corporation in the 1950's after II World War, as it first developmental needs were to forecast impacts of warfare technology. There is different price range and type of online tools such as *ExpertLens*, that allow panellists have online anonymous text-based discussion (RAND 2024).

As a systematic method, anonymous expert panels gather online together, go through several rounds of discussion and/or questionnaires about the subject, and are able to iteratively refine the subject matter. Anonymity and iterative nature of Delphi is aimed to ensuring independent thinking, bias reduction and promoting refined insights as a result,

Overall, Delphi is seen to control some biases through anonymity, collect iterative data, have ability to have participants feedback and gives statistical response to group feedback (Khodyakov 2023).
Delphi is time consuming, as communicating online anonymously is not as fast paced as spoken communication. Yet, the achieved consensus in this process is considered to be more reliable than only one expert's opinion (Khodvakov 2023). There are generally three rules for Delphi:

1. Choosing experts wisely
2. Proper conditions for performing
3. Considerable caution when deriving single combined position from various opinions. (Helmer 1967, 5).

Facilitator plays a role in the Delphi-panel, as gathering of answers from each runned round is done by facilitator. Summary of the results is gathered and input again to the panel by facilitator, so the role is critical to remain impartial and non-influencing (Ogbeifun et al. 2016).

PESTE -analysis

PESTE analysis is a tool integrated with the method of horizon scanning. Horizon scanning is typically the initial step in a longer foresight process, focusing and observing the future operational environments, its key actors, and forces driving the change (Ahteensivu et al. 2022, 106). The identified elements include weak signals, trends and megatrends, which serve as the foundation for the further analysis.
PESTE itself is a strategic analysis tool used to understand the external macro-environmental factors that influence and organization or a decision-making process. It is rooted in the late 60's in business development and was ETPS where it evolved to PEST. The acronym today stands for Political, Economic, Social, Technological and Environmental factors. Each of these dimensions provides a lens through which external drivers and trends can be examined, offering insights into opportunities and risks. (Ahteensivu et al. 2022, 107-108).

1. **[P]olitical**:
   Examines government policies, regulations, political stability, and other governance-related issues that may impact to the organization or scenario.
2. **[E]conomic**:
   Focuses on economic trends such as inflation, interest rates, currency exchange rates, market growth, or elements which affect to financial outcomes and operational strategies.

3. **[S]ocial**:
   Analyses societal trends, demographics, cultural shifts, and consumer behaviours that influences organizational goals.

4. **[T]echnological**:
   Reviews innovations, technological advancements, and their potential disruption or benefits to the organization.

5. **[E]nvironmental**:
   Considers ecological and environmental factors such as climate change, sustainability requirements, and resource availability.

PESTE analysis is widely used in strategic foresight and scenario planning to identify drivers of change and anticipate how they may evolve. It assists organizations prepare for uncertainty and align their strategies with external conditions. There are variations in this framework as well, as there are additional elements such as Value, Culture or Legal (Ahteensivu et al. 2022, 108-110).

PESTE has notable limitations, primarily due its simplicity. Identifying actors in each area can create an illusion of comprehensive understanding of the operational environment (Ahteensivu et al. 2022, 108). However, if any area is overlooked or inadequate explored, the same illusion may result in critical knowledge being excluded or unnoticed.

Future concepts

Understanding of various elements of future analysis is essential for effective strategic foresight and decision-making. These elements – weak signals, opportunities, drivers, trends, megatrends, wild cards, and black swans – offer a unique insight to the complex and dynamic nature of the probabilistic future. Each element serves a distinct purpose in the exploration of potential futures and as a tool they assist to understand the nature of probabilistic outcomes. Change is somewhat present in each element.

- Weak Signal:
  These early indicators of emerging change that may evolve into significant trends f events are Weak Signals. They are often subtle and not widely recognized, requiring careful observation and interpretation. Examples include initial mentions of a novel technology in niche research communities or shifts in consumer behaviour on a small scale or discussion and pictures in social media indicating value changes. Identifying and analysing weak signals enables organizations to anticipate future developments and respond proactively.

- Opportunity:

  Opportunities represents the potential advantages or favourable conditions that can arise in future scenarios. They are positive outcomes, that can enable organization to act proactively, gaining a competitive edge or addressing societal needs. For instance, the rise of green technologies presents opportunities for industries to align with sustainability goals while opening new markets.

- Driver:

  These evets are underlying forces that shape change in the future. Drivers can be economic, social, political or value-based factor just to mention few, and they set the trajectory for trends and megatrends. For example, digital transformation, climate change, and globalization are key drivers impacting multiple sections and regions. By understanding drivers, organizations, can better anticipate and prepare for shifts in their operation environments.

- Trend:

  Trends are observable patterns or directions of change driven by underlying forces. They represent intermediate-term developments, often lasting years or decades. Examples include the increasing adoption of remote work, the aging population, and the shift towards renewable energy. monitoring trends helps organizations identify areas od growth or disruption and adapt their strategies accordingly.

- Megatrend:

  These events are large scale, long term-forces, that shape the global landscape over decades. They often have profound and wide-ranging impacts on societies, economic and industries. Examples of megatrends includes urbanization, climate change, demographic shifts, and technological convergence. Understanding megatrends enables organizations to align their strategic goals with broader global dynamics and navigate transformative changes effectively.

- Wild Card:

  With low probability and high impact, wild cards can disrupt existing trends and systems. These events are difficult of predict but can significantly alter future scenarios. For example, breakthroughs in quantum computing or the sudden emerge of disruptive technologies like AI could shape industries. Considering wild cards in strategic planning helps organizations build resilience and prepare for the unexpected and unpredictable directions of development (figure 11).

- Black Swan:

  Extreme, unpredictable events with massive impacts originated outside the realm of normal expectations are the nature of Black Swans (Taleb 2007, 33-34). While Black Swans cannot be predicted, fostering adaptability and robust scenario planning can help organizations to mitigate their effects and recover more quickly. COVID-19, the 2008 global financial crisis or the rise of internet, fall of Berlin Wall are sometimes referred as Black Swans. In can be argued that there was information available of all of these, yet it caused no actions towards avoidance of the larger disaster. According to Taleb (2007), Black Swan characteristics are

  1. Rarity lies outside of our expectations.
  2. Extreme Impact is often catastrophic.
  3. Retrospective Predictability due hindsight bias.

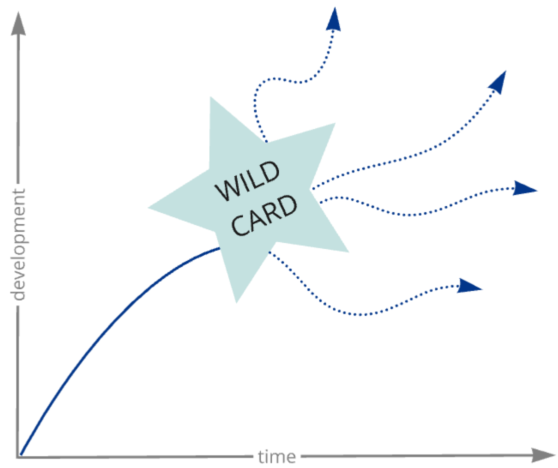

Figure 11: Wild Cards alters the development direction to be unpredictable (Rubin).

2.3 Cognition

Cognition is one of the major elements when thinking of strategic intelligence, alongside with the analytical abilities (Levine et al. 2413-2414). Cognition plays a pivotal role in strategic foresight, risk management, and intelligence by enabling the analytical processing of data through human thought. Withing cognition the dual-process theory distinguishing System I and System II thinking (Kahneman 2011, 16) i.e. concepts such as metacognition versus cognition and consciousness versus subconsciousness highlight the two primary modes of the cognitive operation.

System II represents slow, deliberate and analytical thinking. Its essential for reasoning and analyzing information, though its typical working with slow speed. In contrast System I is characterized by fast, intuitive and subconscious processing capable of delivering extraordinary insights in mere moments. To illustrate the difference of the two means, while System II process the information at a rate of 40-50 bits in a second when System I operates in at astounding 11 million bits per seconds (Raami 2016, 30-32).

Building on these solid basics and foundation of cognition, certain elements stand out for exploration in the context of strategic foresight. These include the influence of time, cognitive biases and AI, all of which contribute to the creation and application of foresight knowledge. Each aspect provides unique insights into enhancing the effectiveness of strategic foresight and intelligence analysis decision making processes.

2.3.1 Time

According to contemporary scientific understanding the perception of time arises within episodic memory, which creates anticipatory schemas from fragments of personal memories (Schacter et al., 2007, p. 657). Consequently, each individual's experience of time is unique, shaped by their subjective memory compositions. This supports the hypothesis of time as an illusion, where time is viewed as a quantum-level consequence of quantum entanglement (Coppo et al., 2024).

In strategic foresight, time is a key variable, yet its true nature complicates its evaluation. Time is not necessarily linear, nor is it definitively governed by the thermodynamic "arrow of time." The arrow of time, derived from thermodynamics, suggests a unidirectional flow dictated by entropy; however, this may not apply at the quantum level (Roberts, 2022, p. 167).

Consciousness plays a important role in generating anticipatory imagery of the future, which some argue evolved as a survival mechanism to predict outcomes for survival (Schacter et al., 2007, p. 657). Episodic memory facilitates this process by collecting and reassembling fragments of stored information (Schacter et al., 2012, p. 773). However, this anticipatory computation is prone to distortions, as the brain continually simulates future events based on time predictions. This highlights the assumptive nature of the prospective brain.

Chronesthesia, the capacity for subjective time awareness, parallels spatial vision in its ability to sense space (Tulving, 2002, pp. 312–315). Chronesthesia enables individuals to construct a subjective sense of time, while self-awareness, a form of reflective consciousness, provides a sense of "now" within the continuity of time (Revonsuo, 2010, pp. 86–87). This deep connection between consciousness and time reinforces the notion that the brain is fundamentally a temporal organ due to its predictive nature.

In strategic contexts, the distinction between conscious time and physical time is crucial. Conscious time inherently lags behind physical reality, as the brain processes stimuli through neurons, which require time to transmit impulses. This delay results in a subjective extension of the moment, introducing a bias in consciousness (Durging & Sternberg, 2002, p. 286). Additionally, different individuals experience variations in perception, as the brain dynamically recalibrates and processes signals at different speeds (Eagleman, 2008).

At the fundamental level, time does not exist; it emerges only at higher levels of reality, akin to how a table feels solid despite being composed of atomic motion (Callender, 2010). Elements such as mental time travel, conceptualization of time, memory and prediction, and the distinction between past and future all contribute to this higher-level understanding of time (Buonomano & Rovelli, 2021).

Rovelli (2011) states: "*Time is, that is to say, the expression of our ignorance of the full microstate.*" This statement aligns with two dominant philosophical perspectives on time:

1. Presenteism: Only the present is real, time flows, and change is authentic.
2. Eternalism: All moments—past, present, and future—are equally real, suggesting a "block universe" where the future is as fixed as the past (Callender, 2010; Buonomano & Rovelli, 2021).

In Einstein's relativity of time, gravity distorts time, making it relative rather than universal. Similarly, in foresight, time is observed through the subjective lens of consciousness, which acts as an interpreter of temporal events (Buonomano & Rovelli, 2021). Rovelli suggests that reality is composed of events, not static objects (Jaffe, 2018). Events are the fundamental building blocks of the universe defined by their time and location (Rovelli, 2011).

This perspective resonates with future studies, where events—whether as possibilities, risks, or black swans—are the primary focus. Individuals project their subjective temporal frameworks onto these events, making foresight inherently tied to cognition and perception.

Strategic foresight leverages tools like ego-moving and time-moving frames to map time-space relationships and evaluate goals (Crilly, 2017, p. 2387). By understanding time as a subjective construct shaped by consciousness and perception, strategists can better align their objectives with the fluid and multifaceted nature of temporal reality.

Time, consciousness, and foresight are interconnected. Recognizing time as a subjective, emergent phenomenon rather than a fixed, linear construct enables a richer understanding of strategic challenges and opportunities. This nuanced perspective positions foresight practitioners to navigate uncertainty more effectively, embracing the complexity of the future as a dynamic interplay of events, cognition and perception.

2.3.2 Biases

In addition to time, consciousness and brain do play a role in biases and in cognitive decision-making. Causality has significant role in all future-event related foresight processes. Yet, the illusion of causation arises from the interplay of physical brain activity and conscious experience together.

As a feature of consciousness, self-awareness greatly influences the individuals' ability mentally to travel in time. For example, amnesia reflects the deficit in self-awareness, as it impairs the ability to retrieve memories from storage. (Revonsuo 2010, 44, 137).

Consciousness is a frontier, that affects a lot to the decision-making process in myriad ways. Peripheral consciousness may leave important data in lesser attention (Revonsuo 2010, 75) which can lead to scenarios evolving to self-fulfilling prophecies (Talsma et al. 2019; Niemelä 2012). Self-fulfilling prophecies can be positive, negative or neutral. However, catastrophic thinking - a bias rooted in the brain's reward system – tends to favor negative outcomes, as fear strengthens easily neural connection (Quartana et al. 2009, 745).

The Dunning-Kruger-effect (figure 12) highlights the tendency to overestimate one's competence when lacking competence or knowledge. Overconfidence diminishes as individuals gain expertise, resulting in more realistic self-assessment. (Kruger & Dunning 1999, 1131-1132).

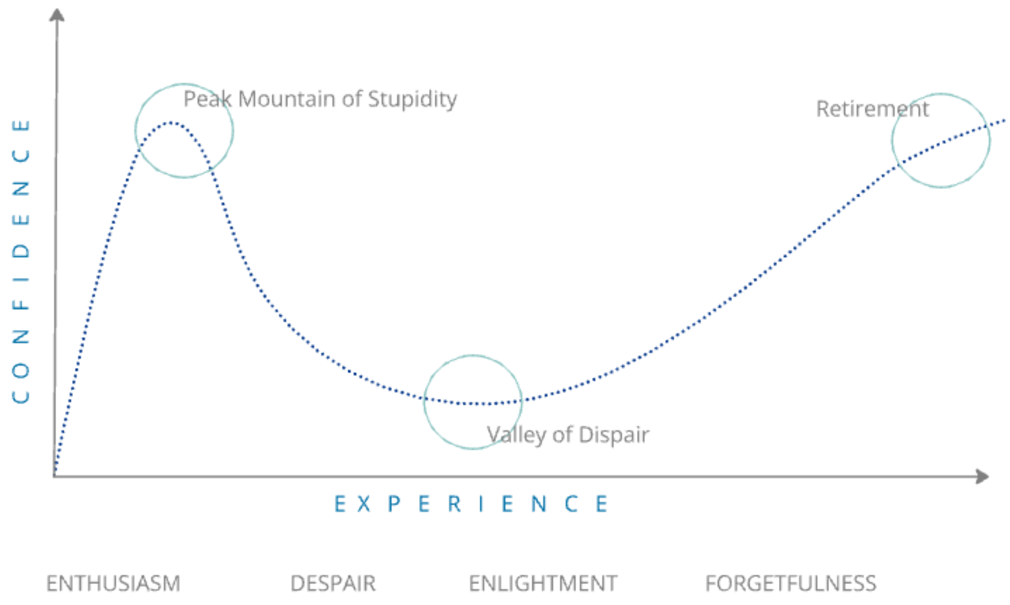

Figure 12: Dunning-Kruger-effect (Kruger & Dunning 1999).

Similarity bias occurs when shared traits such as personality, education, gender or political affiliation influence into decision-making. Studies suggest that similarity in leadership or analysis teams can affect outcomes, though experienced individuals tend to rely less on cognitive shortcuts (Becker et al. 2019).
In the other hand, framing bias involves exaggerated optimism leading to underestimation of risks but can mitigated through negation approach (Bonaccorsi et al. 2020, 4-11).
Anchoring bias results from fixating on a single parameter during problem-solving. Reducing of tis bias can be reached through techniques such as devil's advocate-approach aka. opposing arguments to provoke debate (Bonaccorsi et al. 2020, 11). Evaluator experience effects to intensity anchoring effect (Bonaccorsi et al. 2020, 9), which can be derived from Dunning-Kruger effect.
Expert bias excludes out the knowledge, that exists beyond the expertise knowledge limitations (Raami 2020, 55-57, 78-82, 122-124).

Despite the prevalence of cognitive biases, certain individuals consistently make more accurate future predictions. Research shows that they share common traits including disciplined study, critical thinking, openness to alternative perspectives, meticulous synthesis of information, granular values, self-criticism and willingness to revise their conclusions (Tetlock & Gardner 2015, 220). To refine it, these individuals biases are more known, controlled, and the possibility to be wrong is acknowledged.
Enhanced use of System I fast thinking or super-intuition is not merely a passive reception of information, but also a method for actively retrieving insights (Raami 2020, 78-82).
In strategic contexts, analytical, practical and creative reasoning are essential cognitive skills for mitigating biases (Maccoby 2015, 20). After all, biases are present always no matter what the case is. Mitigation and acknowledging them is the key factor.

2.3.3 Artificial intelligence

The ongoing paradigm shift driven by artificial intelligence is transforming how we use time and work, releasing time in various ways (Vairimaa 2024). The vast leaps in several fields of AI development are progressing at a pace that leaves humans struggling to keep up (Kiiski 2024). As AI development raises ethical, security and existential questions, one certainty remains: It will fundamentally change all aspects of life (Vairimaa 2024; Kiiski 2024).
While human brain relies on neuroplasticity allowing them to adapt and learn through learning (Hawkings 2021, 8-13), AI operates through algorithms and machine learning (Brown 2021). Unlike the organic human brain, AI lacks critical thinking capabilities making human critical

reasoning more essential than ever (Vairimaa 2024). The human brain also requires proper stimuli during the key developmental phases to maintain functionality and creativity, elements, which may be reduced with excessive amount of use of the AI instead of neural networks of the brain. This balance is especially important when employing AI for foresight, intelligence, creative or mathematical tasks that do need human thinking besides algorithms. Further study is needed to fully understand AI's role and effect in these areas of human cognition.
Lacking critical thinking in AI produces different range of biases, which needs to be addressed in all work AI that is used in knowledge creation (Nicoletti & Bass 2023; Athaluri et al. 2023, 5). Previously described Dunning & Kruger bias can be used as a valid tool for evaluating AI use (Salvagno et al. 2023, 2). Hallucinations are a problem producing pseudo-science, which affects to all work when biases interfere to work where AI is used.

Regulations are created always in wake waves, meaning that significant development or reaction to major events are present e.g. cybersecurity or major disasters. Due EU AI Act (European Parliament 2024), first regulation around AI in the whole world, yet AI development is far ahead. As the possibilities are evolving, so are the risks. The information that are fed into AI, for example to ChatGPT, may be mined out too (Mez 2024). Cybersecurity threats are expanding, as also OpenAI is hackable (Kilovaty 2024).
Science community with further studies may be faster than regulations, but not as fast as malicious activity around AI. Already existing cyber threats and hybrid warfare are watching the development of AI as well. And they're not the last dystopias that are said aloud. Even though healthy safety culture is evolving around AI, risk assessments are not visible as rest of the safety components (Webb & Schönberger 2024, 22).

Besides gloomy aspects, AI has enormous number of encouraging possibilities. It is said, that stopping of it would be the same as stopping the development of internet when it first came (Kärkkäinen 2023). AI is possible to adjust for specific use and make work for hundreds of human hours (Kiiski 2024). AI has already a Foresight Generator that extrapolates trends from historical-, marketing-data, social media and internet, technological development by using several analysis methods such as statistical analysis and machine learning.
AI will be inevitable in the scope of every person, every organisation or institute, government and business. However, trust in AI hinges on traceability and transparency as these factors are crucial for trust building (Van der Steen & Van der Duin 2012). Just like humans, AI has its own biases. While learning in humans and animals can be conducted from single event, AI requires multiple iterations to achieve a learning outcome (Viale & Malewski 2020, 338). In human memory, feelings do boost significantly the learning process by enforcing the neural wiring (Tyng et al. 2017), which is not absent element from the AI.

Ai’s role in decision-making reveals its limitations and potential. For example, AI has failed with complex comparative reasoning in juridical legal judgements, occasionally producing false information reasoning hallucinations or exhibiting contrafactual bias by assuming unverified premises (Dahl et al. 2024). In the other hand, trained AI has spotted a patterns and trends of human cognition biases specifically in courtroom decision making (De’Shazer 2024, 19-20). Quantum perspectives suggest that time exist only at higher levels, which may open totally new avenues for the foresight and the whole future knowledge acquisition.

3 Methodology of the study

The strategic integration of foresight and intelligence analysis was the red thread throughout the whole study process from the beginning to the end. Consequently, strategic design thinking was considered from the earliest stages of planning the study. While design thinking alone is valuable tool for guiding the process, adopting the strategic approach through strategic design provided a more precise methodology for developing a robust tool for strategic means. This approach successfully combined creative and analytical thinking, leveraging the strengths of both perspectives (Park & Lee 2020, 170).

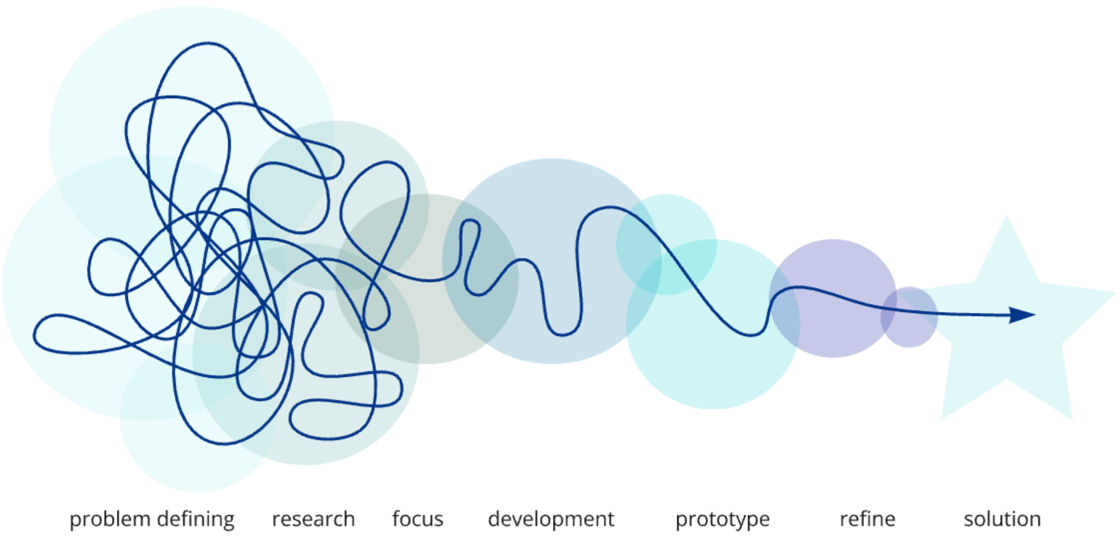

Figure 13: Design process (Almqvist 2017, 2526).

3.1 Design

The design process was structured around strategic design thinking, incorporating elements of lean philosophy to enhance efficiency and maximize value creation in strategic use of the objectives.
To ensure traceability, process journal was maintained (appendix II) recognizing that the inherently complex nature of the design process (figure 13) makes it difficult to replicate it in its entirety.
Lean philosophy was applied specifically to the design process, even though it was not explicitly included in the framework's structure. Lean philosophy aims to minimize the activities that do not contribute to the value, recognizes the used time as a value, eliminates the overly complex workflows and focuses on the end user value gain (Bhasin & Burcher 2006, 66). In contrast, strategic design thinking allows the process to have unrefined elements at the early stages of the design, which is not straight aligned with the lean philosophy. This semi-controlled process fosters an environment where innovations can emerge organically throughout early stages of the process.

3.1.1 Fusion of frameworks

The design process was built on around three core requirements: 1. process acceleration, 2. incorporation of numeric values and 3. bias recognition – behind the research question. The **Future Cone** was employed as a design framework, categorizing future events in the probable, plausible and possible future domains (figure 14).

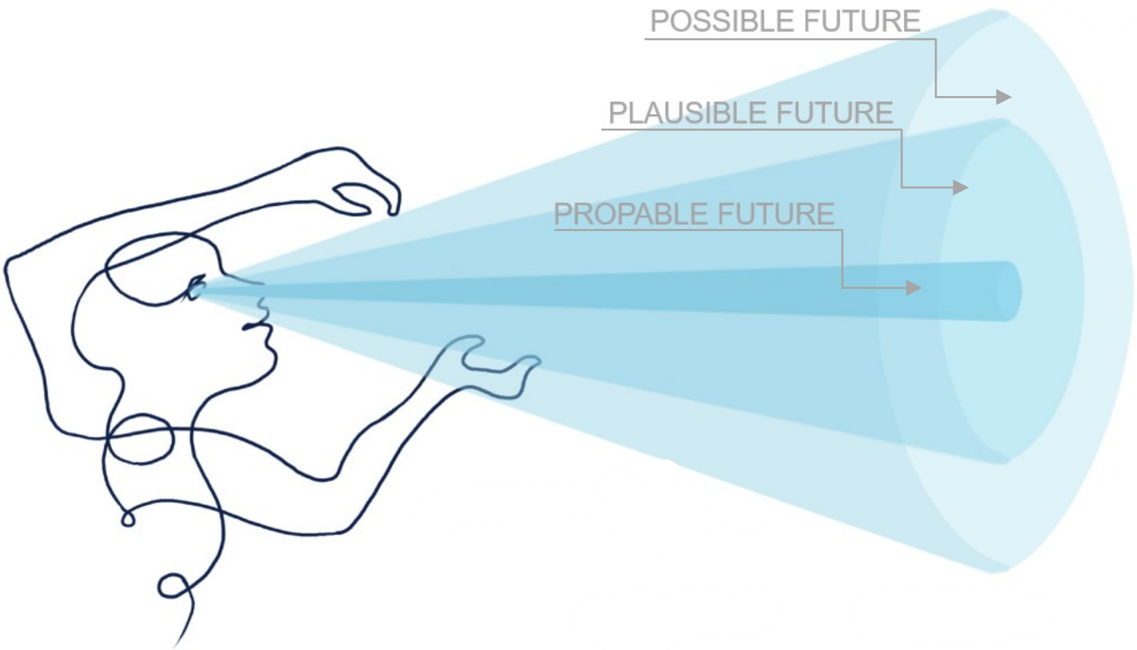

Figure 14: Stages of the Future Cone.

This framework was further adapted to serve as an analytical tool by examining the Future Cone. With the cross-section (figure 15) of the Future Cone, it's possible to reveal the "arrow of time" in new perspective. This new angle to the cone allows to user to analyse possible scenarios in the three fields of future: probable, plausible and possible.

Through this cross-sectional view it was possible to integrate operational fields with the Future Cone. Several models do exist for mapping future scenarios or events withing these fields. In future studies, frameworks like PESTE (Political, Economic, Social, Technological, Environmental) and its variations area commonly used for example in horizon scanning. Sometimes, PESTE is expanded with additional branches such as Values or Time. (Aalto et al. 2022 105-110).

In contrast, intelligence and military applications often focus on security-oriented frameworks such as DIMEFIL (Diplomatic, Information, Military, Economic, Financial, Intelligence, Law enforcement) or PMSII (Political, Military, Social, Infrastructure, Information), which also do have their variations (Abaianiţi 2018, 45).

In this design process, elements from PESTE and PMSII as well DIMEFIL were fused, with addition of Legal and Value fields to create comprehensive analytical framework for the new tool and the method. Since Time was inherently embedded in the cross-section of the Future Cone, there was no need to add it among other fields. This integration led through the strategic design process to MEPITESI-LV -radar (figure 15) encompassing fields from both corporate and military based scanning tools.

MILITARY
ENVIRONMENT
POLITICS
INFRASTRUCTURE,
TECHNOLOGIC
ECONOMIC
SOCIAL
INFORMATION
+ LEGALITY
+ VALUE

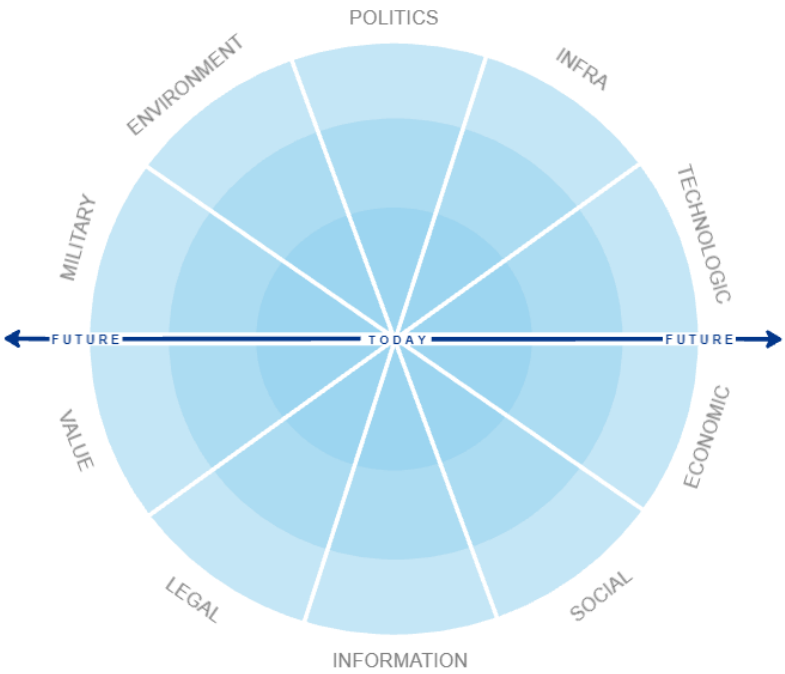

Figure 15: MEPITESI-LV -Radar.

By combining these frameworks, the operational field was refined to provide a more precise analysis of the dynamic and rapidly evolving information environment we inhabit today. This approach enables a deeper understanding of contextual factors and their interplay in shaping the future events.

3.1.2 Future events

A key element in the design process is the integration of opportunities and risks, which became quantitatively evaluable components in the new tool. Formed future events (Mohun 2016, 30) are the basic unit when measuring the scenarios they are constructing. The numeric evaluation is derived from a risk management formula, and it is tailored to align with the future cone

framework. In this approach, risks are plotted with negative values on the x-coordinate, while opportunities are assigned positive values (figure 16).
Risks are categorized Extreme, High, Medium, and Low risk events based on calculated risk number. Positive events on the other hand, are classified into Opportunity, Driver, Trend, or Megatrend categories. Events with low value are placed on Weak Signal category, characterized by low impact and likelihood. These elements are of interest in the monitoring of them longer period of time due their tendency to evolve and acting as early warnings. For instance, Wild Cards -future events with low likelihood and high impact often emerge from Weak Signals, so acknowledging causality gives more depth to the analysis work tools is able to provide.

Classification of future events settled on the x-coordinates as followed (figure 16). Formation of events were derived from figures based on risk management (table 2).

Figure 16: Future events classification.

	SIGN	PROBABILITY	IMPACT	ACTION
Extreme Risk	-	Major	Massive, vast and negative consequences.	Needs imminent actions.
High Risk	-	Serious	Obvious negative effect to main event.	Comprehensive actions are requested.
Medium Risk	-	Minor	May cause losses.	Anticipatory mitigations, monitoring.
Low Risk	-	Small	Very small impact if happens.	Monitoring is needed or mild mitigations.
Weak Signal	- +	Very small or negligible	Near no impact or very small	No mitigation needed; monitoring requested through developing nature

				(Risk, Opportunity, Wild Card)
Opportunity	+	Small	Positive possibility with minor effect.	Observation of possible threads.
Driver	+	Minor	Obvious positive movement.	Business possibility, minor anticipatory actions.
Trend	+	Serious	Generally accepted opinion, large impact.	General opinions, has the numbers behind. Anticipatory actions.
Megatrend	+	Major	Very strong impact and way of causality.	Possibility, general value or opinion. Need actions.
Wild Card	- +	Likelihood very small	Immense impact, can be positive or negative	Anticipatory key-element if happens. Develops from Weak Signals.
Black Swan	- (+)	Likelihood not known Known unknown Unknown unknown	Vast, yet unknown impact Usually seen as negative surprise	No possible action.

Table 2: Classification of FE's.

Through this strategic design process, numeric value gained future events are possible to place into the future cone and into scenarios (figure 17).

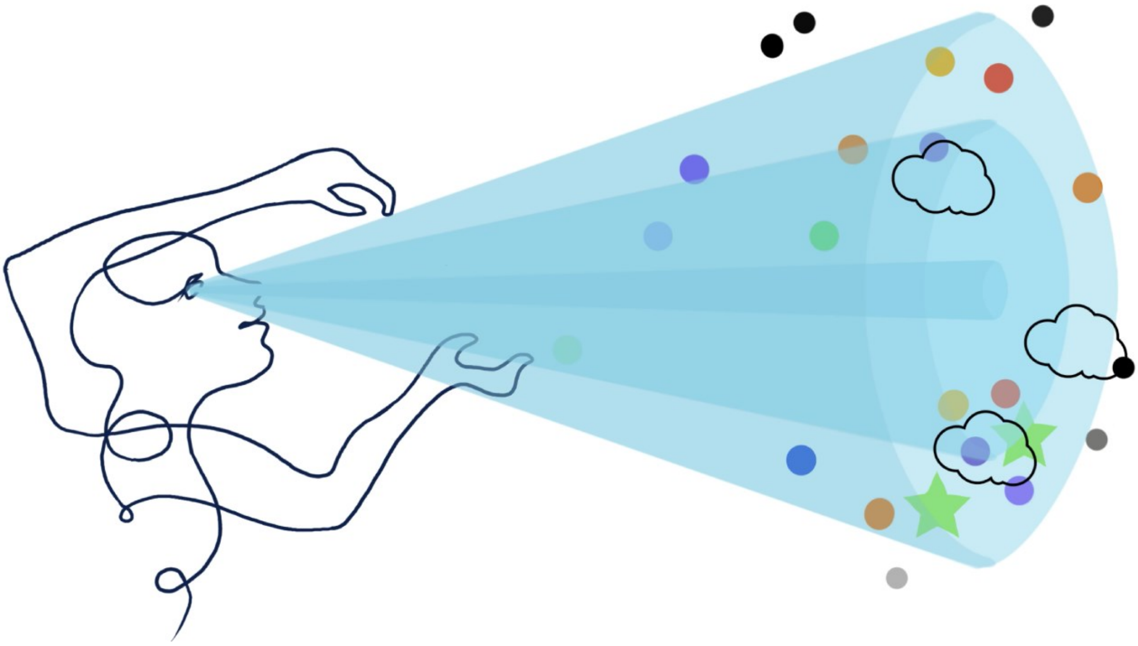

Figure 17: Organisational perspective through modified Future Cone.

3.1.3 Tools

Several tools were adopted in the study, playing a crucial role in managing and implementing the various frameworks. These tools were essential for ensuring the integration, visualization of the methodologies, enabling the functional study to work coherently. The tools utilized in this study can be divided into two categories: Designing tools and actual prototype tools.

- **Designing tools**: These included online visualization boards, which facilitated the design progress and understanding of the processes. Traditional pen-and-paper was heavily applied as an early stage designing tools.
- **Prototype tools**: The prototype was built using Microsoft Excel (MSN365), where the framework was added onto. Due to the exploratory and testing nature of this project, the prototype consisted of multiple tools, which was not ideal but necessary withing the thesis' limitations. Forms, Teams and Excel all were used as they worked well together.

Early stages of the strategic design process required physical and conceptual tools, particularly when applying lean philosophy. The Design Diamond was an instrumental tool in refining and integrating various framework elements into a cohesive whole. This tool made possible the concepts to align and avoid any entanglements, particularly when combining the ACH analysis, Delphi-method and risk evaluation through numeric scoring. Design Diamonds iterative process typical to design thinking, assisted the constant testing and designing of the Excel -based F&A tool.

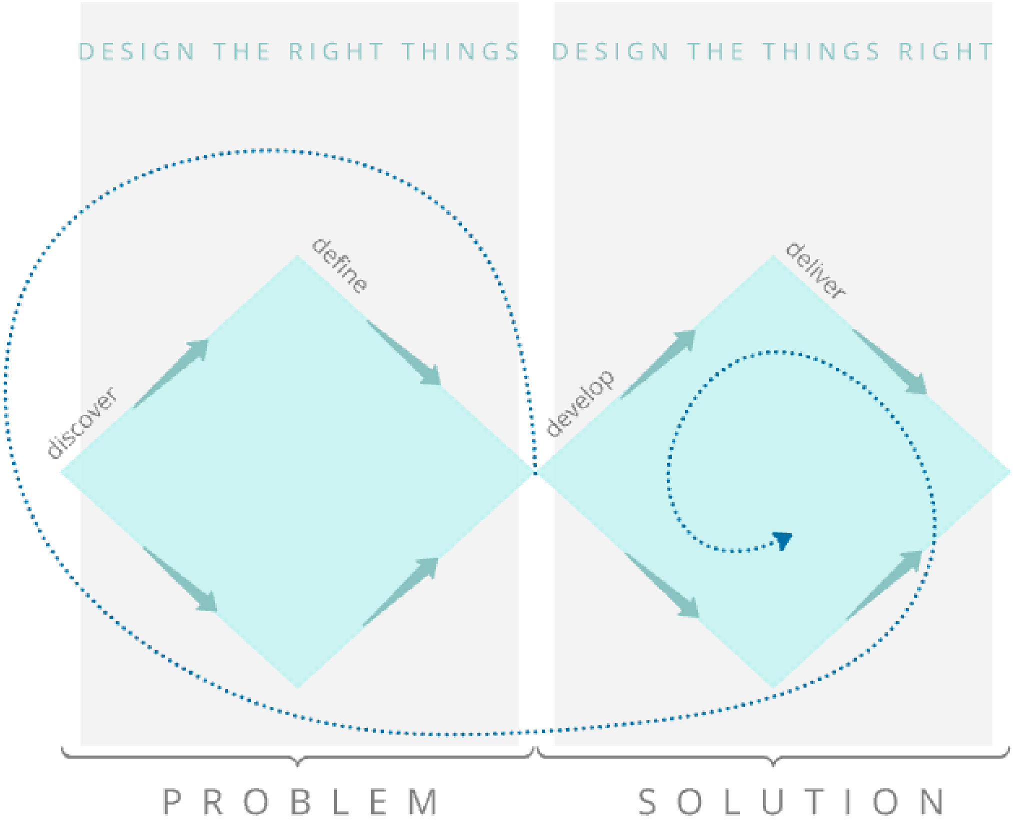

Figure 18: Double Diamond (Gustafsson 2019, 7-9).

Besides designing tool sets, the actual prototype required three different software tools to handle specific tasks:

1. Plotting of calculations.
2. Conducting the panel online.
3. Visualizing the panel results.
4. Data collection.

These software tools were selected for their compatibility and ability to work cohesively. Despite relying on multiple tools, the study was possible to conduct. However, the use of various tools and platforms introduced a potential risks and errors for the study, which were anticipated given the experimental and functional nature of the study process.

4 Results

Main result of this study is the developed new tool and method. These are viewed through the process of the prototype, implementation and the test runs. Overall analysis follows specific approach to evaluate features of foresight studies. Planning, design and framework fusion are important elements in the results.

4.1 Prototype

The prototype consists of actual method and combined tool. The actual process of created method is opened in the next chapter, yet the developed prototype tool understanding needs to be done at first, as it retrospectively affects to the whole process.

It is important to distinguish between *likelihood* and *probability* in this context of the prototype design, as they tend to get mixed easily. Excel-based F&A tool calculates probabilistic for each future events, and likelihood is plotted for each scenario that consists of these future events.
Probability calculations adopt the ACH-method, which emphasizes credibility and relevance when assessing the likelihood. By evaluating the credibility and relevance when assessing the collected evidence for each observed scenario, the F&A -prototype was designed to calculates a probability of value that F&A compares to withing the risk matrix (Appendix I). A 4 x 4 risk matrix (figure 19) was selected for the prototype design to provide greater granularity that 3 x 3 matrix while avoiding the complexity of 5 x 5 risk matrix at this stage of the early design. Probability is multiplied by the squared impact value - derived from the risk management equation- to enhance the dispersion and minimize margin of error (Ilmonen et al. 2022, 97). The simplified formulas used in the prototype are:

$$\textbf{Future Event} = \textbf{Probability x Impact}^2$$
$$\textbf{Probability} = (\textbf{Credibility} + \textbf{Relevance})\ \textbf{x Consistency}$$

In this formulation, probability is a composite value derived from credibility and relevance, weighted by the consistency factor. Credibility and relevance are each rated on a scale of 1 to 4 and combined to produce final value between 0 and 4. This emphasis factor determined by the relationship between these elements in the same evidence, influences the event evaluation. Variance in this formulation is possible in the future.

Probability was designed to follow a view of ACH -method, where emphasis is on credibility and relevance when considering the probability. By given evaluation of used evidence credibility and relevance considering each observed scenario, prototype calculates a value that is compared withing risk-matrix. 4 x 4 risk matrix was chosen for the prototype design, as it gives more granularity than 3 x 3 matrix, yet is not running wide as 5 x 5 matrix may would.

			Impact Probability	1^2	2^2	3^2	4^2
			8	8	32	72	72
			6	6	24	54	54
			5,5	5,5	22	49,5	49,5
			4	4	16	36	36
			3,5	3,5	14	31,5	31,5
			3	3	12	27	27
			2,75	2,75	11	24,75	24,75
			2,5	2,5	10	22,5	22,5
			2	2	8	18	18
			1,75	1,75	7	15,75	15,75
			1,5	1,5	6	13,5	13,5
			1,25	1,25	5	11,25	11,25
			1	1	4	9	9
			0,75	0,75	3	6,75	6,75
			0,5	0,5	2	4,5	4,5
			0,25	0,25	1	2,25	2,25
-2,25	-2,25	-1	-0,25				
-4,5	-4,5	-2	-0,5				
-6,75	-6,75	-3	-0,75				
-9	-9	-4	-1				
-11,25	-11,25	-5	-1,25				
-13,5	-13,5	-6	-1,5				
-15,75	-15,75	-7	-1,75				
-18	-18	-8	-2				
-22,5	-22,5	-10	-2,5				
-24,75	-24,75	-11	-2,75				
-27	-27	-12	-3				
-31,5	-31,5	-14	-3,5				
-36	-36	-16	-4				
-49,5	-49,5	-22	-5,5				
-54	-54	-24	-6				
-72	-72	-32	-8				

Figure 19: Modified Risk Matrix.

The calculation process can be summarized as follows:

1. **Evidence is evaluated in relation to each scenario**. Value will be given to
   - Credibility: rated 1-4
   - Relevance: rated 1-4
   - Impact: Squared value of rated $(1\text{-}4)^2$
2. **Scenario consistency**:

- consistency score is assigned based on the evidence's alignment, and elements from Step 1 are multiplied accordingly.

Credibility	Relevance	Factor I	Factor II
Extreme	Extreme	4	8
High	Extreme	3	6
Medium	Extreme	2	4
Low	Extreme	1	2
Extreme	High	3	6
High	High	2,75	5,5
Medium	High	1,75	3,5
Low	High	0,75	1,5
Extreme	Medium	2	4
High	Medium	1,75	3,5
Medium	Medium	1,25	2,5
Low	Medium	0,5	1
Extreme	Low	1	2
High	Low	0,75	1,5
Medium	Low	0,5	1
Low	Low	0,25	0,5

Figure 20:Emphasis values.

The evaluation values are provided by an expert panel to ensure consistency. The prototype itself does not assign evaluation values; its role is to streamline the calculation process. The F&A-prototype classifies the future events by type and value, ensuring greater consistency in monitoring and evaluation.

	Evidence		Impacts								Credibility	Relevance	Scenarios			
	Name	Type	S1		S2		S3		S4				S1	S2	S3	S4
													7,25	3,5	9	5,25
E1	Evidence 1	Hearsay	Serious	-	Minor	-	Major	+	Major	+	Medium	High	C	C	C	CC
E2	Evidence 2	Publication/report	Serious	-	Minor	-	Serious	+	Serious	-	High	High	C	C	C	C
E3	Evidence 3	News	Serious	+	Minor	-	Serious	-	Serious	-	Medium	High	I	I	I	I
E4	Evidence 4	Article	Minor	-	Minor	-	Minor	-	Minor	-	Medium	High	C	C	C	C
E5	Evidence 5	Article	Serious	-	Minor	-	Minor	+	Minor	-	High	High	C	I	C	I
E6	Evidence 6	Google	Serious	+	Serious	-	Minor	+	Serious	-	Medium	High	C	C	C	C
E7	Evidence 7	News	Serious	-	Serious	-	Serious	+	Serious	-	High	High	I	C	C	C
E8	Evidence 8	Google	Serious	-	Minor	+	Serious	+	Minor	-	Medium	High	I	CC	CC	I
E9	Evidence 9	Article	Serious	-	Minor	-	Minor	-	Minor	-	High	High	C	CC	CC	I
E10	Evidence 10	International policy	Serious	-	Serious	+	Minor	-	Serious	-	High	Extreme	C	I	C	C
E11	Evidence 11	Publication	Serious	-	Serious	+	Serious	+	Minor	-	High	HIgh	II	CC	C	I
E12	Evidence 12	Google	Neglible	-	Neglible	-	Minor	-	Neglible	-	Medium	Medium	C	II	C	II
E13	Evidence 13	Google	Serious	+	Serious	+	Minor	+	Minor	-	High	High	C	C	I	II
E14	Evidence 14	Google	Serious	+	Serious	+	Major	+	Major	-	High	High	I	CC	I	I
E15	Evidence 15	Google	Serious	-	Minor	-	Minor	-	Minor	-	High	High	I	II	II	C
E16	Evidence 16	Google	Minor	-	Minor	-	Minor	-	Minor	-	Medium	Medium	II	CC	C	C
E17	Evidence 17	Google	Minor	-	Serious	-	Minor	-	Minor	-	Extreme	Medium	C	II	II	I
E18	Evidence 18	Google	Serious	-	Minor	+	Serious	+	Serious	-	High	High	C	C	C	C
E19	Evidence 19	Publication	Minor	-	Minor	-	Serious	+	Serious	+	High	High	C	I	C	C
E20	Evidence 20	Publication	Serious	+	Minor	+	Minor	+	Serious	-	High	High	I	C	C	I
E21	Evidence 21	Google	Minor	-	Minor	-	Minor	-	Minor	-	High	Medium	II	I	II	I
E22	Evidence 22	Google	Minor	-	Neglible	-	Minor	-	Minor	-	Extreme	Low	I	II	II	I
E23	Evidence 23	Google	Serious	-	Minor	-	Serious	+	Minor	-	Low	High	I	C	C	I

Figure 21:F&A tool input.

			SCENARIOS												
			S1			S2			S3			S4			
	Evidence	Evidence Type	Propability	Impact	Events	Propability	Impact	Events	Propabili	Impact	Events	Propability	Impact	Events	
			-0,5			0,75			-9,25			#N/A			
E1	Values for clean seafaring is growing	Assumption	-4	64	Megatrend	2	-8	Medium Risk	-2	18	Trend	4	16	Trend	
E2	Demand for small cruise ships grows	News	1,75	-15,75	High Risk	3,5	-31,5	High Risk	-3,5	3,5	Opportunity	-1,75	15,75	Trend	
E3	Sample evidence 3	Event	-0,25	-1	Weak Signal	0	0	Wild Card	-0,25	-1	Weak Signal	0,25	-2,25	Low Risk	
E4	Sample evidence 4	News (Google)	0	0	Weak Signal	-4	-64	Extreme Risk	4	64	Megatrend	-8	32	Megatrend	
E5	Sample evidence 5	Publication	2	2	Opportunity	2	18	Trend	-2	18	Trend	#N/A	#N/A	#N/A	
E6	Sample evidence 6	Data (DNV)	2,75	24,75	Trend	-2,75	44	Megatrend	-5,5	-5,5	Medium Risk	#N/A	#N/A	#N/A	
E7	Sample evidence 7	AI (copilot)	-3	-12	Medium Risk	6	#N/A	#N/A	3	#N/A	#N/A	#N/A	#N/A	#N/A	
E8	Sample evidence 8	SoMe (IG)	4	64	Megatrend	-4	#N/A	#N/A	0	#N/A	#N/A	#N/A	#N/A	#N/A	
E9	Sample evidence 9	News (HS)	0,75	-6,75	Medium Risk	0	#N/A	#N/A	0,75	#N/A	#N/A	#N/A	#N/A	#N/A	
E10	Sample evidence 10	0	-1	16	Wild Card	2	#N/A	#N/A	1	#N/A	#N/A	#N/A	#N/A	#N/A	
E11	Sample evidence 11	0	5,5	-88	Extreme Risk	0	#N/A	#N/A	5,5	#N/A	#N/A	#N/A	#N/A	#N/A	
E12	Sample evidence 12	0	4	16	Trend	4	#N/A	#N/A	0,75	#N/A	#N/A	#N/A	#N/A	#N/A	
E13	Sample evidence 13	0	1	16	Wild Card	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E14	Sample evidence 14	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E15	Sample evidence 15	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E16	Sample evidence 16	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E17	Sample evidence 17	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E18	Sample evidence 18	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E19	Sample evidence 19	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E20	Sample evidence 20	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E21	Sample evidence 21	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E22	Sample evidence 22	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E23	Sample evidence 23	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E24	Sample evidence 24	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E25	Sample evidence 25	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E26	Sample evidence 26	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	

Figure 22:F&A tool output.

4.1.1 Process

To clarify the merged elements, process diagram (figure 23) reveals the panel's three steps. In this design understanding of problems related to scenario generation and evidence research in ACH were considered through biases, as anonymization brings needed courage for the panellists. In the process, hypothesis used in ACH are modified as scenarios of fuse together future cone, mapping of operational field and general understanding of new, created framework.

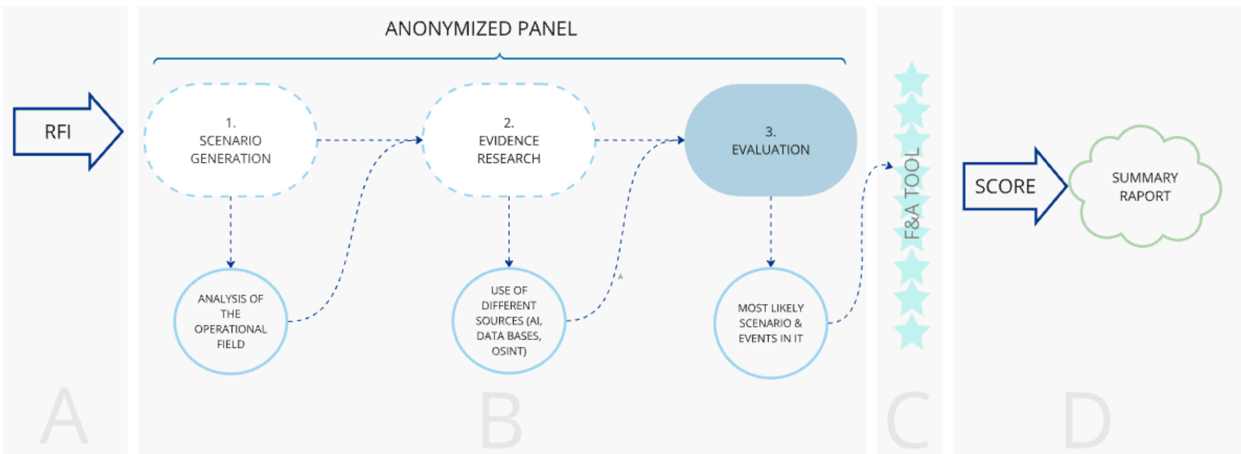

Figure 23: Process Diagram of F&A.

Panel selection is critical part of the nouvelle design and needs to be done within every runned panel with all respect. Generally, panel is based on human thinking and understanding of how anticipation is based on recombination of all collected individual data i.e. personal memories. Therefore, similarity of selected panelists with create similar type of information. To bring variance to the final outcome and tackle similarity-bias, selection of panelists from different

background is important. Collaboration with other individuals can be seen as chemical reaction, where new substances are created through integration. In designing of panel, this means creation of new knowledge through panelists interaction. More variance it has from its starting point, more new combinations of future events can be created.
If others would know each other positions and backgrounds, it would bring easily biases to the produced information. Delphi is known for this anonymization, as well its ability to crystallize information through several rounds with feedback loops and with small dispersion with results (Salminen 2000, 77-78). It has been used in military and foresight senses, which makes it an approachable method when combining intelligence- and foresight elements. Therefore, Delphi -method is selected as a backbone frame structure, where in fused ACH analysis are used. In this sense, using Delphi means anonymization of answers, position, name, gender, education work and all other elements, that would come visible when panelists are known to each other.

Process steps (figure 23) are:

A. **RFI**
B. **PANEL**
    1. **Scenario Generation**
    2. **Evidence Research**
    3. **Evaluation**
C. **F&A -TOOL**
D. **RESULTS**

In this process, panel works in three steps, which after panel-based data is filtered through F&A-tools.

4.1.2 Implementation

Prototype created in iterative design thinking process lasting six months, was implemented through test runs and actual piloting of it. These insights all gave an excellent chance to study the method and tools, which all profited valuable information for the study.

RFI

The Request For Information (RFI) is critical for any work, was the subject based on construction, intelligence or foresight. No RFI-tracking number or specification, categorization, log or database (Carter et al. 2016) was not made in this study, or any test runs due thesis limitations. Request of the information had a certain timespan and a subject it was aimed to explore. Timespan was between the agreed request and actual panel. Timespan is designed to management aims to handle several requests in adequate time, as time plays significant role in foresight in general. One aim to RFI usage is to avoid the creation of outdated information.

RFI was a pre-set in 3 test runs to study other means, and for pilot run RFI was formed by the test organization based on its specific needs. Pilot run organization refined its own RFI after several rounds, as it's not a familiar concept straight away.

Panel

Importance of test panel selection was discussed in meeting with the pilot test organization representatives. Variation in the group, out of the box thinking and classification of the information were on the table. Actual test panel was selected after organization needs, and in this prototype, case was formed with panellists. In the other test runs, panel was selected randomly of available representatives, as focus was more on technical aids.
Panel selection has a great emphasis, as data is collected through human filtration in the anonymous panel work. Many lean philosophy -based projects end up failing, where one perspective could be human engineering hence human factor is often cut out in lean-projects (Magaroo-Pillay & Coetzee 2021, 212). Human factor is important in this design work besides formulas and algorithms, AI, lean-philosophy and framework behind it all. After all, this method and prototype tool are not designed to work without humans and knowledge creation between individual interaction.
Yet, panel selection does need to be selected by knowing variables such as gender biases, areas of expertise, status biases, cumulation of the knowledge in younger generations such as students and so on. Human thinking becomes an asset when working with AI algorithms, formulas, equations and acceleration of computational speed. Especially in comes relevant in foresight.
More accurate the selection of the panel is in consideration of three elements besides fast and slow thinking, time, biases and AI assistance, more reliable future information can be fetched.

Panel work implementation progressed by following the process (figure 23):
1. First step: Delphi based round is *Scenario Generation*, where panel generates 2 to 4 scenarios that exclude each other (figure 21). For example:

Scenario 1 (S1) "Cruise ship sizes increase by 2050"
Scenario 2 (S2): "Cruise ship sizes decrease by 2050"
Scenario 3 (S3): "Cruise ships stay the same by 2050"
Scenario 4 (S4): "Cruise ships do not exist anymore by 2050"

This generation is based on given RFI and brainstormed together with panelist having MEPITESI-LV radar (figure 15) as an aiding tool with them.

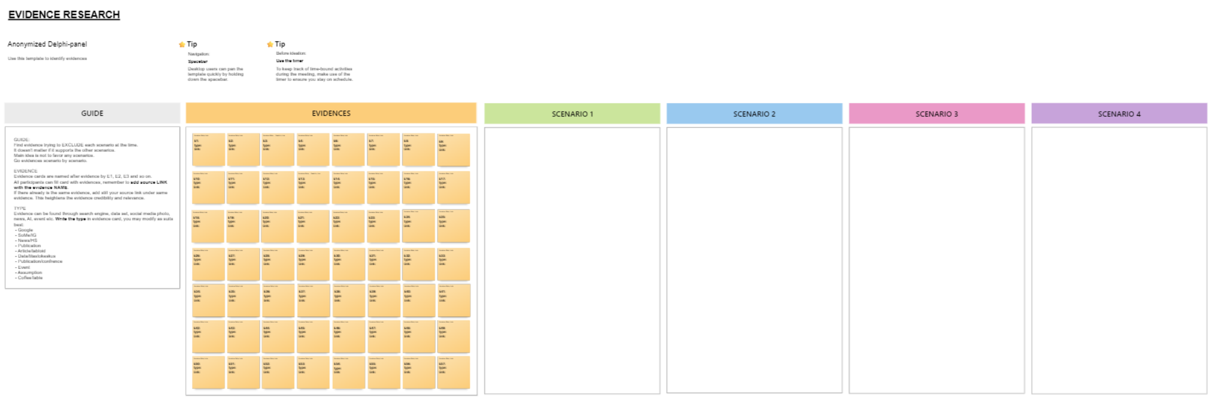

Figure 24: Panel whiteboard.

2. Second step: In this Delphi round *The Evidence Research* is AI-aided. AI can act as a beneficial tool yet is not recommended to use instead of human organic knowledge creation through interaction. Interaction is encouraging through online discussion based on the expert knowledge. AI is an excellent workhorse, but not a good master on emotions and creativity. Evidences are created in the perspective to repeal each scenario, which is an ACH method based to acknowledge analyst bias to favor any of the scenarios.

3.Third step: Delphi based round is *Evaluation*, where panelist evaluate collected evidences and their relation to the scenarios. Data collection in the prototype is done via online questionnaires.

They evaluate first the evidence by the

- Credibility
- Relevance

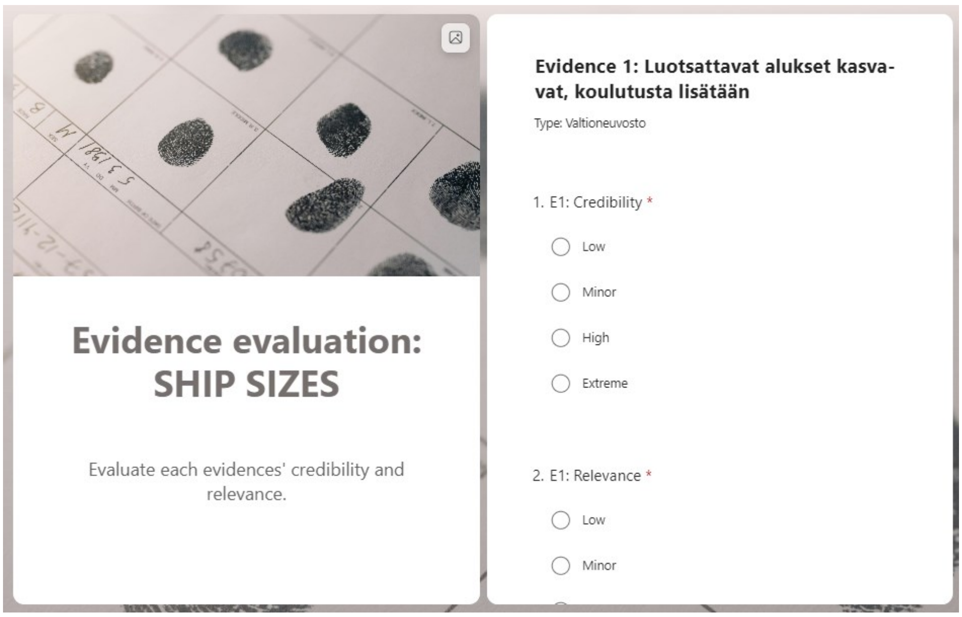

Figure 25: Evidence Evaluation.

Which after evaluation is done to each scenario after the evidence consistency.

- Consistency
- Impact

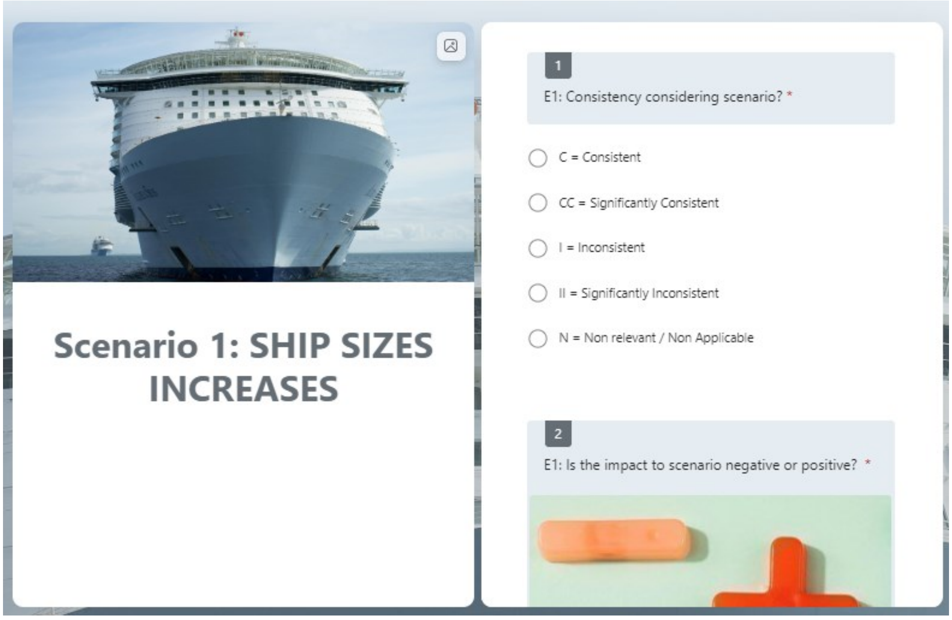

Figure 26: Scenario Evaluation.

F&A-tool

After the panel completes its task, the F&A tool serves as a catalyst for the remaining part of the process. Collected data is derived to Excel straight as used tools are connected. The F&A-tool immediately refines the collected data producing the score that highlights the most likely scenario and the future events it encompasses. The refinement occurs in the real time, aligning the lean philosophy embedded in the F&A -concept and formula. Intelligence based collection, synthesis and analysis is paced up with this process.

4.1.3 Test Runs

Overall study consisted of four test runs, which of three were conducted in technical testing aims and one as final pilot run (appendix II). All test runs were conducted on companies operating in technology industries. In timespan, there were first two test runs and after them pilot run was conducted. After gained knowledge, third test run was decided to conduct for further evaluation.

Pilot panel's evaluation is an important step, as the panel can be seen as organic data base where the knowledge is exposed through this process and use of F&A-tool. Future knowledge is created through interaction (Dufva 2015, 37).

First test run was conducted to evaluate all the technical aims on 21st of October 2024. There basic functionality was studied for the use for these aims. Anonymisation, whiteboard and questionnaire evaluation were tested for further study with high satisfaction of functionality.

Second test run was conducted with three participants online on 20th of October 2024. Test was held small to test basic functions and usability. Functions worked well from the anonymization to evidence search, and evaluation was possible to conduct fluently via questionnaire. Tool reports worked well as the results were instants. In this point answers were collected on average means, which left some questions considering the results. This theme was kept on agenda, while approaching towards pilot test. Test run took approximately three hours.

Pilot run was conducted on 28th of October 2024 online to large size technology company's management level representatives and their stakeholders. Pilot was arranged between 8:00-16:00, yet time was undercut with several hours. There were untraceable glitches in co-operation of the softwares, which affected the passage of the panel. Error in panel work took time and attention and gave a good data for further software development. Panellists found difficult to interact with chat and were looking after anonymised possibility for audio discussion. Evidence creation gave interesting insight. Result of the panel work were sent on next days to the test panel representatives, who found it to be rapid.

Last test run was held after gained data from the pilot run, where refinement of the calculation was done. Last test run was conducted to evaluate calculation of evaluation answer collection. This far it was average, which gave the solution based on bell curve (Little 2017). In the last run data answer solutions were calculated through average with emphasis on distribution density, where answer value is x and distribution density is w:

$$Weighted\ Average = \frac{\sum_{i=1}^{n} w_i\, x_i}{\sum_{i=1}^{n} w_i}$$

4.2 Analysis

The analysis encompassed general examination of the process, prototype development, and feedback from the test participants. Evaluation included utility-, technical-, ethical- and impact assessments (Piirainen et al. 2012, 471), selected specifically to evaluate foresight data. In addition to this approach of evaluation framework, results were analysed in the relevance of the research question (Gerhold et al. 2022, 123).

The pilot panel's evaluation played an important role, serving as an organic data base where the knowledge was revealed through the process and the use of F&A-tool. Future knowledge is created through interaction (Dufva 2015, 37).

The process was observed as a cohesive whole, with the recognition of the iterative design process approach. A process diary (appendix 2) was maintained from the early stages of the study to document key milestones from a developmental perspective, ensuring traceability and transparency (Gerhold et al. 2022, 70-72).
Although time delays occurred in the latter half of the process, the project timeline was accommodated without urgency: The project has started way ahead of actual implementation. These mentioned delays were stemmed from organizational schedules and adjustments to the panellists' availabilities.

4.2.1 Utility

The thesis explored prototype tool that was built as a combination of existing resources acknowledging from the outset that this approach might lack sensitivity compared to a purpose build-in solution. Design thinking applied throughout the process prioritized end-user experience even in a raw prototype. The development of the tool was guided by both the design process and methodology, leading to two key findings with supporting insights.

Testing and feedback highlighted the importance of user interference (UI) and user experience (UX) suggesting the need for a unified platform. Features like visualizations for polling, anonymized discussions with altered voices and online result sharing were deemed critical (Appendix V). Anonymous communication emerged as the most valuable feature for gathering foresight information, as participants found writing slow and frustrating compared to speaking. This highlighted the potential for anonymized speech capabilities in panels. Despite the shorter 6-hour session compared to weeklong Delphi or ACH studies, participants still found the duration lengthy, although interest in the evidence-finding phase extended some of the sessions.

The study observed a 30-year time span in all the test- and panel runs, but did not evaluate the short term, leaving the hypothesis of the tool's adaptability to different time spans open for the future research. The tools were found suitable for non-overlapping scenarios but requires further development due ACH's limitations, as its nature oversimplifies complex, overlapping situations.

4.2.2 Technology

The designed prototype combining ACH, risk management values and Delphi panel, proved to be viable during testing. While the method effectively accelerated the evaluation process, it's remains in raw stage with further improvements possible through enhanced user interactions in the design.

The prototype collects data via OODA-loop and processes it using the DIKW-pyramid. Integration of AI offers promising opportunities for strategic foresight, where collaboration between human cognition and AI could lead to successful outcomes. Testing, particularly the pilot run, revealed that participant anonymity is crucial for reducing biases, which otherwise influence the solutions and outcomes. Anonymisation for facilitator is needed as much as its needed for the panellists.

The Excel-based tool functioned smoothly, significantly accelerating the process. An adjustment to emphasize distribution during the calculations improved the tools performance. The combination of ACH and Delphi applied through numeric methods, proved to be and effective and adequate approach for probabilistic future evaluation.

Future development could enhance the tool by integrating Excel formulas to suggest actions each potential future event. This addition would provide more processed and actionable information for end-users, further accelerated by automation. Leveraging human cognition alongside AI and machine learning could deliver more precise insights into likely future scenarios. Therefore, more advanced softwares and algorithms would be beneficial in development means.

4.2.3 Ethics

Overall, the process was a combination of a strategic design thinking principles with robust traceability and project management of the study. Several test runs, including the pilot run, were conducted during the fall 2024. Each test run provided opportunities to gather data for refinement and identified developmental needs through iterative feedback loop from each round.

From an ethical perspective, limitations of this study do hold the reduced number of test runs, which restricted the ability to repeat the same RFI for several panels. Ability to conduct variety of test runs would have provided wider dataset not only terms of foresight but also from an ethical standpoint. Following the discovery of glitches in the used toolset, and evaluation was done to determine whether the entire tool collection should be replaced. Rather than study and design the whole new technical aids, it was decided to continue with existing toolset to minimize discrepancies in varying tool sets as well as having integrity to the study as a whole.

Many of the items were developed simultaneously, especially when all the elements of the frameworks started to merge together. Future events and Future Cone are a good example, as either of them wouldn't have progressed without each other. This complexity brings insights to ethical perspective, as evaluation needs to be understood through the process. For the reader, the ethical understanding of level of the resulting future events is important. For instance, "Megatrend" is always a result among the panellist's summary. If there is possibility to conduct several panels from the same RFI, "Megatrend" starts to gain the value it generally has among vast amount of people.

Anonymous questionnaire was sent after every test run to panellist for evaluation means. Most of the panellist answered, yet some answers remained unrecieved. In the panel of small as six persons, two un-answered questions make 33% gap bias to the results. Yet, relevance can be seen to obtained, as all test feedback were quite similar.

Some participants found the use of Forms frustrating, while others familiar with the format completed it efficiency. This group managed the task fast through. Overall feedback of using Forms got development ideas for visual user interference and more collective experience through common visual board. Especially if voice and speech could be added through anonymised means. Feedback was gotten in pilot from scenarios, where overlapping could be seen, as scenarios work best when they are excluding each other. It was seen that robust exclusion of the scenarios would ease up the analysis task of the panellists.

4.2.4 Impact

Feedback from panellists emphasized the importance of foresight in their roles and work, regardless of role, gender or age. The evidence finding was perceived as a creative process phase, which inspires towards new thinking. Understanding towards foresight tools and means was valued among all panel participants, and there was a consensus that greater familiarity with foresight tools and methods would benefit industries where such practices are less common.
The tool and method were seen highly potential, particularly after utilization of improvements to software usability. Especially the competitive advantages, and ability to prepare for the upcoming futures was seen both interesting and beneficial for the organizational thriving.

Security means emerged from successful panel work, as the competitive advantage that may result from well conducted panel works, will create a need for data classification and protection.

Rights for generated data are something that need to be considered in early stages. Overall impact brings stakes to all competitive advantages enhancing faster actions towards strategically designed future.

4.2.5 Synthesis

Central findings from prototype creation and testing resulted from the evaluation, were considered the role of the facilitator, importance of anonymization, acceleration of the process, futures UX-development and possibility to discuss through anonymized means.

- In the perspective of the bias acknowledge in the process, facilitator of the panel was not kept anonymized. This is something that need to address in the future, when technology means are more developed for facilitator role to be more controlled.
- Besides the anonymization of the facilitator and so minimization of role, gender, education, similarity or any other biases mitigation, panel anonymization has been evaluated very high. Panellists considered the results be biased, if anonymization fails. This was ranked very high on the feedback and was seen more biased than any other present bias in all the test runs. Security means through this were mentioned as well, when handling sensitive information.
- Acceleration of the process was imminent through the nouvelle prototype design. In comparison, Delphi and ACH both consumes days or weeks, when F&A was possible to conduct panel and results in a one day. Development to more mature method through UX and UI would accelerate the process even more.
- Bias recognition and relevance of the panel work could be increased with anonymized audio possibility for discussion, yet it needs to be tested through known bias of talkative panellists who don’t let other talk or doesn’t know how to listen.

5 Conclusions

Overall conclusion is that skeleton of the new method combining foresight and intelligence analysis by means of risk management has been established: The prototype tool demonstrates the functionality and significantly accelerates the data processing workflow. All used elements in design process are existing and commonly used, yet the new way to observe and combine of them has been established creating the new method.
However, limitations in data collection accuracy were identified, resulting in biases in the outcomes due technical and UX-based constraints. These limitations, while outside the thesis, highlights opportunities for future development particularly n refining the classification of future knowledge.

Several developmental areas emerged due to the prototype nature of the F&A -tool and actual method. As the quality of future knowledge depends on panel selection and collaboration, understanding the probability and estimate values of results becomes critical. Just like all forms of future science and risk managements, foresight rarely provides definitive answers. Instead, it offers well-reasoned estimates applicable across diverse fields, including finance, military, government, industry and education.
The tool enables rapid harnessing of future knowledge and provides mathematical comparisons across collected data. However, as more data is incorporated, the presence of biases increases. While the F&A -methods is accounts for biases in its design, eliminating them entirely is not feasible. Consequently, bias recognition must remain as integral to the tool's continued development.

This tool represents a significant step toward and engineered approach to foresight merging the goals of intelligence, foresight, risk management with means of lean philosophy and strategic design thinking. Technical aids, such as AI and its development withing the tool is recognized. With the foundational architecture established, the next critical step is improving UI and UX design to create a more robust and user-friendly tool.
The prototype tool stands as an intersection of future studies and various scientific disciplines. Its development required knowledge spanning foresight, risk management, statistical mathematics, engineering, intelligence, simple coding, AI data management and design processes to mention some. The multidisciplinary nature highlights the unique approach f the future studies, which diverges from the single-discipline focus. By bridging multiple sciences, the tool underscores the broad applicability and benefits of foresight in a wide range of contexts.

The F&A -tool's integration of diverse methodologies and disciplines establishes a strong foundation for advancing future knowledge. While there is significant potential for further development, particularly in addressing technical limitations and enhancing user interaction, the prototype provides a promising framework for leveraging foresight as an actionable and scalable resource in strategic decision-making.

The study successfully merged strategic foresight and strategic analysis through documented methodologies and a structured design process, resulting in the creation of a new tool and method based of existing knowledge. Combination of foresight and intelligence methods tied together with risk management means, designing of a new tool is the most robust result of the study. Referred to throughout the thesis as the **F&A -tool**, it's a prototype built using Excel-software and formulas integrated in it.

The evaluation and pilot run demonstrated that the tool is most likely to be implemented as an organizational consultation tool, where it provides significant value for preparedness and knowledge to most likely future. The F&A -tool efficiently answers the RFI questions delivering the most likely scenarios and associates the future events in it. The process is notably accelerated, with the potential for further speed and usability improvements through focused algorithm, UI- and UX- development.

5.1 Development

The most important areas of development of the tool and method are:

- Data management
- Automation through advanced algorithms and software
- Security improvements
- UX and UI via visualization and AI

A key objective is to integrate all the tools used in the prototype into a single software platform consolidating calculations, panel interaction, data analysis and visualization into one, unified system. Transitioning to more advanced tools like for instance MATLAB would offer greater flexibility and efficiency, surpassing the capabilities of the current Excel-based formulas.

When dealing with sensitive, strategic future data, effective information management becomes essential. If the data is stored for organizational evaluation and extrapolation, legal considerations like lifecycle management, access control and data rights must be integrated into the design. Traceability needs to be kept in the tools processes due its importance in foresight and credibility.

The pilot run of the prototype highlighted the need for greater automation to enhance UI and UX for both panelist and primary users. Task required manual effort during the test pilot such as data collection from questionnaire excels, generations of visual imagery, and evidence collection could also be partly automated using AI or future QAI making the process even more efficient. Partly AI-driven evidence collection could also add significant value when used as one or several sources, though careful attention must be paid to bias mitigation in AI-generated outputs (Kiiski, 2024).

Security risks associated with AI must be addressed as well. Protecting data from malicious actors requires robust safeguards, such as encryption, access control, and adherence to regulatory standards and requirements. Cybersecurity considerations including data classification and lifecycle management should be integrated form the early stages of the development.
Visualization, particularly from the AI perspective represents the key development area. While broader visualization capabilities were outside the scope of this thesis, providing fast-paced, visually compelling results would greatly enhance he tool's usability. A pre-visualized end-product would make the insights such as the most likely scenario, more digestible and actionable for the panelists.
Through the lens of UX and AI thriven possibilities, feature of anonymized discussion could be in the lens of development evaluation. It may accelerate some of the processes, yet it may bring additional biases. Therefore, study for this is in the scope of UX development.

5.2 Criticism

As no foresight nor intelligence do not operate as a crystal ball by providing the future fully formed and ready at hand, future studies and intelligence often face criticism (Burns 2002, 1-7) with detractors arguing that it's not a precise or traditional form of science. This has led some to question their validity as scientific disciplines. However, introducing classification frameworks and structured methodologies can improve the traceability and enhance the credibility of foresight practices.

Panel selection is another area of concern, as results may vary significantly based on the composition of the panel. In foresight and intelligence -just like in any science- even small changes to a single parameter can alter the outcomes, which can undermine confidence in the process. Accelerated processes enable possibilities to harness knowledge from larger patches of panels, which could increase the accuracy of foresight. Nevertheless, it's essential to recognize that future science is quite young field of study, and much in its advancing stages just like AI and quantum computing.
Diversity in panel composition is critical for minimizing biases and fostering innovative thinking. While anonymization in Delphi method helps mitigating the biases, open panels or workshops even with possible voice anonymization can still be susceptible to biases during discussion behaviors. It's still worth noting, that discussion can lead to more deliberate and reflective knowledge creating through better interaction. After all, new information is generated through interaction. Ensuring the diversity of the panelists such as stakeholders, managers, students, and experts of various disciplines can generate fresh perspectives and lead to out-of-the-box- thinking.
Regarding AI development, cybersecurity concerns are paramount. As the future development must carefully follow regulatory requirements, ensuring data access, and lifecycle management, complexity increases. With given the potential interplay between QAI securing the data and managing

interdependencies will come even more increasingly complex (Harty et al. 2007, 22). Hallucinations in AI-produced evidence or interference to evidence research has to be addressed in all future related work. Problem with hallucinations in produced AI data and sources of them is biasing the results (MIT Management). If these elements are ignored, the traceability will be lost completely producing pseudo-science.

This thesis serves as a starting point for exploring a more classified, probabilistic approach to foresight. However, further critical discussion is necessary to address ethical questions surrounding tools likes this; appropriate application contexts and misuse prevention are collectively needed.

5.3 Limitations

This study required clear limitations due its broad scope and potential workload. While the research lays the groundwork for further development, certain areas were intentionally excluded from the thesis to maintain the focus. The key limitations are as follows:

1. **Data Collection:**
   While study incorporates concrete future knowledge collected as a byproduct of test groups, in sensitivity concerns and thesis workload constraints limited the extent of data collection. However, the evaluation of user experience with the methods and tools remains within the scope of this research.

2. **Tool Development**
   Although AI assisted, and visual data representation are crucial for enabling end-users to process information quickly and effectively, these aspects were excluded from this study. Future development in these areas is essential for enhancing the usability and efficiency of the methods and the tool’s end-product.

These limitations provide a focused framework for this thesis while identifying opportunities for future exploration and improvement. Yet, these areas are important to keep in mind for post-thesis research and hold significant potential for further development and refinement of the actual concept.

References

Aalto, Hanna-Kaisa – Heikkilä, Katariina – Keski-Pukkila, Pasi – Mäki, Maija – Pöllänen, Markus (2022) *Tulevaisuudentutkimus tutuksi.* Tulevaisuudentutkimuksen verkostoakatemian julkaisuja 1/2022. Tulevaisuuden tutkimuskeskus, Turun yliopisto. https://www.utupub.fi/handle/10024/153465, retrieved 3.7.2024.

Abaianiţi, Christian (2018) The role of comprehensive approach in the development of military scenarios using the PMSII model. *Strategic impact*. 2018 (66+67), p.32-48. https://www.proquest.com/docview/2289653950/fulltextPDF/F2DB17C669A64A2FPQ/1?accountid=14774&sourcetype=Scholarly%20Journals, retrieved 7.9.2024.

Acebes, F. – González-Varona, J. M. – López-Paredes, A. – Pajares, J. (2024) Beyond probability-impact matrices in project risk management: A quantitative methodology for risk prioritisation. *Humanities & social sciences communications,* 2024-05, Vol.11 (1), p.670-13, Article 670. https://www.nature.com/articles/s41599-024-03180-5.pdf, retrieved 22.9.2024.

Adom, Alex Yaw – Nyarko, Israel Kofi – Som, Gladys Narki Kumi (2016) Competitor Analysis in Strategic Management: Is it a Worthwhile Managerial Practice in Contemporary Times? *Journal of Resources Development and Management*. Vol.24, 2016. https://core.ac.uk/download/pdf/234696346.pdf, retrieved 18.8.2024.

Ahlqvist, Frida (2017) The fuzzy front-end and the forgotten back-end: User involvement in later development phases. *The Design journal*. 2017-07, Vol.20 (sup1), p.S2524-S2533. https://www.tandfonline.com/doi/abs/10.1080/14606925.2017.1352765, retrieved 8.9.2024.

Ahteensivu, Aarno – Koskinen, Lasse – Jarna Kulmala – Pauliina Havakka (2018) *Riskienhallinnan ajankohtaisia teemoja*. Tampere University Press. https://trepo.tuni.fi/bitstream/handle/10024/103198/978-952-03-0701-1.pdf?sequence=1&isAllowed=y, retrieved 18.8.2024.

Athaluri, Sai Anirudh – Manthena, Sandeep Varma – Kesapragada, V S R Krishna Manoj – Yarlagadda, Vineel – Dave, Tirth; Duddumpudi, Rama Tulasi Siri (2023) Exploring the Boundaries of Reality: Investigating the Phenomenon of Artificial Intelligence Hallucination in Scientific Writing Through ChatGPT References. *Curēus*. Palo Alto, CA. 2023-04, Vol.15

(4), p.e37432-e37432. https://pmc.ncbi.nlm.nih.gov/articles/PMC10173677/pdf/cureus-0015-00000037432.pdf, retrieved 15.9.2024.

Aubrecht, Christoph – Freire, Sérgio – Fröhlich, Josef – Rath, Beatrice – Steinnocher, Klaus (2011) Integrating the Concepts of Foresight and Prediction for improved Disaster Risk Management. *Proceedings of the 8th International ISCRAM Conference* – Lisbon, Portugal. https://www.researchgate.net/profile/Sergio-Freire-2/publication/231814354_Integrating_the_Concepts_of_Foresight_and_Prediction_for_improved_Disaster_Risk_Management/links/0f3175309f856e2b2e000000/Integrating-the-Concepts-of-Foresight-and-Prediction-for-improved-Disaster-Risk-Management.pdf, retrieved 1.8.2024.

Babic, Milan – Fichtner, Jan – Heemskerk, Eelke M. (2017) States versus Corporations: Rethinking the Power of Business in International Politics. *Italian Journal of International Affairs*. Volume 52, Issue 4. Full article: States versus Corporations: Rethinking the Power of Business in International Politics (tandfonline.com), retrieved 23.4.2024.

Bansal, Pratima – Reinecke, Juliane –Suddaby, Roy – Langley, Ann (2022) Temporal Work: The Strategic Organization of Time. *Strategic Organization.* Vol. 20, No 1. https://doi-org.ezproxy.utu.fi/10.1177/14761270221081332, retrieved 14.7.2024

Becker, Jochen – Medjedovic, Josip – Merkle, Christoph (2019) The Effects of CEO Extraversion on Analysts Forecast: Stereotypes and Similarity Bias. *The Financial review* (Buffalo, N.Y.), 2019-02, Vol.54 (1), p.133-164. https://onlinelibrary-wiley-com.ezproxy.utu.fi/doi/epdf/10.1111/fire.12173, retrieved 5.9.2024.

Bhasin, Sanjay – Burcher, Peter (2006) Lean viewed as a philosophy. *Journal of manufacturing technology management*. 2006-01. Vol.17 (1), p.56-72. https://www-emerald-com.ezproxy.utu.fi/insight/content/doi/10.1108/17410380610639506/full/pdf, retrieved 21.8.2024.

Bigelow, Michael E. (2012) *A Short History of Army Intelligence*. https://irp.fas.org/agency/army/short.pdf, retrieved 15.8.2024.

Brown, Sara (2021) *Machine learning, explained*. MIT Management. Sloan Schools. https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained, retrieved 29.8.2024.

Buonomano, Dean – Rovelli, Carlo (2021) *Bridging the neuroscience and the physics of time*. https://arxiv.org/pdf/2110.01976, retrieved 5.9.2024.

Burns, Alex (2002) *Is Future Studies Science or Art?* https://typeset.io/pdf/is-futures-studies-a-science-or-an-art-mbwie2q9gh.pdf, retrieved 13.10.2024.

Capocchi, Alessandro (2023) The Classification of Risks and the Activities that Make up Risk Management. *Vulnerability and the Corporate Immune System*. Palgrave Macmillan, Cham. p. 171-193. https://doi.org/10.1007/978-3-031-30254-1_9, retrieved 15.9.2024.

Carter, Brad – Shim, Euysup – Seongchan, Kim (2016) Request for Information (RFI) Management: a Case Study. *52nd ASC Annual International Conference Proceedings*. http://ascpro0.ascweb.org/archives/cd/2016/paper/CPGT118002016.pdf, retrieved 3.10.2024.

Christophilopoulos, Epaminondas (2021) Special Relativity Theory Expands the Futures Cone's Conceptualisation of the Futures and The Pasts. *Journal of Futures Studies*, September 2021, 26(1): 83–90. https://jfsdigital.org/articles-and-essays/vol-26-no-1-september-2021/special-relativity-theory-expands-the-futures-cones-conceptualisation-of-the-futures-and-the-pasts/?utm_source=chatgpt.com, retrieved 15.8.2024.

Choi, Charles Q. (2023) *Predicting "Black Swans" Disasters With AI – Combining AI with Bayesian reasoning can help forecast events without a historical track record to analyze. IEEE Spectrum*. https://spectrum.ieee.org/weather-predicting-black-swan, retrieved 20.8.2024.

Congress.gov. *H.R.8152 – American Data Privacy and Protection Act*. https://www.congress.gov/bill/117th-congress/house-bill/8152#:~:text=American%20Data%20Privacy%20and%20Protection%20Act,-This%20bill%20establishes&text=The%20bill%20establishes%20consumer%20data,opt%20out%20of%20such%20advertising, retrieved 17.9.2024.

Coppo, Alessandro – Cuccoli, Alessando – Verruchi, Paola (2023) *A magnetic clock for a harmonic oscillator*. 8-9 https://arxiv.org/pdf/2310.13386, retrieved 18.7.2024

Coursera (2024) *9 Power BI Alternatives*. https://www.coursera.org/articles/power-bi-alternatives, retrieved 19.10.2024.

Crilly, Donal (2017) Time and Space in Strategy Discourse: Implication for Intertemporal Choice. *Strategic Management Journal*. Vol. 38. No 12. https://www.jstor.org/stable/45105012, retrieved 18.7.2024

Dahl, Matthew – Magesh, Varun – Suzgun, Mirac – Ho, Daniel E. (2024) *Hallucinating Law: Legal Mistakes with Large Language Models are Pervasive.* Stanford University Human-Centered Artificial Intelligence. https://hai.stanford.edu/news/hallucinating-law-legal-mistakes-large-language-models-are-pervasive, retrieved 17.8.2024.

Dattani, Saloni (2023) *Risk ratios, odd ratios, risk differences: How do researchers calculate the risk from a risk factor? Our World in Data*. https://ourworldindata.org/risk-ratios-odds-ratios-risk-differences-how-do-researchers-calculate-the-risk-from-a-risk-factor, retrieved 15.8.2024.

De'Shazer, Michael (2024) *Advancing Legal Reasoning: The Integration of AI to Navigate Complexities and Biases in Global Jurisprudence with Semi-Automated Arbitration Processes (SAAPs)*. https://arxiv.org/pdf/2402.04140, retrieved 20.10.2024.

Dhami, Mandeep, K. – Belton, Ian K. – Mandel, David R. (2019) *The "analysis of competing hypotheses" in intelligence analysis*. John Wiley & Sons Ltd. 1086-1087. https://onlinelibrary.wiley.com/doi/epdf/10.1002/acp.3550, retrieved 9.7.2024

Dionne, Georges (2013) Risk Management: History, Definition, and Critique. *Risk management and insurance review*. 2013-09, Vol.16 (2), p.147-166. https://onlinelibrary.wiley.com/doi/10.1111/rmir.12016, retrieved 13.8.2024.

Dufva, Mikko (2015) *Knowledge creation in foresight, a practice- and system-oriented view*. Doctoral Dissertation. Aalto University. https://aaltodoc.aalto.fi/server/api/core/bitstreams/f95e7d86-5a64-4414-bad7-fefbead5bb99/content, retrieved 12.8.2024.

Durging, Frank H. – Sternberg, Saul (2002) Time of Consciousness and Vice Versa. *Consciousness and cognition*. 2002-06, Vol.11 (2), p.284-290. https://durginlab.domains.swarthmore.edu/publications/CC_DurginSternberg2002.pdf, retrieved 4.9.2024.

Drigas, Athanasios S. – Pappas, Marios A. (2017) *The Consciousness-Intelligence-Knowledge Pyramid: An 8x8 Layer Model*. Int. J. Recent Contributions Eng. Sci. IT. https://www.semanticscholar.org/paper/The-Consciousness-Intelligence-Knowledge-

Pyramid%3A-Drigas-Pappas/a9c204613431cfa1fb5d7b7734c1998fba541196?p2df, retrieved 3.9.2024.

Eagleman, David M. (2008) Human time perception and its illusions. Current opinion in *Neurobiology*, 2008-04, Vol.18 (2), p.131-136. https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S0959438808000548, retrieved 5.9.2024.

European Commission (2024a) *Data Protection*. https://commission.europa.eu/law/law-topic/data-protection_en, retrieved 2.8.2024.

European Commission (2024b) *Strategic foresight.* https://commission.europa.eu/strategy-and-policy/strategic-planning/strategic-foresight_en, retrieved 2.8.2024.

European Parliament (2024) *EU AI Act: first regulation on artificial intelligence*. https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence, retrieved 19.8.2024.

Frické, Martin H. (2022) Data-Information-Knowledge-Wisdom (DIKW) Pyramid, Framework, Continuum. *Encyclopaedia of Big Data*. 2022, p.364-367. https://link-springer-com.ezproxy.utu.fi/referenceworkentry/10.1007/978-3-319-32010-6_331, retrieved 11.18.2024.

Gall, Tjark – Vallet, Flore –Yannou, Bernard (2022) How to visualize futures studies concepts: Revision of the futures cone. *Futures*. vol. 143. https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S0016328722001240?via%3Dihub#sec0045, retrieved 4.6.2024.

Gau, Kathrin – Scherer, Matthias – Zagst Rudi (2013) *Innovation in Quantitative Risk Management*. Springer International Publishing. Switzerland. https://directory.doabooks.org/handle/20.500.12854/34769, retrieved 2.9.2024.

Gerhold, Lars – Holtmannspötter, Dirk – Neuhaus, Christian – Schüll, Elmar – Schulz-Montag, Beate – Steinmüller, Karlheinz – Zweck, Axel – Holtmannspötter, Dirk – Steinmüller, Karlheinz – Zweck, Axel – Schulz-Montag, Beate – Schüll, Elmar – Neuhaus, Christian (2022) *Standards of Futures Research: Guidelines for Practice and Evaluation*. https://web-p-ebscohost-com.ezproxy.utu.fi/ehost/detail/detail?vid=0&sid=a6039b0d-2588-4106-9776-

7c9a1096d3be%40redis&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#AN=3333813&db=nlebk, retrieved 11.11.2024.

Gov.uk. *Data Protection*. https://www.gov.uk/data-protection, retrieved 16.9.2024.

Gustafsson, Daniel (2019) *Analysing the Double diamond design process through research & implementation*. Master's Thesis, Aalto University. https://aaltodoc.aalto.fi/server/api/core/bitstreams/572b8860-5ad1-4f31-93ce-efbf7bbe322b/content, retrieved 1.9.2024.

Haesebrouck, Katlijn – Van den Abbeele, Alexandra – Williamson, Michael G. (2021) Building trust through knowledge sharing: Implications for incentive system design. *Accounting, organizations and society*, 2021-08, Vol.93, p.101241, Article 101241. https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S0361368221000179, retrieved 15.9.2024.

Hampton, James A. – Aina, Bayo, Andersson, J. Mathias – Mirza, Humímara Z. – Parmar, Sejal (2011) The Rumsfeld Effect: The Unknown Unknown. *Journal of experimental psychology*. Learning, memory, and cognition, 2012-03, Vol.38 (2), p.340-355. https://web-p-ebscohost-com.ezproxy.utu.fi/ehost/pdfviewer/pdfviewer?vid=0&sid=6885f0f7-5f61-418d-9fa8-47cd008911c0%40redis, retrieved 14.8.2024.

Harty, Chris – Goodier, Chris Ian – Soetanto, Robby – Austin, Simon – Dainty, Andrew A. J. – Price, Andrew D. (2007) *Construction Management and Economics*, 2007-05, Vol.25 (5), p.477-493. https://web-p-ebscohost-com.ezproxy.utu.fi/ehost/pdfviewer/pdfviewer?vid=0&sid=9ff7c5de-1f64-46e6-b91f-c1539227504f%40redis, retrieved 13.10.2024.

Hawkins, Jennifer Anne (2021) *Brain Plasticity and Learning*. Cham, Switzerland. https://link-springer-com.ezproxy.utu.fi/book/10.1007/978-3-030-83530-9, retrieved 13.9.2024.

Heidenrich, John G. (2007) *The State of Strategic Intelligence - The Intelligence Community's Neglect of Strategic Intelligence.* CIA. https://www.cia.gov/resources/csi/static/the-state-of-strategic-intelligence.pdf, retrieved 5.8.2024.

Helmer, Olaf (1967) *Analysis of the Future: The Delphi Method*. RAND. <https://www.rand.org/pubs/papers/P3558.html>, retrieved 23.6.2024

Hijazin, Areej – Tamayo-Torres, Javier – Nusairat, Nawras (2023) Moderating the Synergies between Business Intelligence and Strategic Foresight: Navigating Uncertainty for Future Success through Knowledge Management. *MDPI Sustainability*, 2023-10, Vol.15 (19), p.14341. https://mdpi-res.com/sustainability/sustainability-15-14341/article_deploy/sustainability-15-14341.pdf?version=1695905545, retrieved 18.9.2024.

Holmberg, Mathias J. – Andersen, Lars W. (2020) Estimating Risk Ratios and Risk Differences. *JAMA: the journal of the American Medical Association*, 2020-09, Vol.324 (11), p.1098-1099. https://jamanetwork-com.ezproxy.utu.fi/journals/jama/article-abstract/2770607, retrieved 13.8.2024.

Ilmonen, Ilkka – Kallio, Jani – Koskinen, Jani – Rajamäki, Markku (2022) *Johda riskejä: Käytönnön opas yrityksen riskienhallintaan*. FINVA. Turenki. Hansaprint Oy. Referred 13.8.2024.

Inayatullah, Sohail (2008) Six pillars: futures thinking for transforming. *Foresight: the Journal of Future Studies, Strategic Thinking and Policy*. Bradford. Vol 10, Iss.1. https://www.proquest.com/docview/224194368/fulltextPDF/C8B7B331DC3D4BAAPQ/1?accountid=14774&sourcetype=Scholarly%20Journals, referred 8.7.2024

ISO/IEC 27001:2022 (2022) *Information security, cybersecurity and pricacy protection - Information security management systems -Requirements.* ISO Standards. https://www.iso.org/standard/27001, retrieved 14.9.2024.

ISO/IEC 31000:2018 (2018) Risk Management – Guidelines. ISO Standards. https://www.iso.org/standard/65694.html, retrieved 13.8.2024.

Jaffe, Andrew (2018) The illusion of time. *Nature* (London), 2018-04, Vol.556 (7701), p.304-305. https://www-nature-com.ezproxy.utu.fi/articles/d41586-018-04558-7, retrieved 4.9.2024.

Jennex, Murray E. (2017) Big data, the internet of things, and revised knowledge pyramid. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems,* 2017-11. Vol.48 (4), p.69-79. https://dl-acm-org.ezproxy.utu.fi/doi/pdf/10.1145%2F3158421.3158427, retrieved 7.7.2024

Jern, Mikael (1999) Visual Intelligence Turning Data into Knowledge. *1999 IEEE International Conference on Information Visualization* (Cat. No. PR00210), 1999, p.3-8. https://ieeexplore-ieee-org.ezproxy.utu.fi/stamp/stamp.jsp?tp=&arnumber=781525, retrieved 10.8.2024.

Jiménez-Partearroyo, Montserrat – Medina-Lopéz, Ana (2024) Leveraging Business Intelligence Systems for Enhanced Corporate Competitiveness: Strategy and Evolution. *MDPI Systems* (Basel), 2024-03, Vol.12 (3), p.94. https://mdpi-res.com/systems/systems-12-00094/article_deploy/systems-12-00094.pdf?version=1710325573, retrieved 16.9.2024.

Johnson, James (2023) Automating the OODA loop in the age of intelligent machines: reaffirming the role of humans in command-and-control decision-making in the digital age. *Defence studies*, 2023-01, Vol.23 (1), p.43-67. https://www.tandfonline.com/doi/pdf/10.1080/14702436.2022.2102486?needAccess=true, retrieved 13.9.2024.

Johnston, Douglas E. – Djurić, Petar M. (2011) The science behind the risk management – A signal processing perspective. *IEEE signal processing magazine*, 2011-09, Vol.28, p.26-36. https://www.researchgate.net/publication/224255298_The_Science_Behind_Risk_Management, retrieved 12.12.2024.

Jore, S.H. (2019) The Conceptual and Scientific Demarcation of Security in Contrast to Safety. *European journal for security research*, 2019-04, Vol.4 (1), p.157-174. https://link.springer.com/article/10.1007/s41125-017-0021-9, retrieved 18.9.2024.

Kahneman, Daniel (2011) *Thinking Fast and Slow*. Farrar, Straus and Giroux, NY. http://dspace.vnbrims.org:13000/jspui/bitstream/123456789/2224/1/Daniel-Kahneman-Thinking-Fast-and-Slow-.pdf, retrieved 11.8.2024.

Kappes, Andreas – Harvey, Ann H. – Lohrenz, Terry – Montague, P. Read – Sharot, Tali (2020) Confirmation bias in the utilization of others' opinion strength. Nature neuroscience, 2020-01. Vol.23 (1), p.130-137. https://www-nature-com.ezproxy.utu.fi/articles/s41593-019-0549-2, retrieved 12.12.2024.

Khodyakov, Dimitry (2023) *Generating Evidence Using the Delphi Method*. RAND. https://www.rand.org/pubs/commentary/2023/10/generating-evidence-using-the-delphi-method.html, retrieved 3.10.2024.

Kiiski, Ville (2024) *Online interview of AI-specialist about the software and usage of it*. 13.8.2024.

Kilovaty, Ido (2024) Hacking Generative AI. *Loyola of Los Angeles Law Review*. Vol 58. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4788909, retrieved 4.10.2024.

Klusch, Matthias – Lässig, Jörg – Wilhelm, Frank K. (2024) Quantum Computing and AI. *Künstliche Intelligenz*. https://link.springer.com/article/10.1007/s13218-024-00872-7, retrieved 29.9.2024.

Kolt, Noam (2023) Algorithmic Black Swans. *Washington University Law Review*. Vol. 101, Forthcoming. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4370566, retrieved 20.8.2024.

Kuosa, Tuomo (2014) *Towards Strategic Intelligence – Foresight, Intelligence, and Policy Making*. Print Best, Estonia. https://www.diva-portal.org/smash/get/diva2:1235945/FULLTEXT01.pdf, retrieved 1.8.2024.

Kuosa, Tuomo (2016) *The Evolution of Strategic Foresight – Navigating Public Policy Making*. Routledge, London and New York. https://ebookcentral.proquest.com/lib/kutu/reader.action?docID=4452907, retrieved 27.8.2024.

Kruger, Justin – Dunnig, David (1999) Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessment. *Journal of personality and social psychology*, 1999-12, Vol.77 (6), p.1121-1134. https://www.proquest.com/docview/2206254883/fulltextPDF/D0850CB2BB614323PQ/1?accountid=14774&sourcetype=Scholarly%20Journals, retrieve 14.9.2024.

Kärkkäinen, Henrik (2023) Mikko Hyppösen mielipide tekoälystä on jäätävää kuultavaa: ”Meillä on yksi ainoa mahdollisuus”. *Ilta-Sanomat*. https://www.is.fi/digitoday/art-2000009622920.html, retieved 17.8.2024.

Lankford, William M. (2002) Benchmarking: Understanding the basics. *The Coastal Business Journal*. Vol 1: No 1, Article 8. https://digitalcommons.coastal.edu/cgi/viewcontent.cgi?article=1007&context=cbj, retrieved 26.8.2024.

Levine, Seen, S. – Bernard, Mark – Nagel, Rosemarie (2017) Strategic Intelligence: The Cognitive Capability to Anticipate Competitor Behavior. *Strategic Management Journal*. Vol 38. No 12. https://www.jstor.org/stable/45105013, retrieved 17.7.2024

Little, Daniel (2017) *The normal distribution*. University of Turku. https://methods-sagepub-com.ezproxy.utu.fi/video/the-normal-distribution, retrieved 14.7.2024.

Lowenthal, Mark M. (2017) *Intelligence – From secrets to Policy*. Sage Publications, CA.

Li, Ying – Hills, Thomas – Hertwig, Ralph (2020) A bried history of risk. *Cognition*. 2020-10, Vol.203, p.104344-104344, Article 104344. https://www.sciencedirect.com/science/article/pii/S0010027720301633, retrieved 28.8.2024.

Liebowitz, Jay (2006) *Strategic Intelligence – Business Intelligence, Competitive Intelligence, and Knowledge Management*. Auerback Publications, FL. Referred 12.8.2024.

Lowenthal, Mark M. – Clarck, Robert M. (2016) *The 5 disciplines of intelligence collection*. CQ Press. London UK. Referred 12.9.2024.

Luís, Ana – Garnett, Kenisha – Pollards, Simon T. J. – Lickorish, Fiona – Jude, Simon – Leinster, Paul (2021) Fusing strategic risk and futures methods to inform long-term strategic planning: case of water utilities. *Environment systems & decisions*, 2021, Vol.41 (4), p.523-540. https://link.springer.com/article/10.1007/s10669-021-09815-1, retrieved 18.8.2024.

Maccoby, Michael (2015) *Strategic Intelligence: Conceptual Tools for Leading Change*. Oxford University Press. New York. https://web-p-ebscohost-com.ezproxy.utu.fi/ehost/ebookviewer/ebook/bmxlYmtfXzEwNjkxOTdfX0FO0?sid=7c02bab7-ec01-4cbe-ae50-65614a29700b@redis&vid=0&format=EB&lpid=lp_19&rid=0, retrieved 19.9.2024.

Mangaroo-Pillary, Mia – Coetzee, Rojanette (2021) Lean Frameworks: A Systematic Literature Review (SLR) Investigating Methods and Design Elements. *Journal of industrial engineering and management*, 2022-03, Vol.15 (2), p.202-214. https://libkey.io/libraries/348/articles/519988857/full-text-file, retrieved 3.9.2024.

Mariković, Milan – Al-Tabbaa, Omar – Khan, Zaheer – Wu, Jie (2022) Corporate foresight: A systematic literature review and future research trajectories. *Journal of business research*.

2022-05, Vol.144, p.289-311. https://www.sciencedirect.com/science/article/pii/S0148296322001096, retrieved 12.12.2024.

Menthe, Lance – Sullivan, Jefferey (2008) *A RAND Analysis Tool for Intelligence, Surveillance, and Reconnaissance The Collections Operations Model*. RAND. https://apps.dtic.mil/sti/pdfs/ADA492835.pdf, retrieved 15.8.2024.

Meyer-Nieberg, Silja – Pickl, Stefan – Zsifkovits, Martin (2015) Operations Research for Risk Management in Strategic Foresight. *GRF Davos Planet@Risk*, Volume 3, Number 2. https://www.researchgate.net/profile/Martin-Zsifkovits-2/publication/280932093_Operations_Research_for_Risk_Management_in_Strategic_Foresight/links/55cc59fd08aeca747d6c27ab/Operations-Research-for-Risk-Management-in-Strategic-Foresight.pdf?__cf_chl_tk=BE_MaeVsAZgSuo_d2COLSekQ3Hxab0kMmQ.SLh6y5xk-1730026170-1.0.1.1-ywix95OGvYOJEL7G2CXIQ19PMXUJfU_q_f7LIr7uO5k, retrieved 20.8.2024.

Mez, Cade (2024) A Hacker Stole OpenAI Secrets, Raising Fears That China Could, Too. *New York Times*. https://www.nytimes.com/2024/07/04/technology/openai-hack.html, retrieved 2.9.2024.

MIT Management. *When AI Gets It Wrong: Addressing AI Hallucinations and Bias*. MIT Management. STS teaching & Learning Technologies. https://mitsloanedtech.mit.edu/ai/basics/addressing-ai-hallucinations-and-bias/, retrieved 11.11.2024.

Herskowitz, Nicole (2022) *Introducing Microsoft Teams Premium, the better way to meet.* https://www.microsoft.com/en-us/microsoft-365/blog/2022/10/12/introducing-microsoft-teams-premium-the-better-way-to-meet/, retrieved 9.9.2024.

Newhouse, William – Souppaya, Murugiah – Kent, John – Sandelin, Ken – Scarfone, Karen (2023) *Data Classification Concepts and Considerations for Improving Data Protection*. U.S. NIST. Department of Commerce. https://nvlpubs.nist.gov/nistpubs/ir/2023/NIST.IR.8496.ipd.pdf, retrieved 1.10.2024.

Nicoletti, Leonardo – Bass, Diana (2023) Humans are biased. Generative AI is even worse. *Bloomberg*. https://www.bloomberg.com/graphics/2023-generative-ai-bias/, retrieved 3.9.2024.

Niemelä, Kyösti (2012) Ennuste toteuttaa itse itsensä. *Helsingin Sanomat*. Ennuste toteuttaa itse itsensä | HS.fi, retrieved 11.7.2024

NSA (2023) *Post-Quantum Cryptography: CISA, NIST, and NSA Recommend How to Prepare Now*. National Security Agency / Central Security Service. https://www.nsa.gov/Press-Room/Press-Releases-Statements/Press-Release-View/Article/3498776/post-quantum-cryptography-cisa-nist-and-nsa-recommend-how-to-prepare-now/, retrieved 20.8.2024.

Ogbeifun, E. – Agwa-Ejon, J. – Mbohwa, C. – Pretorius, J.H. (2016) The Delphi technique: A credible research methodology. *Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management Kuala Lumpur, Malaysia*. March 8-10, 2016. https://core.ac.uk/download/pdf/74247862.pdf?utm_source=chatgpt.com, retrieved 22.6.2024.

Park, Woonghee & Lee, Hyun-Kyung (2020) Creative integration of design thinking and strategic thinking in a design education framework. *Creativity studies*. Vol. 14. p.170. https://www.proquest.com/scholarly-journals/creative-integration-design-thinking-strategic/docview/2550053047/se-2?accountid=14774, retrieved 15.5.2024.

Peters, Michael A. – Jandric, Petar – Green, Benjamin J. (2024) The DIKW Model in the Age of Artificial Intelligence. *Postdigital science and education*. 2023-02. https://link-springer-com.ezproxy.utu.fi/content/pdf/10.1007/s42438-024-00462-8.pdf, retrieved 2.9.2024.

Pickering, Ethan – Guth, Stephen – Karniadakis, George Em – Sapsis, Themistoklis P. (2022). *Discovering and forecasting extreme events via active learning in neural operators*. https://arxiv.org/pdf/2204.02488, retrieved 20.8.2024.

Piirainen, Kalle A. – Gonzalez, Rafael A. – Bragge, Johanna (2012) A systemic evaluation framework for futures research. *Futures: the journal of policy, planning and futures studies*. 2012-06, Vol.44 (5), p.464-474. https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S001632871200050X, referred 18.9.2024.

Pythian, Mark. (2013) *Understanding the Intelligence Cycle*. Routledge, Taylor & Francis Group. New York. https://ebookcentral.proquest.com/lib/kutu/reader.action?docID=1209543, retrieved 13.9.2024.

Quartana, Phillip J. – Campbell, Claudia M. – Edwards, Robert R. (2009) Pain catastrophizing: a critical review. *Expert review of neurotherapeutics.* 2009-05, Vol.9 (5), p.745-758.

https://www.proquest.com/docview/912445523/fulltextPDF/9E19C72252604CC8PQ/1?accountid=14774&sourcetype=Scholarly%20Journals, retrieved 16.9.2024.

Raami, Asta (2016) Älykäs intuitio. S&S, Helsinki. Referred 26.7.2024.

Raami, Asta (2020) Intuitio3. Otava. Referred 26.7.2024.

RAND. *Our History*. https://www.rand.org/about/history.html, retrieved 10.9.2024.

RAND (2024) *Delphi Method*. https://www.rand.org/topics/delphi-method.html, retrieved 2.9.2024.

Revonsuo, Antti (2010) *Consciousness – The Science of Subjectivity*. Psychology Press. Hove and New York.

Richards, Chet (2020) Boyd's OODA Loop. *Necesse* 2020, Vol 5, Issue 1, 142-165. https://fhs.brage.unit.no/fhs-xmlui/bitstream/handle/11250/2683228/Boyds%20OODA%20Loop%20Necesse%20vol%205%20nr%201.pdf, retrieved 18.8.2024.

Roberts, Bryan W. (2022) *Reversing the Arrow of Time*. Cambridge University Press. https://www-cambridge-org.ezproxy.utu.fi/core/books/reversing-the-arrow-of-time/D7E6FB349B290D1284A504AAD72DE174, retrieved 14.9.2024

Rohrbeck, René – Battistella, Cinzia – Huizingh, Eelko (2015) Corporate foresight: An emerging field with a rich tradition. *Technological forecasting & social change.* 2015-12, Vol.101, p.1-9. https://www.sciencedirect.com/science/article/abs/pii/S0040162515003224, retrieved 12.12.2024.

Rousku, Kimmo (2017) Ohje riskienhallintaan. *Valtiovarainministeriön julkaisuja*. Vol. 22/2017. Julkisen hallinnon ICT. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/80013/VM_22_2017.pdf?sequence=1&isAllowed=y, retrieved 18.8.2024.

Rovelli, Carlo (2011) Forget time. *Found Phys 41*. 1475–1490. https://link-springer-com.ezproxy.utu.fi/article/10.1007/s10701-011-9561-4, retrieved 5.9.2024.

Rubin, Anita. *Villit kortit*. TOPI – Tulevaisuudentutkimuksen oppimateriaaleja. https://tulevaisuus.fi/menetelmat/toimintaympariston-muutosten-tarkastelu/villit-kortit/, retrieved 9.6.2024.

Salminen, Esa (2000) *Satelliittien hyväksikäyttö puolustusvoimissa*. Julkaisusarja 1, No. 8. Maanpuolustuskorkeakoulu, Tekniikan laitos.

Salvagno, Michele – Taccone, Fabio Silvio – Gerli, Aleberto Giovanni (2023) Artificial Intelligence Hallucinations. *Critical care*. London, England. 2023-05, Vol.27 (1), p.180-180, Article 180. https://link.springer.com/article/10.1186/s13054-023-04473-y, retrieved 18.9.2024.

Sandhu, Roopinder K. – Andrare, Jason G. (2023) Quality improvement and the Rumsfeld matrix. *Heart rhythm*, 2023-07, Vol.20 (7), p.1009-1010. https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S1547527123021756, retrieved 15.8.2024.

Saressalo, T – Huhtinen, AM (2022) Information Influence Operations: Application of National Instruments of Power. *Journal of Information Warfare*, Vol. 21, No. 4 (Fall 2022), pp. 41-66. https://www.jstor.org/stable/27199995, retrieved 1.12.2024.

Schacter, Daniel L. – Addis, Donna Rose – Buckner, Randy L. (2007) Remember the past to imagine the future: the prospective brain. *Nature review*. Neuroscience, 2007-09, Vol.8 (9), p.657-661 https://www-nature-com.ezproxy.utu.fi/articles/nrn2213, retrieved 4.9.2024.

Schacter Daniel L. – Addis, Donna Rose – Hassabis, Demis – Martin, Victoria C. – Spreng, R. Nathan – Szpunar, Karl (2012) The Future of Memory: Remembering Imagining, and the Brain. *Neuron* 76 (4) (November): 677-694. https://dash.harvard.edu/handle/1/11688796, retrieved 3.9.2024.

Stone, Brendan (2007) *Globalized Corporations and the Erosion of State Power*. GlobalResearch. https://www.globalresearch.ca/globalized-corporations-and-the-erosion-of-state-power/5661?utm_source=chatgpt.com, retrieved 7.6.2024.

Taleb, Nassim Nicholas (2007) *The Black Swan: Impact of the Highly Improbable*. Random House, New York. https://archive.org/details/10.1.1.695.4305/page/n9/mode/2up, retrieved 18.8.2024.

Talsma, Kate – Schüz, Benjamin – Norris, Kimberly (2019) *Miscalibration of self-efficacy ≠ self-fulfilling prophecy*. Learning and Individual Differences. Vol 69. pages 182-195, https://www-sciencedirect-com.ezproxy.utu.fi/science/article/pii/S104160801830178X?via%3Dihub, retrieved 11.7.2024

Total Military Insight (2024) Exploring the Key Types of Military Intelligence Today. Military Intelligence. https://totalmilitaryinsight.com/types-of-military-intelligence/, retrieved 17.8.2024.

Tetlcok, Philip E. – Gardner, Dan (2015) *Superennustajat – Ennustamisen taito ja tiede*. Terra Cognita. Helsinki. Referred 13.8.2024.

Tyng, Chai M. – Amin, Hazeef U. – Saad, Mohammad N. M. – Malik, Aamir S. (2017) The Influences of Emotion on Learning and Memory. *Frontiers in psychology*. 2017-08, Vol.8, p.1454-1454. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2017.01454/full, retrieved 11.8.2024.

Vairimaa, Reetta (2024) *Tekoäly muuttaa yhteiskunnan, aivot ja ihmisyyden*. Helsingin yliopisto. https://www.helsinki.fi/fi/uutiset/ihmisten-teknologia/tekoaly-muuttaa-yhteiskunnan-aivot-ja-ihmisyyden, retrieved 4.10.2024.

Van der Steen, Martijn – Van der Duin, Patrick (2012) Learning ahead of time: how evaluation of foresight may add to increased trust, organizational learning and future oriented policy and strategy. *Futures*. Vol. 44. Iss.5. https://www.sciencedirect.com/science/article/abs/pii/S0016328712000523, retrieved 29.9.2024.

Viale, Riccardo – Marewski, Julian N. (2020) *Routledge Handbook of Bounded Rationality*. Routledge, London. https://www-taylorfrancis-com.ezproxy.utu.fi/books/edit/10.4324/9781315658353/routledge-handbook-bounded-rationality-riccardo-viale, retrieved 13.9.2024.

Voros, Joseph (2003) A generic foresight process framework. *Foresight* (Cambridge), 2003, Vol.5 (3), p.10-21. https://www-emerald-com.ezproxy.utu.fi/insight/content/doi/10.1108/14636680310698379/full/pdf, retrieved 12.10.2024.

Voros, Joseph (2017) *The Futures Cone, use and history*. https://thevoroscope.com/2017/02/24/the-futures-cone-use-and-history/, retrieved 16.10.2024.

Webb, Lynette – Schönberger, Daniel (2024) *Generative AI and the problem of existential risk. Forthcoming on Oxford Handbook on the Foundations and Regulations of Generative AI*. Oxford University Press. https://arxiv.org/pdf/2407.13365, retrieved 6.10.2024.

Wiggers, Kyle (2022) *Black Swan analyzes social media to predict which products will be successful*. TechCrunch. https://techcrunch.com/2022/06/30/black-swan-analyzes-social-media-to-predict-which-products-will-be-successful/, retrieved 18.9.2024.

Wabartha, Maxime – Durand, Audrey – Francois-Lavet, Vincent – Pineau, Joelle (2021) Handling Black Swans Events in Deep Learning with Diversely Extrapolated Neural Networks. *IJCAI'20: Proceedings of the Twenty-Ninth International Conference on International Joint Conferences on Artificial Intelligence*. Article No.: 296, Pages 2140 – 2147. https://dl.acm.org/doi/10.5555/3491440.3491736, retrieved 22.8.2024.

Wärtsilä (2024) *Risk management*. https://www.wartsila.com/investors/governance/risk-management, retrieved 6.7.2024.

WSFS. *About Future Studies*. World Futures Studies Federation. https://wfsf.org/about-futures-studies/, retrieved 1.9.2024.

Zio, Simone – Bolzan, Mario –Marozzi, Marco – Scioni, Manuela (2024) Delphi-based scenarios and risk management: A parallelism between paths destined to meet. *Socio-economic planning sciences*, 2024-04, Vol.92, p.101832, Article 101832. https://libkey.io/libraries/348/articles/603298813/full-text-file, retrieved 14.8.2024.

Appendices

Appendix I: Matrix

			SCENARIOS														
			S1				S2				S3				S4		
	Evidence	Evidence Source	Likelihood		Impact	Events	Likelihood		Impact	Events	Likelihoo		Impact	Events	Likelihood	Impact	Events
			-0,5				0,75				-9,25				#N/A		
E1	Values for clean seafaring is growing	Assumption	-4	4	64	Megatrend	2	2	-8	Medium Risk	-2	2	18	Trend	4	16	Trend
E2	Demand for small cruise ships grows	News	1,75	2	-15,75	High Risk	3,5	3,5	-31,5	High Risk	-3,5	4	3,5	Opportunity	-1,75	15,75	Trend
E3	Sample evidence 3	Event	-0,25	0	-1	Weak Signal	0	0	0	Wild Card	-0,25	0	-1	Weak Signal	0,25	-2,25	Low Risk
E4	Sample evidence 4	News (Google)	0	0	0	Weak Signal	-4	4	-64	Extreme Risk	4	4	64	Megatrend	-8	32	Megatrend
E5	Sample evidence 5	Publication	2	2	2	Opportunity	2	2	18	Trend	-2	2	18	Trend	#N/A	#N/A	#N/A
E6	Sample evidence 6	Data (DNV)	2,75	3	24,75	Trend	-2,75	2,75	44	Megatrend	-5,5	6	-5,5	Medium Risk	#N/A	#N/A	#N/A
E7	Sample evidence 7	AI (copilot)	-3	3	-12	Medium Risk	6	6	#N/A	#N/A	3	3	#N/A	#N/A	#N/A	#N/A	#N/A
E8	Sample evidence 8	SoMe (IG)	4	4	64	Megatrend	-4	4	#N/A	#N/A	0	0	#N/A	#N/A	#N/A	#N/A	#N/A
E9	Sample evidence 9	News (HS)	0,75	1	-6,75	Medium Risk	0	0	#N/A	#N/A	0,75	1	#N/A	#N/A	#N/A	#N/A	#N/A
E10	Sample evidence 10	0	-1	1	16	Wild Card	2	2	#N/A	#N/A	1	1	#N/A	#N/A	#N/A	#N/A	#N/A
E11	Sample evidence 11	0	5,5	6	-88	Extreme Risk	0	0	#N/A	#N/A	5,5	6	#N/A	#N/A	#N/A	#N/A	#N/A
E12	Sample evidence 12	0	4	4	16	Trend	4	4	#N/A	#N/A	0,75	1	#N/A	#N/A	#N/A	#N/A	#N/A
E13	Sample evidence 13	0	1	1	16	Wild Card	#N/A	#N/A	#N/A	#N/A	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A
E14	Sample evidence 14	0	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A
E15	Sample evidence 15	0	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A
E16	Sample evidence 16	0	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A
E17	Sample evidence 17	0	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#	#N/A	#N/A	#N/A	#N/A	#N/A

	Evidence			Impacts								Credibility	Relevance	Scenarios			
	Name	Link	Type	S1		S2		S3		S4				S1	S2	S3	S4
														-0,5	0,75	-9,25	#N/A
E1	Values for clean seafaring is growing		Assumption	Major	+	Minor	-	Serious	+	Minor	+	Extreme	Medium	II	C	I	CC
E2	Demand for small cruise ships grows		News	Serious	-	Serious	-	Neglible	+	Serious	+	High	Medium	C	CC	II	I
E3	Sample evidence 3		Event	Minor	-	Major	+	Minor	-	Serious	-	Low	Low	I	N	I	C
E4	Sample evidence 4		News (Google)	Minor	-	Major	-	Major	+	Minor	+	Extreme	Extreme	N	I	C	II
E5	Sample evidence 5		Publication	Neglible	+	Serious	+	Serious	+	Minor	-	Extreme	Medium	C	C	I	
E6			Data (DNV)	Serious	+	Major	+	Neglible	-	Minor	-	High	High	C	I	II	
E7			AI (copilot)	Minor	-							High	Extreme	I	CC	C	
E8			SoMe (IG)	Major	+							Extreme	Medium	CC	II	N	
E9			News (HS)	Serious	-							High	Low	C	N	C	

Appendix II: Design process journal

Date	Action	Tool	Eureka	Next Step
4.5.2024	Elements on the table	Future Cone Miro-board +- Risk Management	Adding risk management to future foresight	Making the numeric evaluation of future events
15.5.2024	Method development	ACH & Delphi	Combining Delphi structure to ACH Bias acknowledges	Making of process diagram with Miro-board
16.5.2024	Design plan	Strategic Design	Right tool for right aim	Literature glance
20.5.2024	Fusion of operational field scanning	PESTE + V PMSII + T	Fusion of similar intelligence & foresight scanning elements	Eliminating the same ones and combining the rest
1.6.2024	Security	Anonymization	Sensitive data protection, lifetime and access	Consult internally supervisors & experts
16.6.2024	Radar observation	Future radar Procreate (visual)	Slicing the future cone in the middle	Adjusting future radar to round tool with adjusted elements
20.6.2024	Excel modification	ACH excel	Hypotheses = Scenarios	Semantic understanding with concepts
24.6.2024	Excel development	Risk Management	Evaluating likelihood through credibility & relevance	Formula generations on correction
1.7.2024	AI observation	Copilot	Risk of use	Traceability, evaluation in F&A
10.7.2024	Planning the questionnaire	Forms	Same questionnaire before and after	Preparing the questionnaire

	to the test group and organization			
19.7.2024	Planning the pilot	Jamboard Teams/Zoom Whiteboard	Integrated whiteboard usage	Test online with few voluntary persons before pilot
8.8.2024	Online test	Kahoot! Forms	Voting tool was needed to accelerate the process.	Evaluate the tools
18.8.2024	Secondary evaluation of Framework	Brains	Future of foresight with QAI and concept of time.	Work not in the scope of the thesis
30.9.2024	RFI & Panellists	Communication	Crystallisation of RFI and selection of panel do need more time than actual Panel work.	Addition to work.
5.10.2024	Invitations	Email	More cantered anonymization means	Future developmental means.
7.10.2024	Testing Teams	Teams	Communication online	Continue testing
11.10.2024	Test of Teams features	Teams Premium	Lacking some anonymity, new tool needed.	For pilot run, communication via chat. In general, AI usage in sound?
21.10.	Testing Run I	Teams Premium	Anonymity works	Test run
22.10.	Test run II	Testing the method	Test panel worked throughout together: whiteboard, evaluation forms, and feedback ok	Ready for Pilot

27.10.2024	Final adjustments	Teams, PP, Forms	Developmental aids have cleared out through testing.	Pilot run
28.10.2024	Pilot run	MS365 tools, Teams, Forms, Teams whiteboard	Facilitator possible anonymization, more fluent technical tools	Feedback and analysis
1.11.2024	Test run III	Tools	Calculation correction to mean	Finalising thesis

Appendix III: AI Disclaimer

All content was independently created by the author, with all design thinking and organic ideas developed without any use of AI. However, the final text was reviewed and refined for part to part using AI solely for grammar structure and language corrections. Used AI tools were ChatGPT and Copilot.

Appendix IV: Questionnaires

1. E1: Credibility *

- ◯ Low
- ◯ Minor
- ◯ High
- ◯ Extreme

2. E1: Relevance *

- ◯ Low
- ◯ Minor
- ◯ High
- ◯ Extreme

Appendix V: Forms evaluation

7

Which of the features you'd like to see implemented to method in the future? *

- [ ] Cybersecurity
- [ ] Mobile application
- [ ] Enhanced AI
- [ ] Visualization
- [ ] Databases add-on
- [ ] Acceleration of evidence search
- [ ] Possibility to speak anonymously with panelists
- [ ] Other