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Improving Strategic Foresight in Public Policymaking

Dissertation thesis

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Declaration

1. I hereby declare that I have compiled this thesis using the listed literature and resources only.
2. I hereby declare that my thesis has not been used to gain any other academic title.
3. I fully agree to my work being used for study and scientific purposes.
4. During the preparation of this thesis, the author used ChatGPT in order to increase clarity of selected parts of the text. After using this tool/service, the author reviewed and edited the content as necessary and takes full responsibility for the content of the publication.

In Prague on June 26, 2024 **Jan Kleňha**

References

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Abstract

This research investigates the role of participation in national strategic foresight and the potential benefits of integrating forecasting tournaments with traditional expert-based methods. A multi-step case study finds that forecasting tournaments can enhance participation and potentially improve foresight results. According to the ex-post evaluation, widely participatory methods were found to be of a comparable quality to those of the expert Delphi, indicating the viability of participation for strategic foresight. The research posits that broader participation could improve the quality of foresight outcomes, thereby strengthening the basis for national policymaking. Additionally, the study suggests that forecasting tournaments can serve as a stand-alone method even for long-term foresight, presenting a potentially cost-effective alternative to expert-based methods. The research concludes with the analysis of the most important design elements for conducting forecasting tournaments, designing foresight studies and improving the institutionalization of foresight in public policy.

Abstrakt

Tato studie zkoumá roli participace v národním strategickém foresightu a potenciální přínosy integrace metody forecastingových turnajů s tradičními metodami založenými na zapojení expertů. Ve vícefázové případové studii bylo zjištěno, že forecastingové turnaje mohou zvýšit kvalitu participace a potenciálně tak zkvalitnit finální výstupy. Na základě ex-post evaluace byly výstupy široce participativních metod kvalitativně srovnatelné s výsledky expertní metody Delphi, což naznačuje vhodnost participace pro strategický foresight. Výsledky potvrzují hypotézu, že širší participace může zlepšit kvalitu foresightu, a tím zlepšovat veřejné rozhodování. Studie navíc naznačuje, že forecastingové turnaje mohou sloužit jako samostatná metoda i pro účely strategického foresightu, což představuje potenciálně nákladově efektivní alternativu k expertním metodám. Závěr studie je dedikován designové analýze nejdůležitějších faktorů pro facilitaci forecastingových turnajů, designování foresightových studií a celkové posilování institucionalizace foresightu ve veřejné politice.

Keywords

National strategy, foresight, Forecasting tournament, Delphi method, deliberation, prediction, consensus.

Klíčová slova

Národní strategie, foresight, Forecastingový turnaj, metoda Delphi, deliberace, predikce, konsensus.

Title

Improving Strategic Foresight in Public Policymaking

Název práce

Zvyšování kvality strategického foresightu při tvorbě veřejných politik

Acknowledgment

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Most importantly, I want to thank all 200+ participants, who provided their inputs as part of my initial testing pilots, the forecasting tournament, Delphi study or a questionnaire for the interim evaluation. I am confident that your time spent on participating in this research produced highly positive value for the society, be it through the direct impacts of the research outcomes being used by Czech policymakers to make slightly better strategic decisions, or future foresight practitioners using more evidence-based combinations of foresight studies.

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Summary

Improving national strategic foresight can help the formation of more robust and informed policies. In the theoretical parts of this dissertation thesis, I explore the main use cases for foresight, the role of participation in foresight methods, and the feasibility of combining these methods within individual foresight studies. I, then, explore the combination of Delphi (expert based, long-term foresight method) with Forecasting tournaments (participation based, short-term foresight method) to support two main hypotheses of this research: Forecasting tournaments improve the quality of participation, while better participation can improve foresight results.

The evidence supporting the first hypothesis is based on a case study where a group of 119 participants in a Forecasting tournament predicted the results of a Delphi consisting of 24 experts. Experts in Delphi could take into account the arguments of participants from a prior forecasting tournament and thus make better-informed decisions. This design turned out to be technically feasible, the outputs from the forecasting tournament were appreciated by the experts, and participants in the forecasting tournament produced better predictions, on average, than they did when using a questionnaire.

To support the second hypothesis, an interim evaluation was conducted in two rounds 1.5 and 3 years later, providing evidence that the aggregate predictions of hundreds of non-experts have a similar quality as the predictions of tens of collaborating experts, relative to this first evaluation. More consequent rounds of evaluation and more similar independent studies should be conducted to strengthen or falsify this finding, but it shows that forecasting tournaments have the potential to be used in strategic foresight in combination with other expert-based methods or even as a stand-alone method, which could be significantly more cost-effective.

Finally, the design analysis of the most viable approaches to strategic implementation of forecasting tournamets and other foresight methods to the wider policymaking processes in democratic countries identifies a few principles, according to which these processes should be improved in order to systematically institutionalize foresight in democratic countries.

Over all, these findings suggest that current foresight methods mostly lack wide participation which can improve the quality of outcomes, and that Forecasting tournaments are a method that can effectively facilitate such participation. More generally, I claim that

the quality of foresight outcomes can be empirically improved and doing so should be a research priority, since strategic foresight seems to play an increasingly important role in national policymaking in democratic countries.

1. Introduction

Studying how governments create important strategic documents is crucial in the field of public policy and international relations. These documents are usually created with the use of strategic foresight. Generally, strategic foresight studies at the national public policy level are conducted to directly or indirectly influence the future trajectories of a nation's domestic and international policies. As a result, these studies are highly important for the quality of domestic policymaking as well as for the development of international relations.

In this dissertation research, I explore the possibilities for methodological improvements in foresight studies. I carried out all parts of this research in the period between September 2018 and December 2022.

For full transparency, I note that I am the author of both the theoretical research and the design of the empirical case study, and I carried out the collection of data and interpreted the findings from this case study. The case study (Chapter 5) consisted of two parts with a total of 6 questions (Q1-Q6) that I designed solely for the purpose of this research, except for Question 4 (Q4), which was asked as part of the Delphi study in the project FUTURE-PRO. This is the only part of the case study, which would be carried out by me and my colleagues from the research organization České priority, z. ú. even regardless of this dissertation research. It was also the most intensive part of the case study, where I needed to work with a team of multiple other researchers. This is why I use the terms “us” as “our team” instead of “I” and “me” when referring to the facilitation of the Delphi study.

In order to disseminate the academic outcomes of this research, parts of it were published in a scientific article, one certified methodology and a few academically unpublished research reports that are available online, all of which are cited accordingly in the following text. I fully carried out this research at the premises of Charles University, specifically mostly at the Faculty of Social Sciences in Prague. I have also consulted all important strategic and design choices related to the teoretical research and the case study with my supervisor.

1.1 Structure

This study contains 9 chapters. Since the topic of foresight is very cross-sectoral and multidisciplinary, I start out in Chapter 1 by introducing the concepts broadly. In chapters 2,

3, and 4, I proceed with the methodological analysis and keep narrowing down the focus, studying the important aspects of the use of foresight and of individual foresight methods. Chapter 5 is the narrowest part of the study, where I describe the core case study of my research. From Chapter 6 onward, I return to broadening the scope of the research, conducting a design analysis to identify general aspects of the most potentially effective was to implement and sytematizatize foresight within policymaking processes (Figure 1).

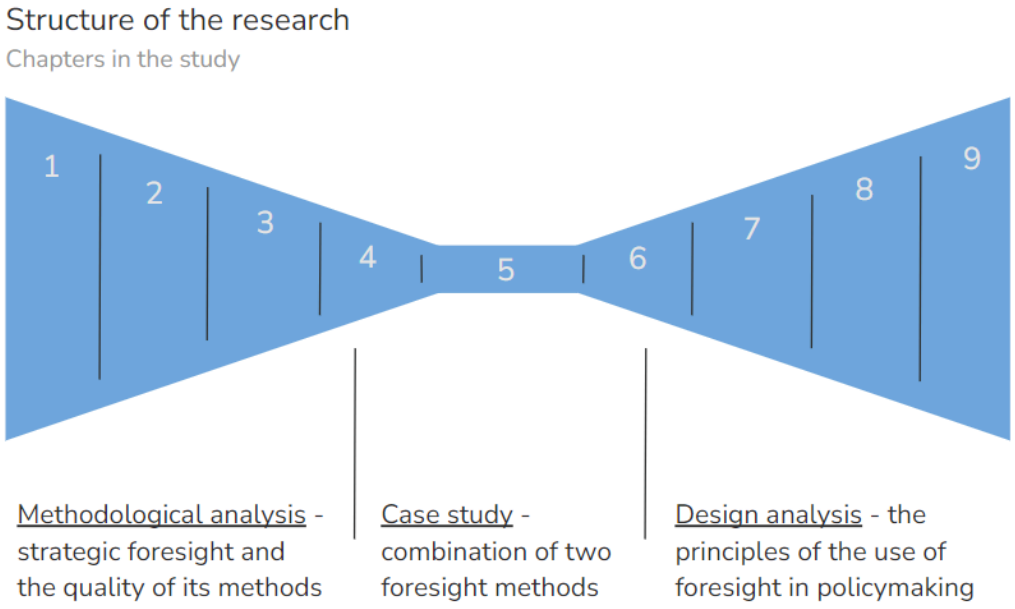

Figure 1 - Structure of the research

As I continue to explain in the introduction, this work is a contribution to academic research, but some of its findings and implications might directly or indirectly serve as an inspiration for policymakers and foresight practitioners in their work. Since even small improvements in the ability of governments to anticipate future while making large strategic decisions might introduce large benefits to the society, this could be a notably postive secondary impact of this research. In the next paragraphs, I briefly explain the content of each chapter.

Chapter 1 is an introductory chapter. I explain how this study is structured, what is the goal of my research, what are the specific research goals and questions, and which methodological approaches were used in the case study. Importantly, this chapter closes with an explanation of terminology, which might be useful to read even for foresight experts, since some of the terms are used differently by various practitioners in various territorial regions due to this field's relatively novel and multidisciplinary nature.

Chapter 2 is the theoretical cornerstone of this study. This chapter focusing on the methodological analysis of foresight has five subchapters. First, I provide the overview of the current state of the art of strategic foresight, where I already attempt to include various methodological manuals and empirical case study reports along with the academic literature, which, however, still constitutes the majority of the presented resources. Consequently, the importance of strategic foresight is discussed, in light of two core capabilities of foresight - anticipating risks and identifying opportunities. Each of these capabilities is illustrated by multiple successful international examples and a local case study conducted by our research teams in the Czech Republic in recent years.

The last subchapter concerns the use of foresight methods to strengthen the public participation of citizens. This has been usually seen as a side-benefit of foresight, but it is currently receiving increasing international attention. Since strategic planning and thinking about the future is a domain close to many citizens in their daily lives, the use of selected participatory foresight methods might represent a very important practical tool to decrease the political polarization of societies.

After understanding what is foresight and what it is useful for, Chapter 3 provides an overview of 14 specific methods of foresight, specifically in light of their use of wider public participation or expert deliberation. These 14 methods are categorized into the foresight framework consisting of three phases of a foresight study - the “understanding” phase, the “anticipating” phase, and the “planning” phase. The resulting finding about the actual extent of the use of participation in these methods enforces the case for my consequent research.

In Chapter 4, I explain which two foresight methods I consider potentially most beneficial to combine, why, in theory, they should be complementary, and why this combination has yet been understudied. This chapter contains an in-depth exploration of these two methods, their benefits, and their limitations. There is also a discussion about the metrics that could be used to assess the outcomes of the interaction of two otherwise independent foresight methods. The theoretical outcomes of this chapter should be useful mainly for scholars and researchers, who want to further explore the use of these foresight methods on various topics, in various settings, and with various participants.

Chapter 5 is the heart of this research. I start by explaining the case study design and its two parts. The first part was conducted between March 2021 and October 2022, and the second part 1.5 years later. While describing the steps in the process of the study, I already mention some particular findings and limitations. Finally, the results of both parts of the

study are presented, supporting the research hypotheses. A more comprehensive discussion of what these findings mean, how robust they are, and what limitations they have follows.

Chapter 6 is the first part of the conseqent design analysis of the principles of the use of foresight in policymaking. It analyzes the importance of design elements, processes and steps that could be taken by foresight practitioners who decide to conduct the combination of foresight methods in their foresight study. It focuses especially on the aspects of conducting Forecasting tournaments, for which there is currently a lack of evidence-based methodological guidelines, unlike in the case of the Delphi method, which has been rigorously studied in academic literature. The design findings are confronted with and enhanced by a literature review of policy reports and experiences of policy practitioners.

In Chapter 7, I analyze the design elements of conducting a foresight study in general. This chapter builds especially on the findings from Chapter 3 while reminding readers that the combination of two foresight methods explored in Chapter 5 is not suitable for all possible practical uses of foresight. Overall, foresight practitioners should design their foresight study to combine the phases and methods discussed in Chapter 3 but also keep in mind some wider design considerations, that are explored in this chapter. These generalized considerations come from the combination of additional academic literature and the empirical experience of me and of other academic scholars conducting foresight studies.

Chapter 8 analyzes the design elements of the institutionalization of foresight. I explore the fundamental reasons why most governments currently do not conduct strategic foresight coherently within policymaking processes and why they do not systematically focus on improving the methods of foresight. To study various designs, I present seven case studies of foreign foresight ecosystems and follow up with a summary of recommendations from academic literature. This analysis results in two clusters of elements, that are present in functioning foresight ecosystems. These elements could be further analyzed and potentially applied by policymakers in other countries aiming to systematically institutionalize foresight.

Chapter 9 concludes the study. I summarize the most important learnings from this research in line with the two main hypotheses and discuss the limitations of this research once again. Specific suggestions are then presented on how to build upon these findings in research, especially through collecting more evidence by implementing small-scale pilots of forecasting tournaments in strategic foresight. Finally, I summarize the main findings about methodological improvements and more rigorous applications of foresight in policymaking.

1.2 Research goals

I systematically explore the use of foresight, the methods of foresight, and then specifically the possibilities of using forecasting tournaments as a participation-based method in strategic foresight studies. It is a research direction that is in accordance with current recommendations from the scientific community. For example, The Perry World House, an interdisciplinary global policy research institute at the University of Pennsylvania recommends "launching experiments focused on different types of forecasts on which there is currently little research, including conditional forecasting and longer-term forecasts" (Horowitz, 2021).

This research contributes to the study of the effectiveness of methods of judgemental forecasting, which "has oddly been understudied in the past" and should be a priority focus in this field (Gruetzemacher et al., 2021). This approach is also highly relevant to the study of international relations. The Center for Security and Emerging Technology (CSET) is, for example, regularly using forecasting tournaments to inform policymakers with geopolitical predictions such as the probability of a violent U.S.-China conflict in the South China Sea (Page and Barker, 2020) or the predictions of the U.S.-China Trade (Page, 2021).

1.3 Research questions and hypotheses

This research is concerned with the primary research question "**how to improve the quality of foresight results by effectively combining some of the existing foresight methods?**" I explore the feasibility of using widely participatory methods for addressing long-term questions, such as the future significance of global megatrends, when combined with more deliberative techniques for determining expert consensus, like the Delphi method.

Secondary research question in Chapter 2 is concerned with how is foresight currently used in policymaking of and how successful it is, while in Chapter 3, I explore the use of wide participation in various foresight methods. In Chapters 6-8, the overarching secondary research question asks, what are the most promising aspects and design principles of implementing a forecasting tournament, conducting a larger foresight study and systematically institutionalizing foresight in public policymaking processes.

Concerning the main research question, I operate with two main hypotheses:

1. **forecasting tournaments can improve participation**
2. **better participation can improve foresight results**

To operationalize the first hypothesis, claiming that forecasting tournaments can improve the quality of participation, I conducted a forecasting tournament as well as a questionnaire as part of a national strategic foresight study and then compared the quality of predictions of expert opinions, derived by these two methods. The use of these methods was not a controlled experiment, but an empirical application aimed to improve the quality of the final results of this large-scale foresight study by strengthening the robustness of the results.

The second hypothesis was answered by my additional research conducted 1.5 years after the aforementioned foresight study, providing a preliminary evaluation of the quality of each of the foresight methods. By providing empirical evidence to answer these research questions, I explore a novel space, as it has not yet been researched whether people participating in forecasting tournaments are able to reliably & robustly predict the opinion of a group of experts, e.g. on geopolitical questions or in the area of strategic foresight.

As an additional secondary research question, I built on the previous findings and explored the motivations of participants in a forecasting tournament when asked to predict the next year's opinion of a group of non-experts instead of the next month's consensus among experts, as was the question in this case study. This approach investigates the plausibility of using forecasting tournaments directly for long-term foresight, utilizing a “proxy” resolution derived by the same mechanism one year later. This mechanism could be further researched and piloted as a potentially highly cost-effective novel foresight approach. In general, further research of how to improve foresight methods seems to be able to yield significant societal benefits by increasing the quality of long-term strategic planning in policymaking.

1.4 Research methodology

Since the improvement of the foresight methodology is the core objective of this research, an in-depth methodological analysis is present in Chapters 2-4. This methodological analysis was conducted using literature review and desk research methods, and enhanced by multiple interviews with foresight experts and practitioners from abroad. In this chapter, I provide an overview of the methods used in both parts of the case study (Chapters 4 and 5).

For the methodological case study, I collected multiple datasets between 2021 and 2024. Table 1 below shows the structure and the types of the collected data.

Question		Method (date of collection)	Type of respondents	Number of respondents	Est. avg. time spent per respondent
PART 1	Q1,2	Questionnaire (4/2021)	self-selected participants	238	10 min
	Q3	Forecasting tournament (4/2021)	self-selected participants	119	60 min
	Q4	Delphi (5/2021)	selected experts	24	210 min
PART 2	Q5	Questionnaire (2022, 2023)	selected respondents	50	30 min
	Q6	Forecasting survey (2023)	self-selected participants	53	20 min

Table 1 - Structure of the research data

For the purpose of clarity, I structured the case study research (Chapter 5) into two parts:

- Part 1 - **primary data** - questions Q1, Q2, Q3, Q4 - collected in 2021
- Part 2 - **evaluation data** - questions Q5,Q6 - collected in 2022-2024

Part 1 is relevant primarily for the work with the first hypothesis ("forecasting tournaments can improve participation"). Part 2 is relevant for the second hypothesis of the research ("better participation can improve foresight results"). More specific details about the participants or the questions asked are explained in the introduction of Chapter 5.

For the first part of the study, I prepared the interface for the forecasting tournament using an online platform, and tested and piloted the questionnaire using a dedicated survey tool. At the same time, 18 cards of megatrends to be prioritized by all participants were compiled collaboratively with my colleagues. Details are described in the FUTURE-PRO Methodology document (FUTURE-PRO Methodology, 2021), which also contains the list of the foresight studies and publications identifying global megatrends, that were used as resources.

To properly design the Delphi study (Q4), we then conducted a series of semi-structured interviews with international experts. The full list of interviewed experts is included in the Appendix 1. The interviews were carried out online between November 2021 and March 2022 mostly by me and 1-3 researchers from České priority, z.ú. The experts were selected based on their authorship of relevant recent foresight studies. The notes from interviews

were written in a simple pre-designed protocol and were used to steer the additional research and consequent choice of foresight methods to explore with additional rigor.

The main questions asked in the interviews were the following:

- What was the aim of your study and the expected outputs? Could you describe how the process unfolded? Could you list 1-3 pros and cons for each method you used?
- Could you please provide us with another source of information? Would you recommend other experts to interview?
- What would be a suitable process to identify Megatrends and Grand Societal Challenges relevant at a national level? What methods would be the most relevant?

Regarding the following chapters, in the first part of the practical case study, Forecasting tournaments and a Delphi method were used as two main methods, while an online structures questionnaire was used as a method for the consequent comparison of the quality of predictions of a group consensus. Using a forecasting tournament to predict the results of a Delphi method is one possible combination of foresight methods.

Using short-term forecasting tools to predict the outcomes of social science research has been used in the past (Social Science Prediction Platform, 2022), but its use in predicting the results of a foresight study based on a Delphi approach, with the goal of making these outcomes more robust, is a concept that hasn't been explored in academic writing yet.

My methodological approach was notably influenced by the interactions with the international community of researchers of foresight and forecasting. I was particularly interested in new ways of scoring questions that don't have clear answers, which was a topic of a study “Reciprocal Scoring: A Method for Forecasting Unanswerable Questions” (Karger, 2021), sponsored by the US Intelligence Advanced Research Projects Activity (IARPA) and Open Philanthropy. The selected approach builds on a similar principle of the effectiveness of peer-prediction elicitation, but I have applied forecasting tournaments in a context of more usual procedures used by many nations in strategic foresight studies.

1.5 Terminology

The following table outlines and defines the main concepts used in this research (Table 2).

Foresight	The process and a set of methods enabling systematic consideration of the possible options of future development

	(Miles, 2016).
Forecasting tournaments	Method of crowd-wisdom aggregation for the purpose of gathering informed estimation of future developments, events, trends or outcomes (Tetlock, 2014).
Delphi method	A method for structuring a collective deliberation, based on iterations and anonymity of participants. (Linstone, 2002).
Participation	An approach to collecting information from large, usually not pre-selected groups of citizens or participants, with the aim of achieving breadth of inputs (Carson, 2019).
Deliberation	An approach to collecting information from smaller targeted groups of participants or pre-selected representative samples of the population (Lodewijckx, 2020).
Megatrends	Relatively slow and certain directions of development, identified at the global level, and expected to change the face of the world substantially in the next decades (OECD, 2016).
Resilience	Ability to face adverse forces and future crises (SFR, 2020).

Table 2 - Terminology

Abbreviations used in this study are explained with their first occurrence in the text. In the case study, participants and experts were working with 18 areas of global megatrends and grand societal challenges that were presented in the form of “cards”. According to the context, the terms “megatrends”, “areas” and “cards” are used to refer to the same inputs. The concept of “Grand societal challenges” is very similar to the concept of “Megatrends” and is omitted from this text, for the purpose of brevity.

The prioritization of megatrends was facilitated by voting, so the terms “voting” and “prioritizing” might be used interchangeably, depending on the need to highlight the procedural or the directional aspect of the activity. Throughout the study, I refer to “my work” in parts of the research that I carried out without any assistance, and “our work” in parts of research conducted in cooperation with other researchers, but where I still had a main research or scientific role in the process.

2. Foresight

2.1 State of the art

Foresight can be defined as the process and a set of methods enabling systematic consideration of the possible options of future development (Miles, 2016). Foresight is an established field in academics as well as policymaking. According to Jean-Eric Paquet, the Director General for Research and Innovation, for example, “Strategic Foresight has become an inherent characteristic of modern EU policymaking, one that the Commission has been very keen to mainstream across all its policies and to diffuse across the European Union. Foresight outcomes are used by many national governments, international organizations, and private companies for better strategic planning and decision-making” (SAFIRE, 2021).

On the level of international policymaking, the publication “Foresight Manual - Empowered Futures for the 2030 Agenda” published in 2018 by the United Nations Development Programme is a respected methodological resource for strategic foresight (UNDP, 2018), for example. Our Common Agenda, the latest strategic document of the United Nations, mentions foresight and the “focus on the future, through a deepening of solidarity with the world’s young people and future generations” (Our Common Agenda, 2023) as one of the four main areas of focus, where further work of governments should be a priority.

Recently, strategic foresight has been increasingly developed also in the EU, particularly within the European Strategy and Policy Analysis System (ESPAS), which publishes studies identifying future challenges for EU public policies, and the EU-wide Foresight Network of Ministers for the Future, which is, as of 2023, chaired by the European Commission Vice-President Maroš Šefčovič and which closely cooperates with the Competence Centre on Foresight run by the Joint Research Center of the European Commission, producing annual Strategic Foresight Reports (SFR, 2022) among a number of other foresight outputs.

Two other recognized and well-respected foresight methodological publications come from the United Kingdom´s public administration. “The Futures Toolkit” was published by the British Government Office for Science in 2017 (Government Office for Science, 2017), and “The Future Is Ours: Strategic Foresight Toolkit” has been published by the School of International Futures in 2019. SOIF was an approved provider of foresight content to the UK

Government under the “Futures Framework”, which is run by the Department of Business, Energy and Industrial Strategy (SOIF, 2019).

Finland (SITRA, 2020) can be noted as another example of a nation that designs its public policies based on a rigorous anticipation of long-term future developments. According to Boston (2019), preparing for future developments in society is an integral aspect of good governance. When future developments are taken into account, the strategies as well as particular measures are significantly more effective, robust, and resilient.

From the methodological perspective, the aggregation of collective intelligence is a core concept of strategic foresight. It helps to deliver robust results in highly uncertain settings (Tõnurist, 2020) The “wisdom of the crowds” is a phenomenon coined by James Surowiecki (2005) and expanded by Cass Sunstein (2006) in the early 2000s, but intuitively known at least since the early 20th century (Galton, 1907), claiming that the aggregation of judgments often outperforms the judgments of individuals.

The benefits of using crowdsourcing methods have been shown in many other contexts, such as political elections (Gaissmaier, 2020), economic forecasting (Budescu, 2014) or public policy (Morgan, 2014). In the case of predicting long-term trends on a national and global level, which is highly complex and difficult, many governments and institutions tend to use smaller-scale deliberative methods, where the “crowd” consists of a group of credentialed experts from diverse backgrounds, aiming to capture a wide range of sector-specific expertise (Klenha, 2022).

In practice, however, collective intelligence seems to often not be harnessed very effectively and many foresight methods focus on aggregating the consensus of a few experts instead of using more participative methods to aggregate the opinions of large groups of participants.

I will explore this in more depth in Chapter 3 and then present the results from a case study testing the hypothesis that wider participation should be helpful for the quality of foresight in Chapter 5. In the remainder of this chapter, however, I continue to discuss the important topic of the use cases of foresight in order to establish a more robust understanding of various benefits that could be created by properly conducting strategic foresight studies.

2.2 Importance of foresight

Understanding the role of foresight in planning for the future requires recognizing the inherent difficulty of predicting what's yet to come. This difficulty stems from the perpetual shifts in our world, the infinite potential of human behavior and creativity, and the prospect of unexpected events or disturbances. Hence, readiness for the future means making room for the new and unforeseen. The key to this lies in establishing environments that foster creativity, adaptability, and innovation, ideally by building flexible and efficient structures.

Governments and public institutions have a major interest in examining and interpreting the future. Rather than merely watching the future being created by outside forces, foresight helps to take an active role in shaping it. This systematic reflection on the future aids us in understanding the rationale behind necessary changes, which may be intense and unsettling in a democratic society if there is no suitable preparation. The process of foresight itself is as crucial as the results it produces. Facilitating discourse among different societal groups about our collective desired future and perceived present challenges is usually a core of the foresight process.

Foresight helps to look for signs that provide a glimpse into what lies ahead, albeit with varying degrees of certainty. Foresight usually assumes that future challenges are contextually specific and require our response. The crucial element in our engagement with the future is whether we can identify these challenges and act accordingly. This involves creating and implementing solutions to these problems. Hence, when planning for the future, harnessing a receptive attitude towards potential risks and opportunities is essential.

Foresight can facilitate the creation of tailored public policies and investments to enhance their long-term efficacy. While this might entail short-term costs, long-term strategic planning that takes into account the emerging challenges of the future is of high value, as it can induce large multiplication effects and lead to long-term benefits. Being prepared for future changes is a fundamental aspect of good governance, as strategies and policies formulated in anticipation of the future are significantly more effective, resilient, and robust.

2.2.1 Tool for creating legislation and regulations

Foresight is a tool that uncovers future challenges and opportunities by creating outputs such as trend analyses, predictions, and scenarios of future developments, that are used

strategic work, prioritization, or impact assessment of public policies, but also by public administration in the process of creating new regulations and legislative policy proposals.

Historically, strategic foresight was focused on military and technological development, but in the last 30 years, it has expanded to more general societal topics such as sustainable development, social policies or infrastructure. Strategic foresight used at the national level enables the shaping of specific public policy and investment measures to maximize their long-term effectiveness (Klenha, 2022). In his study, Jacobs (2016) describes the advantages of long-term strategic foresight, whereby the government prepares its strategies and measures taking into account long-term future developments. He shows that it significantly pays off as it has moderate short-term costs but brings large long-term benefits.

While the exact future cannot be predicted, alternative futures can and should be understood and explored to advance the process of policymaking. The same is true for preferred futures. These should be identified, implemented, and continuously evaluated. Working with futures should precede strategic planning and subsequently administrative activities. Foresight activities are continuous and knowledge is constantly changing as new factors and developments emerge (Dator, 2019).

The USA is a good example of a country using foresight in policymaking processes, illustrated by the fact that approximately 50 government departments have their foresight unit. The origin of foresight in the USA dates back to the early Cold War. Specifically, the emergence of foresight is often linked to the US RAND Corporation, whose goal continues to this day to identify the long-term evolution of weapon systems, but more recently also to research social and economic issues (Hines, 2019). Before the end of World War II, a systematic insight into the future was also practiced, but more in the form of extrapolation of past trends, or forecasting of individual trends or developments (Jemala, 2010).

The UK Government Office for Science (2021) mentions several specific policy benefits of foresight. Foresight deepens the knowledge of the drivers that influence a given problem or an area of policymaking. This makes it possible to develop analytical bases for policy proposals that take into account the wider context. Foresight can also contribute to building consensus among stakeholders, which might be crucial in case of some new laws, regulations and policy decisions. Foresight helps to identify the impacts of policy decisions, which can inform stakeholders early about the need to make concessions and compromises.

The focus of foresight is diverse and suitable for all thematic areas of policymaking. At the national level, it is particularly beneficial if studies are carried out in the policy areas, in

which future developments are highly uncertain (such as conflicts, social trends), where we might expert rapid development (such as technology innovation) or where it is necessary to establish consensus on visions and goals (such as sustainable development). Foresight is also highly relevant in areas that can pose major threats (cyber security, natural disasters), are vulnerable to development at the global level (migration, pandemics) or entail a high degree of complexity and interdependence, which is the case in most areas of policymaking (Government Office for Science, 2021).

At the local and regional level of policymaking, foresight can be used, for example, to inform the development of digital infrastructure, the municipal development regarding the future needs of public services or the development of urban and transportation infrastructure. Even more specifically, local representatives can be valuably informed by foresight about what the impacts of a construction of a zoo, swimming pool, or lookout tower would be, how many citizens would use a new public library in the first few years or how new artificial intelligence (AI) tools will affect the municipal budgets in the coming years and decades.

The policy impacts of foresight are difficult to measure, which is one of the reasons for the current inadequate use of foresight. The outcomes of foresight are usually long-term and indirect (influencing attitudes, strengthening awareness or improving policy dialogue), while also significantly influenced by the complexity of the social and political environment. In addition, identified trends may eventually evolve in a different direction because of the emergence of unexpected trend, technology, or a policy. Despite all of this, several examples of measurable and quantifiable positive impacts will be presented in the following chapters. In most of these cases, foresight studies helped to determine important policy decisions by not feeding directly into the individual policy proposals, but by improving the quality and accuracy of strategic materials that were used in the policymaking process.

2.2.2 Tool for strategic prioritization

Foresight is an important resource for strategic planning and prioritization in situations with limited resources on the level of national governments, but also regions and municipalities.

In general, strategic prioritization can be explained as happening on three levels - priority areas, strategic goals, and individual measures (Křikava et al., 2021). The process of prioritization requires the range of all problems to be narrowed down and the focus should be given to a limited number of priority areas, that are then explored and operationalized

with strategic goals and, on the lowest level, with individual suggested measures. Strong and coherent connections across all three levels of prioritization should be ensured.

All three tiers of prioritization must be thoroughly established in terms of institutional, methodological, and procedural aspects. It's also crucial to maintain principles of transparency, accountability, participation from stakeholders and opposition, as well as the enforceability of both positive and negative consequences. At the highest level, the prioritization should be determined by strategic foresight. Choosing the lower strategic goals to be accomplished within the priority areas is a task for governments and politicians. At the lowest level, the selection of specific measures aimed at achieving the strategic goals should be maximally rooted in evidence-based quantitative methods (Křikava et al., 2021)

To illustrate the practical process by which foresight improves national prioritization, I elaborate on the example of New Zealand. In New Zealand, the Cabinet Prioritization Committee oversees and coordinates especially the foresight process of defining priority areas and strategic goals. Based on strategic foresight studies, strategic goals are defined and coordinated across sectors, and the most relevant Cabinet Committee for each strategic goal is responsible for the coordination, implementation, and evaluation of these goals.

The strategies themselves, such as the Child and Youth Wellbeing Strategy (Programme of Action, 2019) are created truly cross-sectorally across ministries and coordination of their creation takes place in the relevant Cabinet Committee. The result is a complex strategy with precisely identified metrics (usually focused on maximizing well-being) and a clear division of responsibility for specific measures among individual ministries. At the lowest level, the selection of specific measures takes place within individual ministries. Each ministry, when designing specific measures, takes into account the obligations assigned to it in the strategies created by government committees for individual strategic objectives.

At the same time, the state budget is being created with regard to individual strategic goals. Since 2019, New Zealand has had a budgetary prioritization mechanism called the Wellbeing Budget (2019). The highest level of prioritization is omitted in this mechanism, but the mechanism directly approaches the two lower levels.

At the level of strategic goals, the primary aim is to maximize well-being, which will be assessed according to the metrics of The Living Standards Framework (2019). Five or six priorities with the greatest potential to achieve this goal are selected every year. At the lowest level, ministries must explicitly refer to their budget proposals on selected budget priorities and present how the desired investments in their agenda will benefit the priorities.

In practice, the New Zealand strategic prioritization mechanism still has some shortcomings and ambiguities. For our purpose, however, this process of using foresight outcomes in the consequent work on lower policy levels helps us to understand and highlight the importance of producing the best possible foresight outcomes, as they can influence the choice of priority areas that then trickle down to most parts of policymaking.

In the following two chapters, I will further explore the possible contents and narratives of such priority areas identified with national strategic foresight. For this purpose, I return to the initial definition of foresight and explore the two aspects that are claimed to be the main reasons for conducting strategic foresight - to anticipate risks and to identify opportunities.

2.2.3 Tool for increasing resilience

Foresight is an important tool used also for the purpose of increasing societal resilience and sustainability in democratic countries. In political science, resilience is the ability to cope with shocks and continue to function in the same way. It is a measure of how much an ecosystem, business, or society can change before it crosses a tipping point into a different state, where it then tends to remain (Walker, 2020).

The concept of resilience has seen a surge in its focus in academic literature in the last decades. Stockholm Resilience Center, for example, is a renowned research center for resilience and sustainability science at Stockholm University in Sweden. The center focuses particularly on socio-ecological resilience, where people and nature are studied as an integrated whole. The center provides advice to policymakers and industry on ecosystem management and long-term sustainable and fair development in Europe and elsewhere in the world. Among the most significant outputs of the center's activities is the concept of Planetary Boundaries (Rockström et al., 2009). The concept presents a total of nine boundaries within which future generations can develop and prosper.

The popular concept of Doughnut Economics, which elaborates on Planetary Boundaries, was defined in 2012 by Kate Raworth. Simply put, the concept can be understood as a compass for human prosperity in the 21st century, aiming to meet the needs of all people within the capabilities of the planet. It consists of two concentric circles, between which lies an environmentally safe and simultaneously socially fair operating space: 1) a social foundation that ensures that no one lacks basic life needs, and 2) an ecological ceiling that ensures that humanity does not collectively exceed the planetary boundaries that protect Earth's life-supporting systems (Raworth, 2009).

Resilience is important mainly for the ability to cope with crises. In the publication Just How Resilient are OECD and EU Countries, the authors focus on quantifying the resilience of member countries in the context of the COVID-19 pandemic (Schiller, 2021). Among other findings, the authors conclude that countries that are resilient and can quickly and effectively incorporate expert advice in policymaking usually respond more effectively to crises. Here, the role of foresight is mainly in helping in advance to prepare for various risks.

Many authors (e.g. Boyd et al. 2015; Muiderman et al. 2020) indeed emphasize that one of the key components of resilience is anticipatory governance. In order for a society to be resilient, it is essential to foresee possible crises and threats of the future. It is important for society to act preventive rather than reactively to problems. Only in such a case can society prepare and adapt to the future state so as not to be significantly changed by an external threat and to continue functioning in a similar manner.

Apart from foresight, two other important elements of the increasing of resilience are a network and a science-to-policy interface. Maintaining a functioning network of all relevant stakeholders is important for the efficient creation of policies while using scientific knowledge in policymaking helps to make decisions based on empirical evidence, which is a core aspect of a resilient society. Efficient knowledge transfer also increases the speed of response in crisis situations, making society more resilient.

Considering that increasing societal resilience is highly important for the sustainability of democratic societies and ultimately for the well-being of future generations, it is possible to use the optics of viewing foresight as one of the core tools for increasing resilience. An additional benefit of foresight is its suitability for citizen participation in policy, which is itself considered as a vital condition for sustainable democratic societies (OECD, 2020).

The synergies of foresight and participation (the use of participation in foresight, as well as the use of foresight in participation, usually conducted with the goal of increasing resilience) will be discussed in Chapter 2.6. Before that, however, I proceed to elaborate on two core capabilities of foresight - anticipating risks and identifying opportunities.

2.3 Anticipating risks

Conducting strategic foresight to anticipate risks, and therefore be able to more effectively prevent these risks, is a usual use case for foresight studies. According to the study by Stauffer et al., “policymaking is largely reactive rather than preventive (...). Too few resources are going into prevention and preparedness. Often, these measures are not only highly tractable but also significantly cheaper. Prevention becomes increasingly important

because of emerging threats with the potential for immediate global impact that could be too large to recover from at all (Stauffer et al., 2021).

In order to understand the practical benefits of this approach, the following chapter is dedicated to the discussion of a few relevant and successful examples of foresight studies in public policymaking that were identified in foreign countries. This is then complimented by a thorough description of a recent case study of strategic foresight in the Czech Republic.

2.3.1 International examples

In 2007, for example, the UK government's foresight unit, the Government Office for Science, issued a report titled “Tackling Obesities: Future Choices” (Butland, 2007). One of the key findings of the report was the risk of a continuously increasing rate of obesity across all age groups in the United Kingdom. If no effort is made to reduce obesity, the societal costs by 2050 are estimated to be nearly 50 billion pounds per year. In light of these findings, the Department of Health and Department of Children released a strategic document “Healthy weight, healthy lives: a cross-government strategy for England” (Department of Health, 2010). The strategy was backed by government investments of 372 million pounds for the period 2008-2011 to support, achieve, and maintain a healthy weight for people.

One of the interim evaluations concluded that the National Health Service´s (NHS) Change4Life campaign, for example, was designed based on the findings of the report. The results of the report were also used by the National Institute for Health and Care Excellence (NICE) in creating public health guidelines. Furthermore, the report influenced the activities of the Biotechnology and Biological Sciences Research Council; specifically, the report contributed to framing the council's strategic plan for the period 2010 to 2015. According to the interim evaluation's conclusions (Mid-term review, 2012), the report has an impact in many areas: within the government, healthcare, business, and academic sectors both in the UK and abroad, and particularly in raising awareness of obesity and setting public policy benchmarks in this area.

Another good practice example is the Foresight Future Flooding study carried out by the Government Office for Science in 2004 (Foresight Future Flooding, 2004). The study provided the scientific basis for the Pitt Review of flooding in 2007 (a document focusing on lessons to be learned from the mentioned floods). Thanks to the foresight study's findings, government spending was increased by an additional 300 million pounds (Johnston, 2012).

The study Mental Capital and Wellbeing (Foresight Mental Capital and Wellbeing, 2008), conducted by the UK Government Office for Science, served as an information basis for the

first strategy focused on mental health, New Horizons: Towards a shared vision for mental health, aimed to limit the expected increase in the prevalence of mental health issues in the UK, among other goals. The strategy was overseen by the Department of Health, which falls under The National Health Service.

On top of these practical cases, it is also important to mention existing philosophical arguments for foresight as a tool to anticipate large, even existential risks for nations and for humanity. These views are often connected with the concept of longtermism, which was recently popularized by the associate professor in philosophy at the University of Oxford William MacAskill in his book What We Owe The Future (2022). Longtermism is based on the ideas that future people have moral worth, there could be very large numbers of future people, and that what we do today can affect how well or poorly their lives develop in the distant future. (MacAskill, 2022).

Mainly outside of academia, longtermism has been recently argued against by some experts. Main arguments against longtermism usually say that the expected lifespan of humanity might not be extensive and that it is very difficult to know if we're positively affecting the far future, while even if we do, our individual probability of making a significant positive impact on the far future may be very small. Another argument claims that our tendency to discount the future and have a greater concern for the present is not necessarily a mistake, especially if the objective moral truth doesn't exist (Greenberg, 2023).

For the purpose of this chapter, it is important that some authors recently attempt to mitigate this discussion by showing that the case for preventing catastrophe does not depend on long-termism. In the recent study “How much should governments pay to prevent catastrophes?”, authors propose that governments should invest more resources in preventing catastrophic events and prioritize catastrophic risks in their efforts to achieve a sustainable future. They claim that "Preventing catastrophic events is a key part of the government's responsibility to protect their citizens from harm" (Shulman, Thornley, 2023).

There are many types of catastrophic risks, including natural disasters, pandemics, nuclear war, and climate change. governments should, according to the authors, invest in preventing all types of catastrophic risks, rather than focusing on a single area. The authors propose that governments should spend around 1% of their GDP on catastrophic risk prevention and adopt a long-term foresight approach to such risks. This approach would “involve taking a long-term perspective and investing in preventive measures that may not yield immediate benefits, but that will be crucial in averting catastrophic events in the future” (Shulman, Thornley, 2023).

2.3.2 Case study - Czech Republic 2030

The strategic framework “ČR 2030” is a pivotal document of the Czech public administration. It is a conceptual document that builds on the Sustainable Development Goals (SDGs) formulated at the UN Summit in New York in 2015 (UN, 2023). It adapts these SDGs to the Czech context, outlining the main long-term development priorities for the Czech Republic up to 2030. These priorities are intended to be considered in all sectoral policies of the Czech public administration. The achievement of these set goals should enhance the quality of life in all regions of the Czech Republic through the integration of social, economic, and environmental sustainability (ČR 2030, 2023).

In 2022 and 2023, The Department of the Sustainable Development of the Ministry of the Environment of the Czech Republic, in collaboration with the non-profit research organization České priority conducted a foresight study “Socio-climatic scenarios of the Czech development” (České priority, 2023) identifying new emerging risks, that should be taken into account in the updated version of the national strategic framework “ČR 2030”.

In this foresight study aimed mainly at identifying climate-related and sociocultural risks to strategically prepare for, it was necessary to reflect on the series of events that have significantly disrupted the Czech society since 2017, when the first version of ČR 2030 was published, such as the COVID-19 pandemic, economic recession, record inflation, housing shortages, the Russian invasion of Ukraine, and ongoing environmental degradation.

The foresight study consisted of two parts. The first part called “future-proofing” focused on the assessment of the relevance of the original goals of the ČR 2030 to determine whether they remain relevant and adequate to the serious risks that society is facing and will continue to face in the coming decades. The second part called “blind spots” was focused on the identification of possible future trends that the original document did not cover, in order to include them in the update and enhance the comprehensiveness of the document. The public release of the updated ČR 2030 document is planned for July 2023.

In the foresight study, Shared Socioeconomic Pathways, specifically their European contextualization (hereafter EUR-SSPs) developed by Kok et al. (2019) were used. EUR-SSPs are four scenarios describing key elements of the future in 2050. Unlike other widely used models of the growth of global temperature, these scenarios also focus on societal aspects of sustainable transition, especially in relation to the societal impacts of adaptation and mitigation measures to combat climate change and biodiversity loss. These four scenarios were developed based on a broad consultation of experts and forecasters,

who formulated possible development directions and consolidated simplified narratives for each of them.

The four scenarios are mainly defined by their differences in terms of inequality and carbon intensity. The first scenario (We are the World) represents a sustainable future with global cooperation and a less environmentally demanding lifestyle. The second scenario (Icarus) depicts a future in which European countries strive to maintain a high carbon-intensity standard of living. In the third scenario (Riders on the Storm), most power is concentrated in the hands of a small elite, and Europe is an increasingly important global player. Finally, the fourth scenario (Fossil-fuelled Development) represents a world in which a lack of interest in the environment is replaced by technological solutions aimed at ensuring economic and social development, requiring excessive use of fossil fuel resources (Kok et al., 2019).

The foresight study was based on a dialogue between representatives of the expert public and public administration. When approaching experts, consideration was given to covering a wide range of disciplines, and the aim was to involve representatives of public administration across departments. A total of 46 experts participated in at least one of the three workshops conducted as part of the foresight study.

The goal of the first two workshops was to identify the blind spots of the ČR 2030 and the challenges and opportunities for achieving Sustainable Development Goals arising from them. The Backcasting method was selected as a proper foresight method for this purpose. The first and the second workshops were identical, differing only in their form (in-person and online) so that people from abroad or those with poor accessibility to the venue could also get involved. Participants were initially divided into four groups, in which they were asked to discuss one individual EUR-SSP scenario. The discussion was framed by the main guiding question: “What assumptions and influences (threats, risks, opportunities, or challenges) can lead to the fulfillment of the presented elements of the EUR-SSPs?”

Threats, risks, opportunities and challenges identified by respondents during workshops were subsequently grouped according to individual key areas of the ČR 2030 document. In collaboration with the key area managers, these challenges were compared with the existing specific goals of the ČR 2030, leading to the identification of topics that the current document does not address. The resulting 60 blind spots were divided according to the key areas to which they thematically belonged, along with a list of threats and opportunities identified during the workshops. At the third workshop, these 60 blind spots were introduced to the participants. This workshop was attended exclusively by public administration representatives because its goal was to assess the relevance of the identified blind spots and current goals for the needs of public policy.

For each of the four EUR-SSP scenarios, participants discussed the conditions that would have to be met for these scenarios to be realized by 2050. These conditions can be seen as drivers of change on a global level. The scenarios were explained not to be predictions of the future, but rather descriptions of different variants of possible developments. This allows for the identification of important drivers of change and conditions for the effective mitigation of risks and realization of opportunities in given scenarios.

The quality of the education system, the degree of societal polarization and conflict, and demographic changes in the context of an aging population were identified as significant factors of change. Technological development was also considered a key factor in future changes in every scenario, the impacts of which are currently quite uncertain, and may represent both risks and opportunities. In the field of economy, the future development of globalization and international trade, and the localization of production capacities were identified as the main factors as well as uncertainties.

Environmental topics discussed across all scenarios related to resource extraction and the carbon intensity of energy production. In the field of geopolitics and governance, the main factors of future changes were related to the development of current conflicts in the EU's neighborhood and the possibilities of its dissolution (České priority, 2023).

The outputs of this foresight process can be perceived as a good example of the use of strategic foresight for the purpose of anticipating risks presented by various possible future developments. The new version of the ČR 2030 document is expected to continue serving as a strategic framework for all thematic and sectoral strategies that will be developed in the Czech Republic in the coming years and decades, effectively limiting the possibility of any of these consequent strategies to omit or disregard important and foreseeable risks.

2.4 Identifying opportunities

Using strategic foresight to identify future opportunities in order to become better prepared to take advantage of these opportunities as a nation, society, institution or even an individual is a different use case of foresight communicated using a different narrative. The appropriate methods of foresight are not necessarily different from the methods used to anticipate risks, but the discussion and deliberation of participants is framed differently. The following international examples and a Czech case study illustrate the practical benefits of using this approach to strategic foresight in public policy.

2.4.1 International examples

Foresight can be used to identify opportunities on various levels of public policy. On a practical level, it is worth mentioning the foresight study Future of Work: Jobs and Skills in 2030, conducted by the UK Commission for Employment and Skills in 2014. According to Rhisiart et al. (2017), its impact two years after the project concluded, the results of this foresight study were used, for example, by an intergovernmental group focused on the future of work, which falls under the Department of Work and Pension and focuses on the development and design of government work and services. The results of this study were also incorporated into EU Commission initiatives focused on leading skills in the field of digital technologies and into the EU foresight on future issues of safety and health at work.

In Wales, foresight was used as early as 1993, when the think-tank Institute for Welsh Affairs organized the project Wales 2010: Creating our future. The goal was to answer the question “What should we, the people of Wales, do to make Wales one of the most prosperous regions of the world, Europe by 2010?” The resulting report created more of a platform than a plan, and included a set of recommendations and areas of activity to realize the vision. Seven years after the report was published, the Entrepreneurship Action Plan for Wales was created, representing the first strategic framework for entrepreneurship in Europe, coordinated at the government level but implemented at the local level.

The specific impacts on businesses in Wales based on this framework are summarized by Rhisiart and Jones-Evans (2015). They argue that, according to data from the UK's National Statistical Office, the number of newly established companies in the period 2002-2005 increased by 21% compared to 13% in the United Kom. Even more importantly, in western Wales and the valleys, where the aforementioned programs were specifically targeted, there was an increase of 24%. As for the impact on the entire population, the number of companies per capita also increased by 18% compared to 9% in the United Kingdom, and during this period the proportion of new companies in the total number of companies also increased.

On a more abstract level, a few interesting examples of long-term national strategies have been recently discussed in the international foresight community. Before delving into these examples in order to illustrate the importance of foresight in creating national visions, it is important to note that there is currently no rigorous methodology available in the academic literature for developing a national vision.

One example of a successful vision based on a successful anticipation of a future trend in a democratic country is Estonia. In 1996, Estonia set “digitalization” as its priority, coining the

term “e-Estonia”. Estonia's progress is primarily the success of a national long-term strategy focused on the digitalization of the state, rather than the result of individual government regulations or programs. Following the collapse of the USSR, the state lacked sufficient resources and means to build an efficient state infrastructure, making the path to digitalization a potentially cost-effective solution.

However, the development of the subsequent digitalization initiative likely did not arise from any individual written document or a rigorous strategic process. Hence, Estonia's development can be characterized as a development-driven strategy rather than strategy-driven development. The complete turnover of the political establishment after Estonian independence also allowed an influx of young and liberal politicians oriented towards the future and the West.

In 1996, the Tiger Leap project was introduced, in which the state was to massively invest in education, the development, and the expansion of the computer network. By 2000, all school classrooms had access to a computer and all educational institutions were online. The state also provided training and educational materials for computer use for free.

In 2000, the public was first introduced to the prototype of the X-Road software (Open software that allows organizations to exchange information over the internet), which forms the basis of e-Estonia. In 2002, e-IDs with digital signatures were introduced, allowing online voting, tax returns submission, and access to banking, or health records. The system is now backed up in Luxembourg with diplomatic protection.

Massive cyber attacks on Estonia in 2007 highlighted the potential fragility of modern technologies. Thanks to its experience, Estonia became the home of the NATO Cooperative Cyber Defence Center of Excellence (NATO CCD COE), whose aim is to strengthen cooperation, information sharing, and capabilities regarding cyber protection. It also researches and develops these across member states and partners. In 2012, the Proge Tiger program was created, aimed at increasing interest in new technologies in education.

In 2014, the e-Residency program was launched, which allows for a fee of 100 euros to establish a company in Estonia without the need to visit the country and with the possibility of submitting a tax return online. Estonia is thus attracting companies from all over the world and ensuring the necessary influx of money into its economy, which would otherwise be weakened by an aging population. Since its launch, more than 50,000 individuals and companies have enrolled in the program. Estonia also offers excellent wage compensation for technology workers, further ensuring the inflow of quality foreign workers.

Recently, the Digital Nomad Visa program was launched, which allows workers from all over the world to legally work in Estonia. In October 2021, the government approved the Estonian Digital Society Development Plan until 2030 (Estonian's digital agenda, 2030). This plan includes a vision and action plan aimed at developing the Estonian economy with the help of technology by 2030. The plan will be implemented as part of the digital society program. It is updated every year along with the budget strategy.

The main success factors of the Estonian e-revolution have been continuity, cooperation, and reciprocity. The vision of a digital state has been supported by all governments since the 1990s, and the private sector and academia have been involved in addition to governments. It has enabled citizens to access their personal data remotely and actively engage in projects designed to educate them about digitalization.

For example, around 10% of the population has participated in the training of computer skills in the past. Estonian president Toomas Hendrik Ilves (2006 - 2016) was an important proponent of this vision, often publicly claiming that “you cannot bribe a computer” (Roonemaa, 2017), for example. As of today, the e-Residency program, for example, is still attracting many companies from abroad to the country and Estonia is providing its digital solutions to other countries.

Another interesting example is the case of Spain. Since 2020, Spain has had a foresight unit called the National Office of Prospective and Strategy; a directorate general of the prime minister's office, responsible for analyzing the challenges and opportunities that Spain will face in the coming decades, and preparing for them. In 2022, one hundred independent experts from various fields, under the coordination of this central foresight unit, prepared the strategic document Spain 2050 (2022).

It is a 700-page document that provides guidance on how to approach the most advanced European countries in key metrics of social well-being, based on a mapping of European and Spanish social trends. The key goals of this vision are to improve understanding of the social, economic, and environmental challenges and opportunities that Spain will face, and through dialogue among multiple stakeholders, to create a long-term national strategy that will allow setting priorities, coordinating efforts, and ensuring prosperity and well-being of our citizens in the future.

The strategy was mainly presented and communicated by Prime Minister Pedro Sánchez. Maroš Šefčovič, Vice President for Interinstitutional Relations and Foresight, also commented on the creation of the document. In his speech, he primarily highlighted the

strategy's focus on education and retraining of the population, which will contribute to fulfilling plans for a greener, digital, and resilient Europe (Ševčovič, 2021). He further described Spain 2050 as a significant contribution to European foresight efforts and an example that other EU countries should follow.

The strategy identifies 9 major challenges that Spain should deal with by 2050 and then elaborates on specific measures to achieve this. The creation process consisted of two phases - Scenario-building and Backcasting. In the first phase, a range of potential future scenarios was created, which can serve as a basis for reflection. These scenarios are not predictive, but rather descriptive. Their creation examined the development of major demographic, social, economic, technological, environmental, and institutional trends in Spain and Europe. Subsequently, their possible development was created using qualitative and quantitative foresight techniques. In the second phase, using the Backcasting method, a realistic roadmap was created, containing 50 specific goals and more than 200 specific measures to guide Spain into the desired scenario.

An inspiring vision is currently being developed in Lithuania. In 2021, the Government's Strategic Analysis Unit began work on the 2050 Vision, which is intended to define a vision of Lithuania's progress, the country's development directions, social changes, economic changes, or indicators of the state of the environment. This vision differs from the first two mentioned above in that it has significantly more citizen involvement in its elaboration. Approximately 5% of the Lithuanian population should be involved in its development (Trainauskienė, 2022).

2.4.2 Case study - FutuRIS Prague

In the Czech Republic, The Prague Innovation Institute (PII) in 2022 contracted the non-profit research organization České priority in cooperation with the Technological Center of the Academy of Sciences (TC AV) to conduct a 6 month long foresight project called FutuRIS (2022). The goal of this project was set to identify the upcoming international trends that could represent opportunities for the ecosystem of innovation and technological development in Prague.

The reasoning behind the project was that early public support directed to local start-ups, private companies, or R&I institutions in the sectors that are most likely to be influenced by these future trends could help them to become leading experts or develop better commercial products. Ultimately, this could be a very effective strategy to attract foreign

investment or intelligence and ultimately to increase the economic prosperity and well-being of the citizens of Prague and the Czech Republic.

For the purpose of mutual learning, the study was designed in a co-creative manner together with PII and it consisted of Desk research and the Scenario Planning foresight method (more in chapter 3.2.1) in the form of expert deliberation during two online workshops. The first workshop focused on the formulation of alternative scenarios for the future development of Prague's innovation ecosystem, taking into account the possible impacts of global megatrends and creating desirable cross-cutting scenarios. In the second workshop, based on these scenarios, participating experts discussed mainly opportunities but also risks for Prague's future development, and then identified the instruments with the greatest potential for the effective development of Prague as an innovation hub and for strengthening Prague's innovation ecosystem." (FutuRIS, 2022).

During the project, both the researchers and the expert participants in the workshops gradually shifted their attention towards discussing possible practical interventions that could enable the very existence of a functioning innovation ecosystem, rather than staying focused only on the discussion of future global trends. Given the timing and setup of the project, this appeared to be a reasonable shift, producing more actionable outputs that were considered by the representatives of PII as very valuable. The final study was publicly communicated on multiple occasions, it is published in full version online (FutuRIS, 2022) and it has so far been used in the development of multiple consequent strategies.

One aspect that was likely highly influential on the quality of the results, was the ability to motivate prominent experts from multiple sectors of innovation and R&I to participate in the workshops without remuneration. This was done mainly by actively involving the Mayor of Prague and by communicating the commitment of PII to carry out an actual allocation of funding to the areas that will be identified by the project as most promising from the perspective of valorization of the public support into the future benefits for citizens.

Two main limitations of this project were the great scope of possible future trends, which made it difficult to carry a deep conversation during the limited time of the workshops, and the difficulty to reach a consensus on the prioritization of trends, which was mainly caused by the complexity and the interconnectedness of the problems. The effect of these limitations was down-scaled by a notable investment into additional desk research, but in the future iterations of similar projects, it could be more effectively mitigated if the project had a longer time span and if the budget of the project would allow to pay for the time of the experts and to implement even more advanced methods for reaching a consensus.

Overall, the design of the project and the final study was in accordance with the academic literature, which will be discussed in more detail in the following chapter, as well as with the international methodological guides and practical reports. As such, it can serve as an example of a foresight study contracted by a public institution aiming to identify future opportunities to effectively increase the well-being and prosperity of the general public.

2.5 Foresight methods and the role of participation

To abstract away from the previous practical examples, foresight offers a wide range of qualitative and quantitative methods characterized by varying degrees of expertise, creativity, or interaction. A well-conducted foresight study often requires a combination of multiple methods, as they complement each other, allow for the inclusion of different perspectives and increase the efficiency of the foresight process and the quality of the results. From the perspective of policymaking, the need for making the foresight process as efficient as possible is being voiced for example by the European Commission (2022).

Choosing the right methods for given purposes and goals can have fundamental impacts on the quality of the outcomes of the foresight study, while it is difficult without a deep expert understanding of the benefits and limitations of individual methods. The understanding of individual methods and the process in which they are often utilized should, therefore, be at the foundation of any further research regarding the improvement of foresight.

Previous chapters highlighted that most foresight methods to a notable extent rely on the aggregation of collective intelligence, which requires the participation of groups of experts or citizens. It also highlighted a different view, that public participation in policy is important for the resilience of the society or the ability of maintaining long-term priorities for public funding, and that foresight is a tool that can be used to effectively frame such participation.

Before I proceed to the third chapter to explore the individual methods of foresight and the actual use of wider participation in each of those methods to get even more nuanced understanding of the frequency, quality and usefulness of participation in foresight, it is vital to define the conceptual terms and elaborate on the difference between Participation and Deliberation, as they are often confused or mistakenly interchanged in literature.

2.6 Participation and deliberation

According to OECD, “Citizen and stakeholder participation is at the very heart of the concept of open government. The participation of the governed in the ruling exercise is a fundamental value of modern democratic societies” (OECD, 2022). Although the concepts of Participation and Deliberation have a common interest in involving groups of participants in decision-making processes, they entail substantial differences.

Participation tends to target large, usually not pre-selected groups of citizens or participants, with the aim of achieving breadth (Carson & Elstub, 2019, 1). It is usually used to provide an opportunity to involve citizens in decision-making (e.g. through voting, filling in questionnaires, etc.). Participants are not expected to have any specific expertise, quality of input, or amount of time to devote to their involvement. Examples of public participation include voting, submitting proposals or suggestions, and participating in surveys, or participatory budgets.

The goals of public participation can, according to the Spectrum of Public Participation (IAP2, 2007) range from informing and consulting citizens all the way to involving and empowering citizens, depending on the specific policy situation. The concept of participation can also be further subdivided into public participation (public involvement organized “top-down”, funded by public resources), civic participation (i.e. citizen initiatives organized “bottom-up”, often funded by donations and grants), and political participation such as elections, referendums, protests or strikes (Plichtová and Šestáková, 2020, 8).

In this study, I explore the use of public participation, which is the process of involving public actors without a direct political mandate in public decision-making. It can occur on an international, national, regional, local, or even community level. The issue of public participation is addressed to varying degrees by different academic disciplines such as political science, law, sociology, social ecology, public administration (...) or urban planning'' (Haken, et al., 2016, 23).

Deliberation tends to target smaller groups of participants and their active involvement is expected. In contrast to participation, pre-selected groups of participants or representative samples of the population are often used (Lodewijckx, 2020). The aim of deliberation is, for example, to facilitate complex, semi-structured discussions and debates between citizens

and other actors, during which participants consider different perspectives on the problem in light of data, explain their own values, and attempt to reach a compromise (OECD, 2021).

The main barrier to organizing a successful public deliberation is the complexity of the process, which also makes it difficult to facilitate deliberation online. While most online tools currently serve to facilitate public participation, deliberation requires more intensive engagement in group decision-making debates, which are more difficult to motivate citizens to engage in, and more difficult to scale up to sufficiently large group or population samples, but the venues to advance in this direction are being actively explored (Data Justice Lab, 2021).

The academic study of public deliberation is focused on by the Center for Public Deliberation at Colorado State University or The Deliberative Democracy Hub at Stanford University, among many other institutions. The recent OECD publication “Innovative citizen participation and new democratic institutions” suggests that the use of public deliberation is beneficial when dealing with value issues, complex issues that require trade-offs, and long-term issues that go beyond a given electoral period. In contrast, deliberation is not a viable substitute for public elections, in cases requiring urgent decisions, in national security issues or in problems with limited options for resolution (Peña-López, 2020).

3. Mapping the use of participation in foresight

According to UNDP (2018), participation is one of the most important aspects of foresight. “Foresight accepts and welcomes the fact that in uncertain and complex environments, relevant knowledge is distributed in the wider system, as opposed to being centralized in technocratic or academic settings. Foresight depends on the participation of a broad range of cognitive perspectives and the effective use of collective intelligence.” (UNDP, 2018, 14).

To explore this observation systematically, I conducted a literature review of the most frequently cited methods foresight to analyze, how many of them include wide public participation aspects, and how many rely on more systematic deliberation of a smaller group of participants. In the review of each of the methods, I also note which other methods it can be combined with.

To structure the following review, I use an UAP foresight framework (České priority, 2022, 42) clustering the methods according to three main purposes in foresight - Understanding, Anticipation, and Planning (alternatively can be labeled as Perceiving, Predicting and Planning). These are also the three main recommended phases to conduct during a fully-fledged foresight study. Similar phases are suggested, for example, by Voros (2003). For each method, I conclude, whether it is mostly based on Statistical, Deliberative or Participative aspects.

3.1 Understanding phase of foresight

Horizon scanning is a frequently used method in this initial phase of foresight. It draws on academic resources as well as project reports or media articles and other resources from the internet, and aims to identify potentially important signals, trends, and drivers through a systematic examination of threats and challenges.

Text analysis (or Text mining) can identify important yet still weakly included trends in the scientific discourse. These can be visualized in causal diagrams or other visualizations of possible impacts and its implications, to be uses in the following phases. Desk research is another standard method for the primary identification of weak signals of change, that currently appear irrelevant but may be important in determining early signals of change.

Other methods directly focus on deliberation. Delphi method is an advanced variation of an expert panel, which relies on the expertise of the participants while using an iterative process of brainstorming. It is usually conducted in multiple rounds of deliberation aimed at building consensus. This method is often used in the following phases of foresight as well. In general, information obtained in this phase are often used for the development of strategic objectives.

3.1.1 Horizon scanning

Horizon scanning aims to better understand the nature and pace of change and to identify indications of future opportunities, threats, and likely developments. The aim of the research by Flick et al. (2020), for example, was to explore the challenges and opportunities of ICT in health and aging. Their approach to Horizon scanning was based on interviews and analysis of literature and policy documents. The authors identified weak signals of change in technology, companies, the general environment of everyday life (smart homes), and the lives of older people.

This method often combines desk research and collective deliberation. The initial information is usually gathered in the initial desk research and followed by a sense-making process. There, the information is discussed and systematized in more detail, by asking questions such as “What do we think we know (known knowns)?”, or “What do we need to know (known unknowns)?” This can be done by individual analysts or by the use of deliberative methods such as Delphi or an expert panel. This analysis is usually conducted within a STEEP (Social, Technological, Economic, Environmental, and Political factors) framework (Markley, 2011). Over all, this method is mostly based on analytical work, but can be strengthened by deliberation. Visioning or scenario planning can be performed based on the information obtained.

3.1.2 Text analysis

The objective of text analysis is to uncover trends, significant occurrences, or other insights from vast quantities of data through the use of computational software. For instance, Rosa et. al (2021) presented a novel variation of text analysis, emphasizing the application of thematic modeling for carrying out a comparative examination to assess how forecasts from citizens vary from those of other institutions. Text analysis serves as a valuable addition and means of comparison to more qualitative approaches, and does not involve any deliberation of participation.

3.1.3 Desk research

Desk research, or secondary research, refers to the process of collecting and analyzing already available information and datasets. The main objective of this method is to describe and understand the current state of the system. The Government Report on the Future, published by the Finnish government (Government Report on the Future, 2017), aimed to answer questions about the future of work and its implications using desk research. The outputs from the research were then compiled by a group of experts and further discussed in 40 workshops and seminars.

This method is not based on participative or deliberative approaches, as it is primarily carried out by searching for articles, datasets, or periodicals in an online environment. The systematic collection of information can be supported by STEEP which ensures that all relevant disciplinary perspectives are covered. The outputs from desk research usually have a form of a report including graphs, and tables, serving primarily as an input to other foresight methods. Even though the collection of online resources can be done, in theory, using a wide-scale participation, I have not found examples of this approach being used in the foresight literature.

3.1.4 Delphi

Delphi is a deliberative, iterative and usually anonymous consultative process conducted in multiple rounds to achieve "convergence of opinion concerning real-world knowledge solicited from experts within certain topic areas." (Hsu and Sandford, 2007). Lintonen et al. (2014), for example, used Delphi to predict drug use in Finland by 2020. Drug experts from Finland and the EU national network came to a consensus, that Finnish society will have to prepare for an increase in demand for drug-related care.

Participants should be familiar with the topic of the study in advance. Consultations in Delphi are usually conducted online. After aggregating the insights from individuals in the first round, feedback is collected in the second round and respondents can adjust their ratings depending on this feedback. The UK Government Office for Science (2017), for example, suggests a five-step process in a Delphi: Establishing an objective, Formulating a claim, Identifying essential claims, Evaluating the most important ideas, and finally Reviewing the ranking and prioritizing outcomes (UK Government Office for Science, 2017).

As I claimed earlier, “The identification of the experts who will participate in Delphi is an important element” (2022). Therefore, Delphi should be viewed as a deliberative method rather than a method of public participation. The outcomes of this method are a suitable input to the Futures wheel method, which examines the impacts of selected issues. Delphi can also be built upon by creating scenarios.

3.2 Anticipation phase of foresight

Anticipation of the future involves a structured imagination of possible and plausible future developments, based on the information gathered in the previous phase. In this step, it is important to consider the wider context of possible changes.

Scenario planning is one of the methods used in this phase. It aims to develop a view of how different conditions could support or constrain the implementation of policies and strategic objectives. Three horizons method has a similar goal, while exploring the current development (1st horizon), potentially disruptive innovations (2nd horizon) and the emerging future trends (3rd horizon). Both methods are usually conducted through workshops, but can also be created through role-play simulations, where participants interact through predetermined specific roles.

Visioning collects input on desirable future developments, usually through workshops. This type of method can involve the wider public and consult their visions for the future, as was the case. for example, in the CIMULACT project (2016). Creative variations can include prototyping or creating future artifacts (e.g. news or art pieces).

Cross-impact analysis originally arose from the need for interaction between forecasts. Its aim is to examine the relationships between each identified series of factors in a particular environment. This method is often used in conjunction with the Delphi method. The Futures wheel is a form of structured collective brainstorming used for detailed mapping of foreseeable impacts of various trends in the form of mind maps.

Judgmental forecasting is a method, that combines multiple incentives to effectively harnesses collective intelligence about the possible future development of specific events or indicators. This method is especially useful in cases, where there is not enough data or historical precedent. To make specific predictions when enough data is available, more

quantitative modeling and simulation approaches using mathematical models to mimic real-world processes can be used.

3.2.1 Scenario planning

Scenarios can be defined as specific stories that describe how the future may unfold. The aim is to take into account several variants of future developments. European Commission (Directorate-General for Research and Innovation, 2022), for example, aimed to map the scale of change that the Covid-19 pandemic may bring to the context of the EU research and innovation policy. Five scenarios were proposed by the Horizon Europe Network as a result of a process involving Scenario planning, Horizon scanning, and online workshops.

A combination of deliberative workshops and complementary research to support the scenarios is usually used. In most cases, it is preferable that the outcomes from Horizon scanning enter the creation of Scenarios. The scenario planning method can make use of existing matrices of the evolution of different drivers (Kahnali et al. 2022). The scenarios should be concise, coherent, plausible, and clearly differentiated. Scenarios can be followed up by the method of Backcasting or Wind tunneling. This can be classified as a deliberative method with the potential for wider participation.

3.2.2 Three horizons

The Three horizons method looks at how might various scenarios evolve in the future. The value of this method lies in the distinction between the current pace of development (1st horizon), potentially disruptive innovations (2nd horizon), and emerging future trends (3rd horizon). Jordan (2021), for example, has used this method to explore the future development of military aviation, in order to understand and describe the process of ongoing changes in this field related to the technological advances associated with the Fourth Industrial Revolution.

This method is usually approached through participatory methods: workshops, expert panels, or Delphi (SOIF, 2019). The output of the process is a visual map illustrating the evolution and interplay of the observed drivers and it can be useful for identifying investment opportunities. Visioning or Scenario planning can usually be combined with it, while it should be followed up by identifying impacts using the Futures wheel method or Wind tunneling method to formulate relevant strategic recommendations. Similar to Scenario planning, Three horizons is a deliberative method with the potential for wider participation.

3.2.3 Visioning

Visioning is a process used to prioritize objectives and to agree on the directions of future developments. The method gives respondents the opportunity to indicate what a desirable or undesirable future looks like. The CIMULACT project (2016), for example, contributed to the relevance of European research and innovation by involving citizens and experts. Respondents used their everyday life experiences and imagination to formulate their wishes for desirable changes and a sustainable future. Thirty countries (including the Czech Republic) were involved, with a full-day workshop in each country where participants debated their visions for the future.

The method provides a high degree of flexibility in the form in which it is facilitated. The results can be achieved through deliberation using workshops or expert panels, or through wider participation such as questionnaires or surveys. It can be categorized as a participatory method, that can be used to validate and discuss specific policy measures or proposed strategies, or to provide a space for citizens to share visions, for example, about the future of their city.

The outcome of visioning often consists of shared aspirations about the future - visions of what should be achieved as soon as possible and what can be postponed. Identifying shared visions serves to build consensus among relevant stakeholders on what is to be achieved. This method should be followed up in the next phase with Scenario planning, Backcasting, or Road mapping.

3.2.4 Cross-impact analysis

Cross-impact analysis is an analytical approach used to estimate the interaction of a set of events. The aim is to determine how the occurrence of one event will affect the occurrence of other events. The aim of the study by Panula-Ontto et al. (2018), for example, was to map the important drivers of change over the period 2017-2030 in electricity consumption in Finland. Many inputs and estimations were collected during workshops, panel discussions, or individual expert work, and then analyzed using computer-based cross-impact calculations.

This method has a relatively prescriptive procedure. The events, impacts, or hypotheses that were identified in the prior Futures wheel, Delphi, or Desk research, should enter the analysis. An important next step is to determine the evaluation scale, such as -5 to +5

indicating weakening or strengthening between variables. Respondents are then asked “To what extent does the occurrence of event A affect the occurrence of event B?” or vice versa. The output is a matrix indicating the events or aspects that interact most and, therefore, should receive more attention.

The output of this method is a valuable resource for prioritization or as an input to additional modeling or deliberation of experts and stakeholders in panels or in a Delphi. Cross-impact analysis can be categorized as a combination of Statistical and Deliberative methods, with a potential for wider public participation in the process of estimating the strengths of the impacts.

3.2.5 Futures wheel

Futures wheel illustrates, how major events or trends may impact the area or policy under study, usually resulting in mind maps. Defila et al. (2018), for example, used this method in analyzing the future of energy policy from the perspective of consumers. The aim was to find out how consumers perceive potential changes and what impacts can various changes have on their lives.

As the Futures wheel is a form of a structured brainstorming exercise, it is appropriate to use deliberative approaches such as a workshop, expert panel, or Delphi. Scenarios can be used as a basis for the deliberation using this method. The main facilitation question to be posed while using this method is “If the situation occurs, what will happen next?” This leads participants to think about both the positive and negative immediate impacts of the situation. Consequently, participants are asked to consider second-order or even third-order impacts (SOIF, 2019). The deliberation can also consider questions such as “Who are the key stakeholders who can best address these impacts?” or “What needs to be done in the short vs. long term?”.

The output of this method is usually a structured list of estimated direct and indirect consequences of given events or trends, as well as ideas on which stakeholders do what in order to utilize potential opportunities or mitigate identified risks. The futures wheel is a deliberative method and it can be a useful tool for adjusting policy proposals or strategic decisions.

3.2.6 Judgmental forecasting

Forecasting through collective intelligence, known as judgmental forecasting, involves making educated predictions about specific events or future development indicators. An example of this method's application includes informing the US Intelligence Community about the potential for conflict in the South China Sea in the coming years (Page, Barker, 2021). Judgmental forecasting is especially beneficial when modeling is impossible due to insufficient data or problem complexity that exceeds the capabilities of existing statistical models. Nevertheless, this method can complement other foresight techniques.

To ensure effective collaboration among participants and generate accurate estimates and supporting arguments, judgmental forecasting employs financial and social incentives. A common form of this approach is forecasting tournaments, which utilize a mix of monetary and non-monetary rewards to facilitate the efficient gathering of high-quality estimates. These tournaments usually last for weeks or months and take place on specially designed online platforms.

During the tournament, participants submit, edit, and comment on their predictions in real-time, enabling communication and information-sharing among them. This interactive nature offers an additional advantage to the judgmental forecasting method. In order to increase the quality of future outputs, it is important that the group of participants is as large as possible to reduce information noise (Kahneman et al, 2021), and that it is as diverse as possible (expertise, gender, age, etc.) to minimize the risk of cognitive biases (Kahneman et al, 1982; Tetlock, 2009).

The outputs are usually probabilistic, numerical, and verbal predictions. They can be used in a consequent Delphi or methods from the Planning phase, but the predictions can also be used directly in policymaking or in strategic prioritization. For many people, the current processes and tools used for judgmental forecasting are not fully intuitive and must be explained prior to participation, but the online nature of this method allows for wide participation, and there are ongoing attempts to make forecasting more attractive and accessible. Therefore, this method can be categorized as a deliberative method with a notable potential for wider participation.

3.2.7 Modelling and Simulations

Modelling and simulation (also referred to as forecasting or extrapolation) are processes of creating and experimenting with mathematical models that mimic the behavior of a real process or system over time. Gössling and Peeters (2015), for example, used a mathematical model to estimate how the rate of natural resource use in tourism will evolve up to 2050.

This method depends primarily on the collection of quantitative data and its processing with appropriate computer software. In cases when optimal (available, usable, and reliable) data relevant to the objectives of the study cannot be found, it is advised to choose another foresight method. After modeling, the results are compared with reality and with other predictions. The outputs are specific numerical predictions of future developments. Simulations can provide useful inputs to Scenario planning, as they can illustrate how the system would evolve based on the established indicators. This is a purely statistical method and does not require deliberation.

3.3 Planning phase of foresight

In the planning phase, it is necessary to work with the information gathered, in order to develop policies or regulations to be implemented. Wind tunneling is a method, that improves the understanding of how various decisions or proposals would perform in different scenarios. As such, this method should be conducted after the development of scenarios using Scenario planning. Backcasting is a method, that can be used to better visualize how the present state of affairs can be linked to possible future developments. This method is based on setting a desired goal and then identifying the potential paths that will need to be followed to achieve it.

Roadmapping, on the other hand, is a method of collecting, synthesizing, and verifying information, which is then displayed as trends, for example in the form of a graphical timeline, to be used in the process of designing specific policies or strategies. Roadmapping does not necessarily require the use of prior foresight outcomes. Delphi is often used in this phase as well.

3.3.1 Wind tunneling

Wind tunneling (sometimes also referred to as stress-testing) is used to understand how new or existing policies, strategies, or measures may be affected in different scenarios. The

generally recommended format is a workshop. However, wind tunneling can also be implemented in an iterative deliberation format similar to the Delphi method. As an example, The Read et al. study (2015) focused on the topic of nanotechnology impacts. To map the government environment, four forward-looking scenarios were developed that capture critical uncertainties. Subsequently, stress tests were conducted on key elements of governance to determine how well they might perform in the identified future scenarios.

According to the Government Office for Science (2017) testing during the wind-tunneling exercise can be accompanied by open commentary from other respondents in the process, it is, however, a deliberative method usually involving tens of highly involved participants.

3.3.2 Backcasting

Backcasting is a foresight method that identifies the necessary steps leading to a preferred future. Respondents identify what needs to change between the present and the future, focusing not only on new actions but also on potential events that disrupt the current state. Höjer et al. (2011), for example, investigated possible futures for the city of Stockholm up to 2050. To use the backcasting method, six images of the future were created. The images illustrate how a combination of planning, behavioral change, and technological development could lead to sustainable energy use.

According to the SOIF toolkit (2019), participants in a back-casting exercise are presented with detailed input scenarios and visions. Participants are then asked to define the main differences between the current reality and the selected future. Then, they imagine a step back from the given future and formulate specific interventions that can suppress or support the progress. This method is based on the assumption that there is no single path to a given future. This method, therefore, also usually takes the form of a workshop and can be seen as deliberative.

3.3.3 Roadmapping

The Roadmapping method demonstrates how various trends and interventions may interact to shape future developments. Essentially, this method involves a timeline where different variables are introduced. For instance, the Roadmap created by the Finnish SITRA (2016) outlines specific actions that can expedite the transition to a competitive circular economy in Finland. This research emphasizes best practices and pilot projects that can be easily replicated, featuring hundreds of suggestions and expert opinions.

Deliberative methods, such as workshops with key stakeholders and experts, are well-suited for roadmapping. This approach does not require adherence to a specific scenario or vision and can be employed to pinpoint the most effective policy responses to emerging trends or events. The Government Office for Science (2017) suggests implementing this method through participatory workshops or expert panels. Initially, there must be consensus on the thematic focus, followed by the creation of a preliminary roadmap and collaborative brainstorming. The final product is usually a timeline that includes events and decision points, illustrating the system's progression.

3.4 Overview of participation in foresight

Out of the 14 analyzed foresight methods, only one is directly based on the participation of large amounts of people (Visioning), and four methods can be categorized as deliberative with potential for wider participation (Judgmental forecasting, Scenario planning, Three horizons, and Cross-Impact analysis), five methods are deliberative and four methods are statistical.

This shows, that participation, as defined above, is not widely used in foresight, which might be harmful to the quality of many foresight studies since wide participation and the use of collective intelligence is often cited as an important aspect of foresight. With this finding, I claim that the use of participatory methods should be focused on as their potential is probably not fully utilized in foresight, not that they are not used in policymaking in general, or utilized for other purposes.

There is a number of participatory methods such as referendums, participatory budgets, Deliberative Polls or Citizens' Councils (Peña-López, 2020) on various levels of governance in many democratic countries, these methods are just not usually directly concerned with rigorously analyzing the future, but rather with providing a space for public voice to be heard, which is also very important.

Aside from these findings, the combinations of the most relevant methods as noted in this chapter can be utilized to deliver relevant results in a large set of public policy and strategic decisions. The detailed steps for practitioners to take during the designing of the most appropriate foresight process using these methods will be elaborated on in Chapter 7.

In the next chapter, I focus on a deeper exploration of the theoretical usefulness as well as the expected practical feasibility of a combination of Judgemental forecasting as a participative foresight method with Delphi as a smaller-scale expert deliberation method.

4. Combining foresight methods

The selection and the combination of foresight methods should always reflect the intended purpose of the final users of its outcomes and the available resources of the institutions or stakeholders conducting or contracting the foresight study. The purpose can range anywhere from impact analysis of an individual policy to long-term national strategic prioritization or identification of future risks and opportunities. The resources allocated to the study can also be highly variable. Both of these aspects, therefore, need to be taken into consideration.

Chapter 7 will be dedicated to the individual steps and considerations necessary to take into account while designing a foresight study, including the choice and the combination of the most relevant foresight methods. At this point, however, it is important to understand the choice of methods to combine and study as the most potentially useful and relevant to the aims of the consequent case study. For this purpose, Figure 2 summarized the three phases of foresight, the most usual methods used in these phases and the most relevant links between these methods.

For the purposes of the study of global megatrends relevant to the Czech republic in the FUTURE-PRO project, I and my colleages conducted a number of interviews with global experts on foresight (Appendix 1) on top of the literature research. As a result, I have selected the combination of Judgemental forecasting and an expert-based Delphi as two main foresight methods (enhanced by an initial desk research), as depicted below (Figure 2).

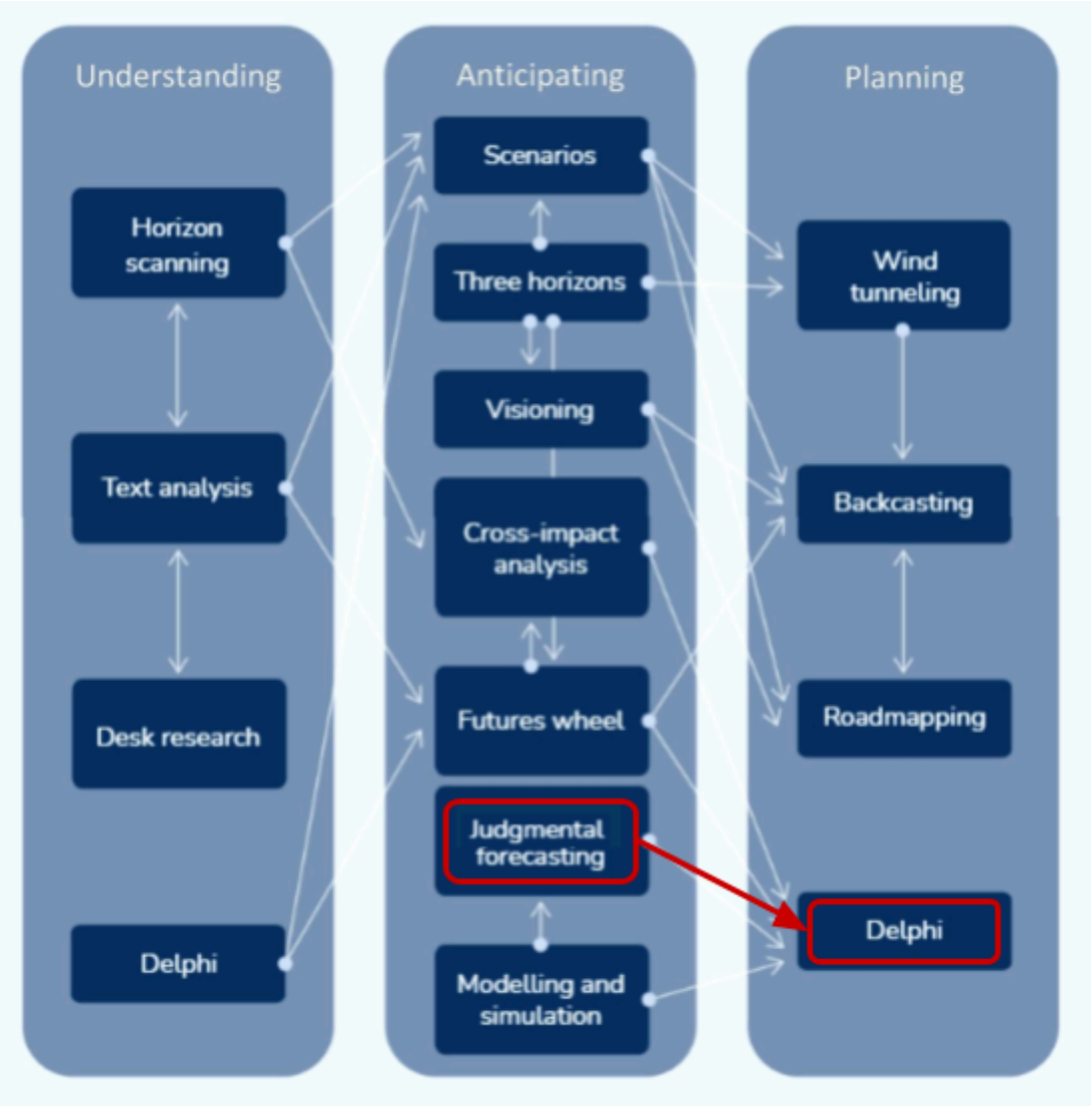

Figure 2 - Choice of foresight methods

As discussed above, one of the most frequently used methods for national strategic foresight is the Delphi method, which, however, has its limitations, such as the need for a high diversity of expertise, some of which might not be properly reflected by the standard academic credentials and therefore difficult to select for when inviting experts, or the time-demanding nature of a Delphi, which might be especially concerning among scholars with higher credentials or professionals as they are likely to be time-constrained.

Forecasting tournaments is another method of crowd-wisdom aggregation, which has been rising in popularity over the last decade and works to solve these very limitations effectively. Its own limitations are, however, the need for a clearly definable resolution, and the need for this resolution to happen in a relatively short-term future. For that reason,

forecasting tournaments have not yet been used for long-term strategic foresight without being combined with other foresight methods.

4.1 Short-term vs. Long-term foresight methods

Forecasting tournaments (as the most usual variation of Judgmental forecasting method) are based on wide, low-barrier participation, while it is a method usually focused on short-term foresight. Delphi, on the other hand, is a method based on more intensive involvement of a diverse group of experts who collaborate in multiple rounds, and it is usually directed to answering long-term, unresolvable foresight questions. All this suggests that a proper combination of these two methods could enhance the quality of the outcomes.

4.2 Delphi method - analysis

The Delphi method was developed by Dalkey and Helmer (1963) at the Rand Corporation in the 1950s. It is widely used for debate structuring among experts and either “achieving convergence of opinion concerning real-world knowledge solicited from experts within certain topic areas” (Hsu, 2007), or identifying recurrent dissensus and conflicting views. It is a method similar to a survey, but it is based on iterations where respondents receive feedback from the previous round and can adjust their estimates based on the estimates of other experts. Another important element is anonymity, which aims to reduce "groupthink" and the prevalence of “senior” opinions (Gordon, 1994).

The identification of the experts who will participate in Delphi is an important element. Gordon (1994) lists several ways to identify and select relevant experts. Experts can be identified based on the authorship of a publication on a given topic. However, this eliminates experts who have not published or whose publications were not noted in the literature synthesis. It is also possible to rely on recommendations from institutions, but in this case there is a risk that only experts who are known to these institutions will be identified, creating opinion “cliques”. To avoid this risk, it is possible to appeal publicly for expertise through the public media (in the media, on bulletin boards, etc.). In this way, even less known experts can be recruited. It is also possible for experts to recommend others.

Experts selected to participate in Delphi usually respond to already formulated statements. These statements are usually based on a synthesis of the literature. For the selection and formulation of statements, several principles must be followed. Statements must be unambiguous, relatively short and precise. It is also recommended not to use technical or

professional terms (FUTURE-PRO, 2022). In a Delphi questionnaire, questions are often formulated to address the respondent's knowledge of the topic, an assessment of the time horizon or likelihood of a given development, an assessment of the implications or impact of the development and an assessment of factors that may hinder or facilitate the development. A range of question types can be formulated, from closed (multiple choice, rating, ranking) to open questions.

Questionnaires in Delphi can be administered on paper or on-line. Today, the most common is on-line completion, where respondents answer the questionnaire on a dedicated website. The feedback can either be displayed immediately after the respondent has answered (Real-time Delphi) or at the end of the round (usually after a few weeks). Outputs are usually presented as the distribution of responses in the form of a graph or histogram. If experts were asked to provide arguments for their answers, the results include written text that can be analyzed by the organizer or e.g. using text mining tools.

4.2.1 Benefits

The two main benefits of the Delphi method are the anonymity of participants and the iterative feedback.

- Anonymity - The anonymity of participating subjects can reduce the effects of dominant individuals which often is a concern when using group-based processes used to synthesize information (Dalkey, 1972). Anonymity also helps prevent participants from making suboptimal decisions due to being influenced by the credentials, expertise or social statuses of the others.

- Iterations - the process of feedback in multiple iterations allows and encourages the selected Delphi participants to reassess their initial judgments about the information provided in previous iterations (Hsu, 2007). This design allows participants not only to change their mind in the light of additional information, but also not to make decisions under pressure or other circumstances.

Other benefits stem from the use of numerical responses, which could then be statistically aggregated, and from the facilitator’s ability to control various parts of the Delphi process, e.g. by providing controlled feedback between rounds or by being able to use statistical analysis techniques to further reduce the risks of the participants’ pressure for conformity within the group (Dalkey, 1972).

4.2.2 Limitations

The two main limitations of Delphi are the needs for a diversity of participants and for their strong motivation.

- Need for high diversity - Selection of participants is the most important step in the entire process of Delphi, as it directly relates to the quality of the results generated (Judd, 1972). Need for a wide diversity of expertise and opinions (especially if the subject of deliberation is highly complex) is crucial and difficult to obtain in practice, usually due to the financial and time limitations. Moreover, many sector experts with credentials and expertise to be nominated to Delphi might not be very good "generalists". Naturally, they may be biased towards the field they have been working in for a long time. They are also more likely to be occupied with other projects and not allocate sufficient time to provide precise arguments. Young educated participants might be less biased, think in novel ways and have more time to conduct additional research, but they often don't have the appropriate credentials yet to be invited into an expert Delphi study.

- Need for strong motivation - Motivation of participants is the key to the successful implementation of a Delphi study and investigators need to actively ensure to maintain a high response rate throughout multiple rounds (Hsu, 2007). Experts need to be motivated (financially or socially) to put a relatively intensive effort into reading the inputs of others and writing thoughtful comments in multiple rounds. Moreover, strong motivation is needed especially in studies with research topics that can never be clearly resolved (e.g. what should be the national priorities or what will be the global megatrends' implications) and therefore no claims are clearly falsifiable, which does not motivate participants to be maximally correct. This is especially important in the case of high-impact decision-making, where the perceived benefits from being deliberately dishonest (e.g. prioritizing issues that one has vested interests in) might outweigh the benefits from being right (e.g. being a participant in an impactful and cited study).

There have been other observed limitations such as the risk of a "pressure to conform with group ratings" (Witkin, 1995, 188), but they can be mitigated by decreasing the effects of the two limitations described above (Bolger, 2011).

4.3 Forecasting tournaments - analysis

Forecasting tournaments is a method of crowd-wisdom aggregation for the purpose of gathering informed estimation of future developments, events, trends or outcomes (Tetlock, 2014). This method can be classified as judgmental forecasting, unlike the methods based on statistical models or machine-learning models (Januschowski, 2020).

Forecasting tournaments, as claimed, have a “potential to improve not only the quality of political decision-making but also the public awareness and participation, and hence general trust in politics” (Dana, 2019). Probably the most famous practical application of this method is the Good Judgement Project developed upon the theoretical findings of Phillip Tetlock and his team (2009) which provided data to multiple subsequent studies and marked the beginning of a rapid growth of the field of forecasting especially in the area of geopolitics and international relations.

Forecasting tournaments is a method to not only effectively aggregate various inputs, but also to increase the incentives of participants to put more effort into formulating their inputs by using a combination of financial and social motivations. Participants in a forecasting tournament are motivated to create and share their predictions, opinions and sources in real-time on an on-line prediction platform with others, which increases the benefits of collaboration and dissemination of ideas within a group. According to Grilo (2023), predictions on the forecasting site Metaculus always beat a low-information prior (aggregation of probabilities of how similar questions resolved in the past), suggesting that the judgemental forecasting as a method does, in fact, improve the quality of information.

Forecasting tournaments usually use scoring methods such as a Brier score (Brier, 1950) to motivate participants to search for the most correct probabilistic predictions and not be overconfident. It is in each participant's interest to update their own predictions during the tournament, for example if influenced by the inputs of others. Other design adjustments can be made to further improve the process and the outcomes of a forecasting tournament, such as using a Categorical scoring rule (to motivate inputs early in the tournament) or rewarding the best comments (to motivate more sharing of information).

4.3.1 Benefits

Forecasting tournaments offer the same two main benefits as Delphi - anonymity and iterations. The benefits of an iteration are further amplified, as the cross-insemination of

views and arguments happens not in rounds, but in real time on-line. The group discussion is usually not moderated (or moderated only for inappropriate or adversarial behavior), participants can publicly react to each other's comments and change their own forecasts at any time. As a result, there is more information sharing taking place than in Delphi. Two additional benefits of forecasting tournaments are:

- Competitiveness - The framing of this deliberation process as a “tournament” increases the incentives of participants to put more effort into providing higher-quality inputs and to be right. The process factors maintaining competitiveness such as motivation, evaluation, feedback, collaboration methods etc., need to be carefully adjusted when designing the tool (Mellers, 2014). Financial rewards are the most commonly used motivator, but many participants claim to be motivated rather by the opportunity to test, show and improve their forecasting skills (FUTURE-PRO, 2022). These motivations can be utilized to further reduce the costs of the method.

- Scalability - The algorithmic and automatized forecasting tournaments allows it to accommodate more participants than a Delphi, which is beneficial for decreasing the effects of each individual input´s and increasing the diversity of the views represented in the process. As this introduces some risks (e.g. the possibility of adversarial collaboration or reputation harms caused by disruptive participants), multiple factors such as training, expertise, general knowledge of participants, etc. should be considered during the preparation (Meller, 2014).

In addition, all inputs are automatically collected on a platform that can later serve as a digital repository of opinions and resources, which may be useful for capacity building and learning purposes of individuals and the institutions, as well as for increased accountability of participants for their inputs.

4.3.2 Limitations

- Need for clear resolutions - To function properly, forecasting tournaments need to ask questions that will be clearly resolvable in the future, to prevent disputes about the outcomes. With the potential for disputes, participants are motivated to adjust to these risks and limit their effort.

- Need for short-term questions - The financial rewards for correctly predicting long-term questions (more than 2-3 years) are less appealing due to the increasing

difficulty as well as the increasing opportunity costs of conducting proper research before making a prediction.

These two limitations notably narrow the scope of available questions, while it is precisely the long-term questions that are at the core of strategic foresight. Long-term questions also carry larger potential for high-impacts and are interesting for policymakers and the public to discuss and to make opinions about.

4.4 Combining Delphi with Forecasting tournaments

From the benefits and limitations of both methods postulated above, it is apparent that the two main limitations of a Delphi can be mitigated precisely by the two described benefits of Forecasting tournaments. The first Delphi limitation - the need for a strong motivation - can be effectively aided by introducing the competitiveness aspect of forecasting tournaments into the process. The second Delphi limitation - the need for high diversity - can be mitigated by the scalability of forecasting tournaments to accommodate a larger spectrum of views while maintaining their effective aggregation.

The two limitations of Forecasting tournaments - the need for a clear resolution and the need for short-term questions - can, in turn, be effectively solved by combining the two methods by using a forecasting tournament to predict the results of a Delphi. The Delphi results are clear (e.g. a final ranking of priorities), delivered using a given methodology and known in a short-term future. This design may increase the cost, complexity and the length of the study, but if it, in fact, helps to deliver better results, it might still be a very cost-effective design relative to the impacts of consequent strategic decisions.

4.4.1 Relevant literature

Asking participants in a forecasting tournament to predict, what will be the opinion of a different group of respondents (in this case experts in a Dephi study), is an empirically credible approach based on the theory behind peer-prediction elicitation. As empirical evidence, Karger, Tetlock et al. recently found that forecasts elicited using Reciprocal Scoring method were as accurate as those elicited with Brier score & both outperformed a control group without incentives (Karger, 2021).

In the field of international relations, a similar approach was used in 2020 in the study by the Canadian research team led by Devlen (2020) to identify the most important future

trends, weak signals and wildcards regarding the development of Turkey-NATO relations. The participants were Canadian policymakers of varying seniority from the Department of National Defence, Canadian Armed Forces, and Global Affairs Canada as well as scholars from Canada, USA, Turkey, and European countries. Twenty people took part in this project. It successfully utilized a forecasting method together with experts deliberation and resulted in an official policy paper.

This method is currently being discussed among experts in foresight and forecasting, and there are already working papers suggesting improvements, such as predicting a consensus of a selected group of experts instead of a consensus of just another group of participants (Sempere, 2022). This approach is nearly identical to this case study, where the tournament participants were motivated to predict the expert consensus resulting from the Delphi as correctly as possible, and I am actively consulting this method and it´s further improvements with these scholars.

4.4.2 Practical considerations

There are a number of design choices to be made during the implementation of this design, but the most important choice is about how much information from the forecasting tournament should be fed into the Delphi. It is important for the experts in Delphi not to see the aggregate of the predictions from the previous tournament, because they could consider it high-quality information that they cannot outperform, and therefore they could give up on doing their research and formulating their own opinions.

The Delphi experts should, on the other hand, be able to see the comments and arguments of the individual participants in the tournament, as they may contain important, yet marginal or contrarian views that the experts can then reflect in the Delphi. The comments can also contain the description of likely biases of the group of experts, which can help the individual experts to be more aware of them and avoid them. Participants in the tournament can try to use the “self-fulfilling prophecy” phenomenon (Merton, 1948) for their advantage, e.g. by writing persuasive arguments for a particular response while predicting, that these arguments will in fact influence the results of the Delphi, which might have interesting effects that are currently underexplored, but this should also introduce information rather than noise to the process.

4.4.3 Metrics for evaluation

As Gruetzemacher and colleagues claim, the effectiveness of existing methods of forecasting “has oddly been understudied in the past” (Gruetzemacher et al., 2021, 37), leading them to the conclusion, that this should be a leading topic to prioritize, in their case to anticipate the progress of the development of AI.

There is some existing academic literature about monitoring and evaluation of foresight. Calof & Smith (2012); Johnston (2012) and van der Steen & van Twist (2012) explore ways of evaluating the process of creation of foresight outcomes. Basic principles of monitoring and evaluation can be used to demonstrate the adequacy of management structure, design, and communication of results, whether the costs of foresight studies are proportionate to their purposes, or whether the improvement of foresight over time is sought (Georgiou, 2003). Rigorous methods of evaluations of the actual accuracy and impacts of most foresight outcomes are, however, largely unexplored, because of the abstractness and the long-term nature (often decades into the future) of many foresight objectives.

Nonetheless, while designing the metrics for the evaluation of a particular combination of two methods, it seems epistemically very important to set up metrics and indicators, that will be used to evaluate, which method produced better outcomes and whether the combination of these methods improved the results. One possible metric, as suggested by Piirainen et al. (2012) is to simply ask experts in Delphi, whether they were influenced by the information from judgmental forecasting, but the results might be very subjective.

A more accurate metric is to evaluate the accuracy of the outcomes later, based on the true occurrence of the events. This is challenging when studying long-term megatrends on a global scale, making it difficult to assess which ones are most important at any single point in time. Nonetheless, it is plausible to conduct an interim evaluation during the unfolding of the megatrends. The validity of this approach is predicated upon the assumption that large global megatrends develop relatively consistently over years and decades, unlike deeply surprising “black swan” events (Taleb, 2007), wild cards or rapid and significant shifts in trajectories referred to as discontinuities (Saritas et al., 2011). If we assume that global megatrends usually remain unaffected and are only gradually influenced by these forces, we can assume that their strengthening or weakening can be reliably observed within shorter periods of time.

The sensibility of interim evaluation as soon as three years later aligns with the literature, which indicates that the quality of predictions by even the best forecasters significantly decreases as the time horizon extends beyond a few years (Tetlock, 2004). This suggests that when asked about events decades into the future, respondents can naturally reason only about specific events, smaller trends, or technological and societal developments in the next 1-5 years. Beyond this period, their predictions rely more on extrapolation and

intuition, which lose relevance as uncertainty increases (Dane et al., 2007). In this study, this means that both experts and non-experts in 2021 were primarily considering events likely to unfold over the coming 1-5 years. Now, we can retrospectively assess these predictions.

In the part 2 of the following case study, I conducted evaluations 1.5 and 3 years after the first part of the case study, which are sufficient timeframes for significant world events to occur and potentially alter the importance of some megatrends. In each evaluation round (25 respondents in 2022 and another 25 respondents in 2023), I asked a diversified group how much they perceived each megatrend's importance to have changed over the last 1.5 years (as described in chapter 5.2). I chose the psychometric method of comparing rankings. The initial foresight study's main output was top-down rankings, so this methodological choice aimed to maintain consistency and ease of understanding. Future evaluations, ideally every 1.5 years, will strengthen the robustness of the results.

4.5 Alternative variations and similar combinations

4.5.1 Prediction markets

Prediction markets is a variation of a judgemental forecasting method, used for elicitation of incentivized crowd predictions (Brown, 2019). It is a method in which participants in the market can use their own money or credit to buy and sell shares of various predictions. Prediction markets are designed specifically to forecast events such as elections (Berg et al, 2008) which is being experimented with by a number of existing on-line prediction markets such as PredictIt, Polymarket or Manifold Markets. The idea of using prediction markets to predict results of scientific studies was introduced by the economist Robin Hanson (1995).

In theory, prediction markets should be a highly efficient method to aggregate accurate short and medium-term predictions, but in practice, it appears difficult to motivate enough participants to ensure that the markets are liquid, which is a necessary condition for them to work (Hanson, 2006). Especially when the resolution of the prediction is further in the future, there is an increased chance that the resolution will be disputable or the project will cease to exist, and that the capital returns will be lower than could have been elsewhere, even if one´s prediction turns out to be correct.

In addition, people are often subject to loss aversion (Tversky, 1991) hesitating to bet their own money, even if the odds are favorable. Specifically in the case of predicting scientific results, prediction markets were recently found to be rather ineffective (Dreber, 2019).

These limitations suggest that in the near-term future, even moderately subsidized prediction markets can be outperformed by different approaches, which is why I have not applied this method.

4.5.2 Surprising popularity

Surprising popularity is an interesting academic concept of crowd-wisdom aggregation, developed by Dražen Prelec in 2007, based on the approach of asking participants to respond and also to predict the average responses of others, and then "selecting the answers that are more popular than people predict" (Prelec, 2017). The main benefit of this novel method is that it can detect cases in which the majority of participants are wrong in their responses, which Delphi or Forecasting tournaments cannot (Chang, 2016).

It also does not require future resolution of the questions, which is beneficial for the purpose of strategic foresight. Even though there is no rigorous evidence yet found for the positive effects of using Surprising popularity in combination with other methods of deliberation, I have used this method to conduct an additional analysis, as described in Chapter 5.

4.5.3 Scenario planning combined with forecasting

Scenario planning is another standard foresight method that combines facts with identified driving forces to create future scenarios. This method has its own limitations such as excessive optimism about certain scenarios, an over emphasis on unlikely events, and over relying on historical precedent (Erdmann, 2015) which might be mitigated by probabilistic forecasting. This is a very recent approach that is being developed by the scientific community behind forecasting tournaments, most notably The Cultivate Labs, the CSET and the team of Dr. Phillip Tetlock. It combines probabilistic forecasting with Scenario planning, hoping that "this holistic method would provide policymakers with both a range of conceivable futures and regular updates as to which one is likely to emerge" (Scoblic, 2020).

In the process of "Strategic Question Decomposition", future scenarios are broken down into pivotal factors and then individual falsifiable signals, that can then be more effectively forecasted (Siegel, 2021). I have not used any aspects of this method as it is still relatively early in the development, but it seems to be a promising approach that could be applied in national strategic foresight as well in the future.

5. Case study

As explained in the chapter 1.4. and depicted in Table 1, the data collection for this case study was conducted in two parts linked to the two main hypotheses of this research.

More specifically, in Part 1, I collected the data (Q1-Q4) to find out, whether it is feasible to use forecasting tournaments in combination with a Delphi study to estimate the future importance of global megatrends and whether using a forecasting tournament, we are able to predict group opinion better than using a questionnaire (Kleňha, 2022).

In Part 2, I collected data to assess the accuracy of the methods based on the first[1] systematic ex-post evaluation (Q5). The evaluation dataset (Q5) combines inputs collected in two separate rounds that took place 1.5 years (25 respondents) and 3 years (25 respondents) after the initial project. I specifically aimed to indicate how accurate the opinions of hundreds of non-experts answering a questionnaire (Q1) were relative to the assessment of dozens of experts deliberating in a three-round Delphi study (Q4). I also evaluated the questionnaire-based data (Q1+Q2) to indicate, whether "surprisingly popular" megatrends should have been prioritized by experts, and then proceeded to explore the motivations of participants in relation to a novel proposed foresight design (Q6).

5.1 Part 1 (Q1-Q4, 2021)

5.1.1 Design

In 2021, I organized a forecasting tournament to enhance the standard application of Delphi in the aforementioned project FUTURE-PRO. The core of the project was a Delphi with 24 participating experts with a pre-designed diversity of academic backgrounds, who were presented with 18 cards of global megatrends and were asked (during three rounds, among other questions) to rate (on a scale of 0-3) their agreement with this statement: "*The area will have a very significant impact on the quality of life in Czechia in the next decades and, therefore, public funding should be preferentially allocated to understanding it and*

[1] Since global megatrends will keep developing in the coming years and decades, I plan to continue conducting similar evaluations periodically, in order to strengthen the robustness of the evaluation process and its outcomes.

addressing it." The aggregate of the final ranking of this question was used as a resolution to the forecasting tournament.

The summary of the content of the 18 cards of megatrends and grand societal challenges is attached in Appendix 2. Each full-lenght card was 6-12 pages long and consisted of the findings from literature research of existing foresight studies mentioning this area, resources from my desk research regarding this area and links to resources discussing implications of these megatrends on the Czech Republic, as well as links to other resources. Th full-lenght cards are accessible in Czech at the website megatrendy.cz and at FUTURE-PRO (2022).

Both the questionnaire and the forecasting tournament were designed to take place before this Delphi and involved 238 participants, who had earlier passed a 1.5-hour online calibration training with a quiz at the end. This training was focused on explaining the basics of working with probabilities and the methods of properly estimating one's confidence, which should result in making well-calibrated predictions. Participants were anonymous - each participant was instructed to choose a name of any foreign city as an identity, which was then displayed on a forecasting platform. I used a forecasting platform developed by the organization Cultivate Labs, which is being used by international forecasting tournaments such as The Good Judgement Project, projects run by the Center for Security and Emerging Technology or The British National Intelligence project "Cosmic Bazaar" (The Economist, 2021).

The recruitment, which resulted in 238 participants, was targeted mainly at students, Ph.D. students, and university scholars in the Czech Republic. The group was relatively young and highly educated - 59.3% of participants were under 35 and 68.2% of participants had a master's degree or higher. The group of participants was diverse with regard to expertise. The most common professional focus of respondents was Economics and Business (24x), Computer and Information Sciences (23x), Political Science (16x), Physical Sciences (12x), Mathematics (8x), Legal Sciences (7x), Other Social Sciences (7x), Sociology (6x), Psychology and Cognitive Sciences (5x), Education (5x) and Biological Sciences (5x). 16 other Fields of Research and Development (FORD) disciplines were represented. 34% of participants did not answer.

All participants were trained in forecasting prior to participation and were familiarized with the technical interface for the forecasting tournament. Apart from this experiment, they used the same forecasting platform to participate in a larger, three-month-long forecasting tournament OPTIONS (České priority, 2021) focused on short-term questions mostly

related to public policy development in the Czech Republic. The tournament as well as the questionnaire and all the provided materials were in Czech language, the whole experiment lasted for two weeks and took place in April 2021.

The participants in the tournament were asked three main questions in this order:

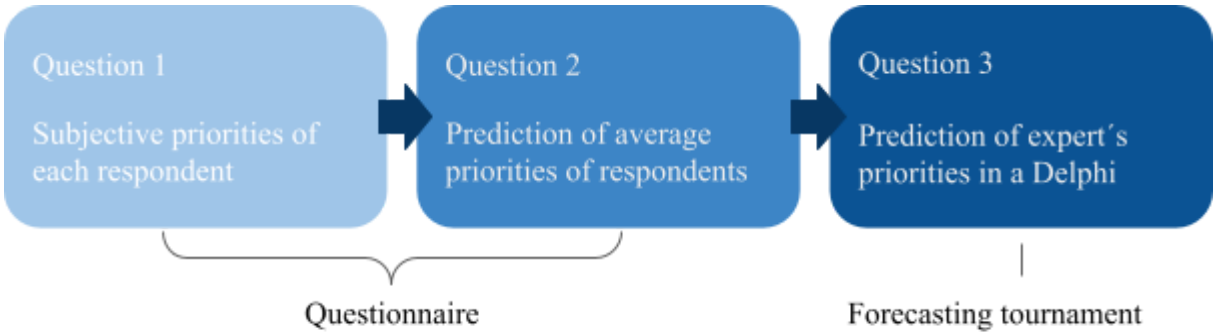

Figure 3: Sequence of questions in Part 1 of the case study

Both the questionnaire and the forecasting tournament were ethically approved and all participants provided consent to use their anonymized data for research purposes by ticking a box to express their agreement during the online registration process before the beginning of their participation.

5.1.2 Process

5.1.2.1 Questionnaire (Q1,2)

The questionnaire was administered for research purposes. It was mandatory and was answered by 238 participants. In its introduction, participants were provided with the links to 18 "cards" of the areas of global Megatrends (each 5-10 pages long) to prioritize from, a document with 1-paragraph summaries of all 18 cards, and an explanation of the context of the project and the design of the expert Delphi.

Question 1 asked *"Choose exactly 6 areas that will, in your opinion, have the greatest impact on the quality of life in Czechia in the next decades and, therefore, public funding should be preferentially allocated to understanding them and addressing them."* Participants were able to tick exactly 6 areas out of 18. This question was posed in order to

control for the effect of participants' own values on their ability to forecast group priorities in subsequent research.

Question 2, which followed, asked *"Which 6 areas, do you estimate, will be selected by the highest number of participants in Question 1 in this questionnaire? The collective score will be derived from a ranking list based on how many times the given area was selected. Again choose exactly 6 areas."* This question was asked in order to better understand the base-rate of the ability of individual participants to predict the consensus of a group regarding these megatrends, before they start participating in the forecasting tournament. I saw this question as creating participants' "track-record" of predicting an opinion of a group regarding these topics, which is a standard approach in other crowdsourcing consensus mechanisms such as the Surprising popularity (Prelec, 2017). After having answered, participants were allowed to enter the platform.

5.1.2.2 Forecasting tournament (Q3)

On the forecasting platform, participants were asked the Question 3 - *"Which of the following 18 areas will rank in the first 6 places of the ranking list compiled on the basis of scores given by experts in the FUTURE-PRO project?"* Answering this question was voluntary in order to limit inputs from participants who would just make uninformed guesses and the participants were asked to write comments and update their predictions as frequently as desired. It was not specified what should be the content of the comments.

Participants had to distribute probabilities of each area being in the TOP 6, which meant distributing the total of 600% between 18 areas. A few participants were confused by this logic, while an explanation had been provided in the first days. The participants were financially incentivized to provide better predictions, as it was announced that after resolution, I will randomly draw 15 participants from all the participants with the above-average Brier score from this question (i.e. from the top 50% of participants), who will receive a voucher in the amount of 1,500 CZK (70 USD). The question was open on a platform for 12 days and the Brier score was calculated each day of the tournament from the Brier scores of each of the 18 areas.

119 participants provided at least one valid prediction. The average participant self-reported spending 95 minutes working on this question. A total of 196 comments were collected, the majority of which were phrases such as "first guess" or "updated". The rest of the comments with considerable content could be classified by three main topics - personal

opinions on what should be the priorities, comments on how the participant came to their predictions, and the comments on the methodology (both the design of the Delphi and the Forecasting tournament).

To reduce the length of all considerable content, I aimed to select up to 15 norm pages of comments with the biggest informational value. This selection was conducted by three independent coders from the project's research team, who ranked all comments on a scale 1-10 according to perceived quality and informational value, which resulted in 13 selected comments. I provided a document with these selected, unedited comments and a two-page summary of all the textual content gathered during the forecasting tournament to the 24 experts before the beginning of the Delphi, which can be found, along with an overview of the 18 cards as well as all the raw comments in the *Extended data* (Kleňha, 2021).

The Delphi study was conducted seven weeks after the end of the forecasting tournament. After the end of the Delphi, I resolved the tournament and distributed the rewards.

5.1.2.3 Delphi (Q4)

The selection of experts to be invited to participate in the Delphi happened well in advance, but the names of the experts remained anonymous until the publication of the final results. The group of experts for Delphi was built with regard to a number of relatively strict criteria. The group was aimed to be heterogeneous in terms of expertise (represented by STEEP-V clusters) and in terms of gender and age.

The experts needed to have a Ph.D. degree or at least 5 years of experience in the field. In addition, they needed to specialize in multiple fields or be capable of interdisciplinary work. The experts needed to have moral credit, a demonstrable ability to work with uncertainty and complexity, and the ability to work with normative frameworks such as the quality of life (FUTURE-PRO, 2021).

As a result, 25 experts agreed to participate in the Delphi process and one expert left during the Delphi process. 60% of experts were male, 80% had a Ph.D. degree and 80% were primarily from the academic sector, while 12% were from the Czech non-profit sector. 12% of experts were under 35 years of age, 72% were between 35 and 50 years, and 16% were older than 50 years. Nobody was older than 65 years (FUTURE-PRO, 2021).

Apart from the 18 cards of megatrends and the report from the forecasting tournament, the experts received supporting material that referred to information sources providing useful context for prioritizing the megatrends. The support material had three parts. The first part, "Quality of life, living conditions and resilience" summarized the prioritization criteria. This

concerned mainly the concept of well-being according to OECD (OECD How's Life, 2020), which works with 11 indicators of well-being.[2] The second part, "Weak signals of technological development" mentioned sources for the so-called weak signals of development. The third part summarized the Sustainable Development Goals (UN, 2023).

Three rounds of Delphi took place online in 1-2 week periods. For this final scoring, experts had a limit of 38 points for the 18 megatrends and they could allocate 0-3 points to each of the megatrends. The exact wording of the question was "*Do you agree with the following statement? Public funding should be preferentially allocated to understanding it and addressing it. You have a total of 38 points for your scoring. You can allocate 0 to 3 points to each area. Please distribute all 38 points.*" Those scores were then converted to percentages where 100% is the maximum score (FUTURE-PRO, 2021). Below are the results of this prioritization.

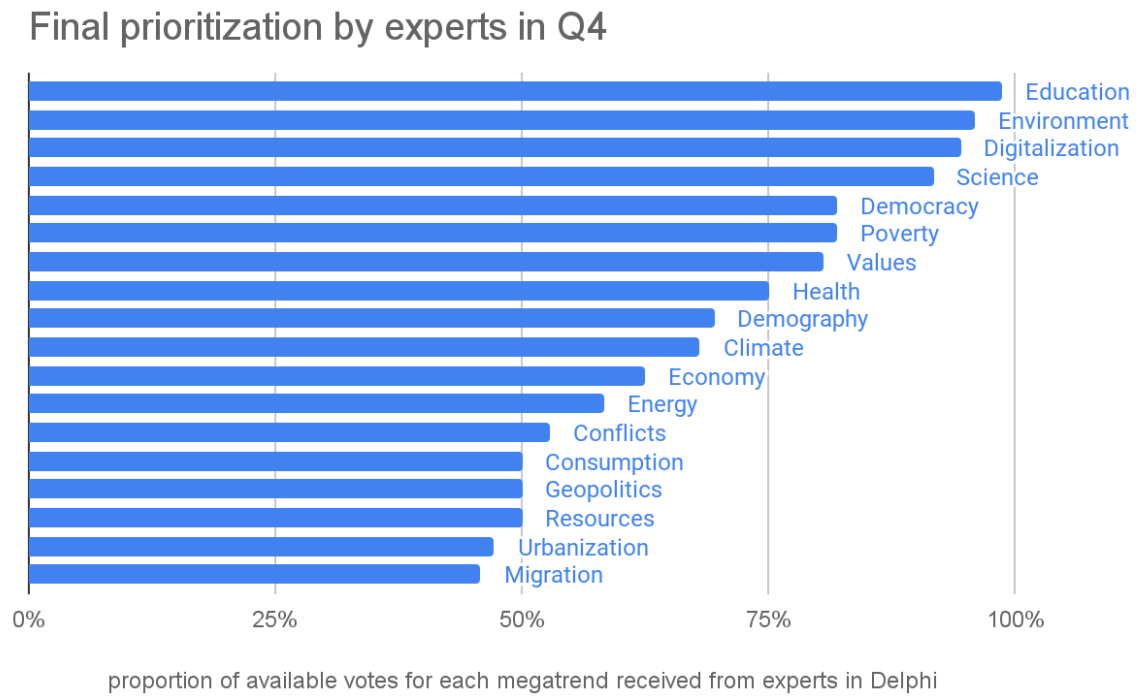

Figure 4: Final prioritization by the experts in Delphi

In a secondary exercise, experts also prioritized the megatrends by the importance of allocation of additional funding to these areas from resources allocated specifically for socio-cultural applied research, the results of which are accessible in the FUTURE-PRO

[2] Income and wealth, Work and job quality, Housing, Health, Knowledge and skills, Environment quality, Subjective well-being, Safety, Work-life balance, Social connections, Civil engagement.

report (2021), but are not directly relevant to this research. Along this prioritization, experts also provided comments and written arguments that were used later in the final report.

5.1.3 Results

The combination of the two methods worked as expected and I did not encounter any significant issue during their implementation. A minor technical limitation was that I could not make the predictions submittable if the sum of all the probabilities was not exactly 600%. This should be, however, an easily solvable problem for future applications. I also found that since most global megatrends are naturally interconnected, it is not always obvious which particular problem is categorized under which area. This can introduce noise to the prioritization of participants who do not allocate enough time to reading all the provided content and prioritize only by the names or short annotation of the areas.

In addition, I investigated the impact of using a forecasting tournament on the ability of participants to predict a group consensus. For this analysis, I selected only those areas that were among the top six priorities by both the aggregate of personal opinions of participants (Q1) and the results of the Delphi. With this selection, I aimed to limit possible bias in the results of the analysis that could exist if the experts in Delphi choose some of the areas inadequately due to limitations of the Delphi method.

The raw data can be found in the Underlying data (Kleňha, 2021). The names of participants are replaced by anonymous numerical identifiers to protect personal information.

Four out of six possible areas were among the TOP 6 in both rankings, namely *Education, Digitalization, Innovation (Science),* and *Environment*. All rankings are available in the FUTURE-PRO final report (2022) For the analysis of predictions in these areas, I used the responses to questions 1 and 2 and observed two aspects:

A. Group accuracy - whether the responses to question 3 were more accurate than the responses to question 2, suggesting that the forecasting tournament increased the group's ability to predict this area to be among the TOP 6 priorities in either of the rankings. The results are visualized in Figure 5.

B. Individual accuracy - whether there were more participants who did not select this area in question 2 and then correctly selected it in question 3 (updated in the right direction) than those who did the opposite (updated in the wrong direction), suggesting that, on average, participation in a forecasting tournament increased the

ability of participants to predict an opinion of a group. The results are visualized in Figure 6.

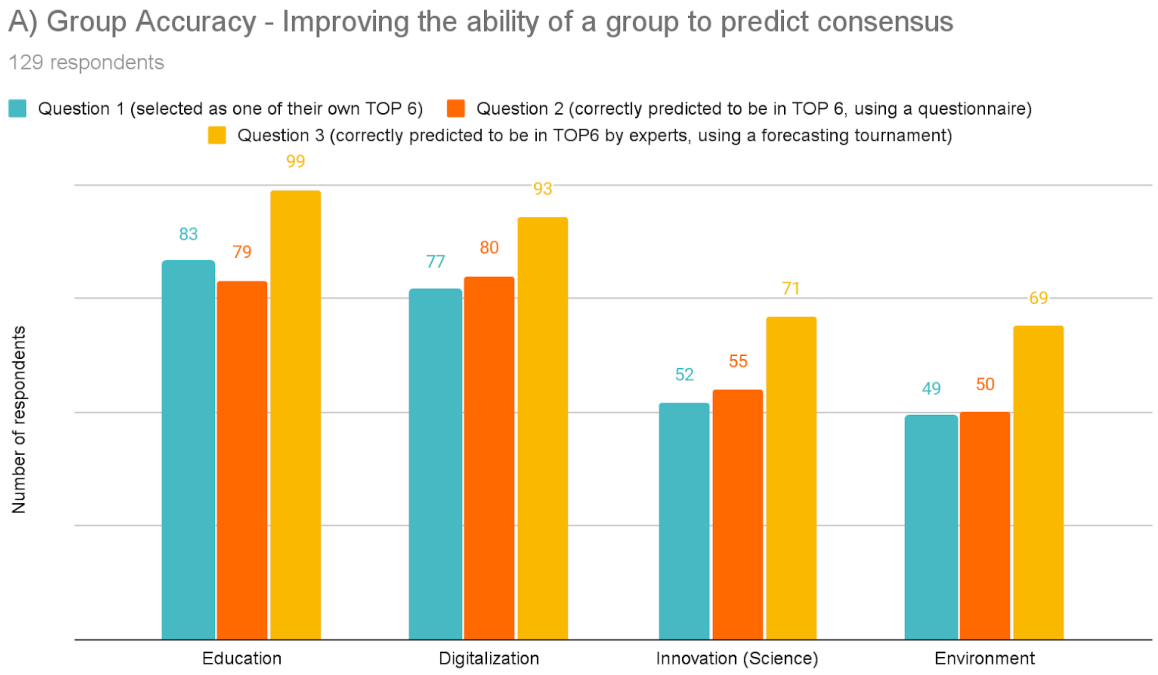

Figure 5 - A) Group accuracy - improving the ability of a group to predict consensus

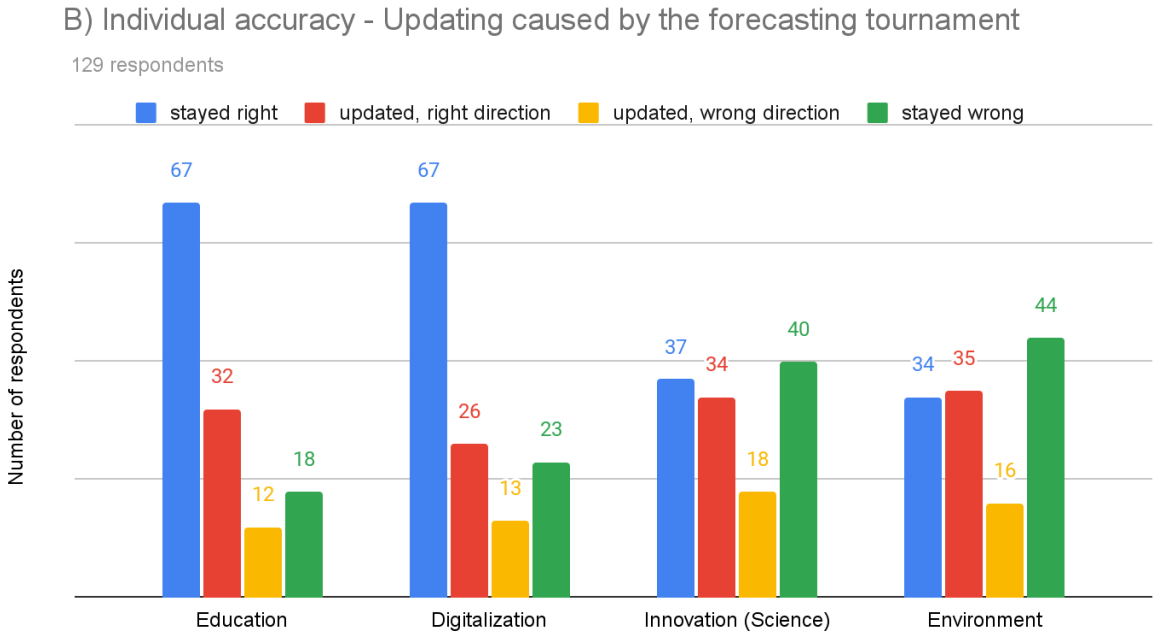

Figure 6 - B) Individual accuracy - updating caused by the forecasting tournament

5.1.3.1 Group accuracy

In all four areas, the average group opinion distilled from a forecasting tournament was more accurate than the average group opinion when a yes/no questionnaire was used, as expected. Moreover, the forecasting tournament seems to have helped participants, on average, to disregard their personal opinions and values more strongly in favor of accuracy, but more evidence is needed.

5.1.3.2 Individual accuracy

On average across these four areas, 56.4% of respondents updated their opinion relative to their prior prediction of a group consensus. Among those who did, 2.2x more people updated in the right direction than those updating in the wrong direction. This finding is in agreement with the hypothesis that forecasting tournaments can effectively reduce bias and noise by, on average, improving the individual ability to correctly predict an outcome, in this case, a future opinion of experts. Among the participants who updated in either direction, their personal values played a minor role (average Pearson correlation -0.03 across the four areas).

5.1.4 Limitations

During the time between the Forecasting tournament and the Delphi study, the name of the card “Innovation” had to be changed to “Science”. Even though both meaning and the content of the card stayed largely the same, this may have introduced noise to the results as the two words have somewhat different connotations and especially the respondents who did not read the content of the card might have prioritized the “Innovation” card differently than they would have if it was labeled “Science”.

The respondents spent considerably (up to one order of magnitude) less time on answering questions 1 and 2 than question 3. It is an important feature of forecasting tournaments that people are motivated to spend a lot more time conducting their own research, writing comments and updating their responses, but I are aware that this discrepancy may have been further amplified by the setup of the experiment. Questions 1 and 2 were part of a mandatory questionnaire, which did not let participants enter the forecasting platform before answering it. This was the best possible setup, as I needed participants to answer questions 1 and 2 before seeing (and being influenced by) others’ comments and

predictions (question 3) on the platform. I had published the questionnaire three days before question 3 was published on the platform and gave notice to all participants even prior to uploading the questionnaire, so that they could plan their time accordingly, but it still may have been a limitation.

I tried to make the amount of information the participants in a forecasting tournament had about other participants similar to the amount of information they knew about the future experts in Delphi (e.g. they knew the distribution of expertise in both groups, but not the identities of neither group members), but possibly imperfectly. In the analysis of the results, I have not measured the strengths of the effects of individual aspects of a forecasting tournament that are not present in a simpler yes/no prioritization questionnaire (mainly the aspects of answering in probabilities, group information sharing, and the possibility of updating), which would be a relevant question for future research.

In addition, our research team was mostly male, and also, there might have been some bias introduced during the process of inviting experts to Delphi (FUTURE-PRO, 2021). I tried to control for these possible implicit biases and had strict selection criteria, but the experts still could be have been slightly disproportionately chosen to represent fields that are more adjacent to the fields of our specializations, which could be an additional possible limitation.

5.2 Part 2 (Q5-Q6, 2022)

For the second part of my research, I collected data for evaluation in two separate rounds: 1.5 years after the initial part of the project (25 respondents) and 3 years after the initial part of the project (25 respondents). Using this data, I aim to assess how accurate the opinions of hundreds of non-experts responding to a questionnaire (Q1) were compared to the assessments of dozens of experts deliberating in a three-round Delphi study (Q4). Additionally, I evaluate the questionnaire-based data (Q1+Q2) to determine whether "surprisingly popular" megatrends should have been prioritized by experts.

I then proceed to explore the motivations of participants in forecasting tournaments to elaborate on a novel design, where participants in a forecasting tournament are asked to predict next year´s opinion of a group of non-experts, rather than the current opinion of a group of experts. This design would have a few additional limitations but multiple advantages over the current combination of forecasting tournaments and Delphi. Therefore, I analyze the results from an additional survey (Q6) conducted to determine the extent to

which participants can remain motivated by the tournament's rewards if they are distributed one year later.

5.2.1 Design

Approximately 1.5 and 3 years after the Delphi study, a group of 25 respondents and then another group of different 25 respondents answered a questionnaire about how each of the 18 global megatrends had increased or decreased in importance over the last 1.5 years (Q5), to create an indicator for evaluating the results. Each response was given on a 5-point Likert scale (Notably decreased - Slightly decreased - No change - Slightly increased - Notably increased). The 1.5-year time gap between the two rounds of data collection was designed to limit potential noise in the data, which could be caused by momentary public overattention to particular global trends.

In the questionnaire instructions, "importance" was operationalized using the same framing as in the original Delphi study. Respondents were asked to think about the importance as if they were answering the question: "*The area will have a very significant impact on the quality of life in Czechia in the next decades and, therefore, public funding should be preferentially allocated to understanding it and addressing it.*" They were effectively asked in which direction and how strongly they would update their response if they were asked this question 1.5 years or 3 years ago. They were also instructed to vote in a balanced manner, indicating increases in importance approximately as often as decreases.

I asked respondents how each megatrend has changed in importance over the last years rather than simply asking about the current importance of megatrends and then comparing new and old rankings for two main reasons: higher expected accuracy of ex-post evaluation and lower expected noise using a more narrow assignment.

According to the literature on evaluation methods, ex-post evaluations often yield more precise and reliable results due to the use of real-world data (Coryn et al., 2011), as opposed to the projections or estimations used in ex-ante evaluations (Rossi, 2004). This applies to the evaluation of foresight as well. Ex-post evaluation framing helps limit information noise (Kahneman, 2021) by stripping away the complexity and uncertainty of predicting many possible future developments and instead focusing on evaluating past developments.

In this foresight task, for instance, to answer "How important will megatrend X be in the coming decades," respondents need to combine their assessments of 1) its current importance relative to other megatrends, and 2) how its importance will develop in the future relative to the estimated development of other megatrends. Conversely, to answer

“Did megatrend X increase or decrease in importance over the last 1.5 years,” respondents are prompted to focus only on the change in importance, think within a limited timeframe, and, most importantly, evaluate the past based on empirical evidence, making their arguments more easily supportable.

Respondents in the ex-post evaluation still need to think about the megatrends comparatively to some extent (as they are asked to calibrate their answers to reflect decreases approximately as often as increases). However, their ability to calibrate well - a skill essential for the best foresight practitioners - is not as critical as it is in creating full rankings based on the estimated future importance of all 18 megatrends.

From the researcher's perspective, the more difficult task of creating full rankings would require gathering a diversified group of at least as many similarly educated respondents as in the original study. This would be costly and might not ensure higher-quality results, as the expected bias in the evaluation dataset would likely be similar to the bias present in the original rankings.

5.2.2 Process

The questionnaire was directed to respondents who were selected and directly asked by email to participate based on two main criteria: they had not participated in the previous parts of the case study, and they, as a group, represented a diverse variety of scientific backgrounds and interests. Of the 50 respondents who chose to participate, 41% were women and the majority were university graduates. Twenty-five different FORD categories of self-reported formal education were represented, while there was also a diversity of areas of informal scientific interest among respondents - each area was chosen as one of the areas of interest by at least five respondents (Figure 7).

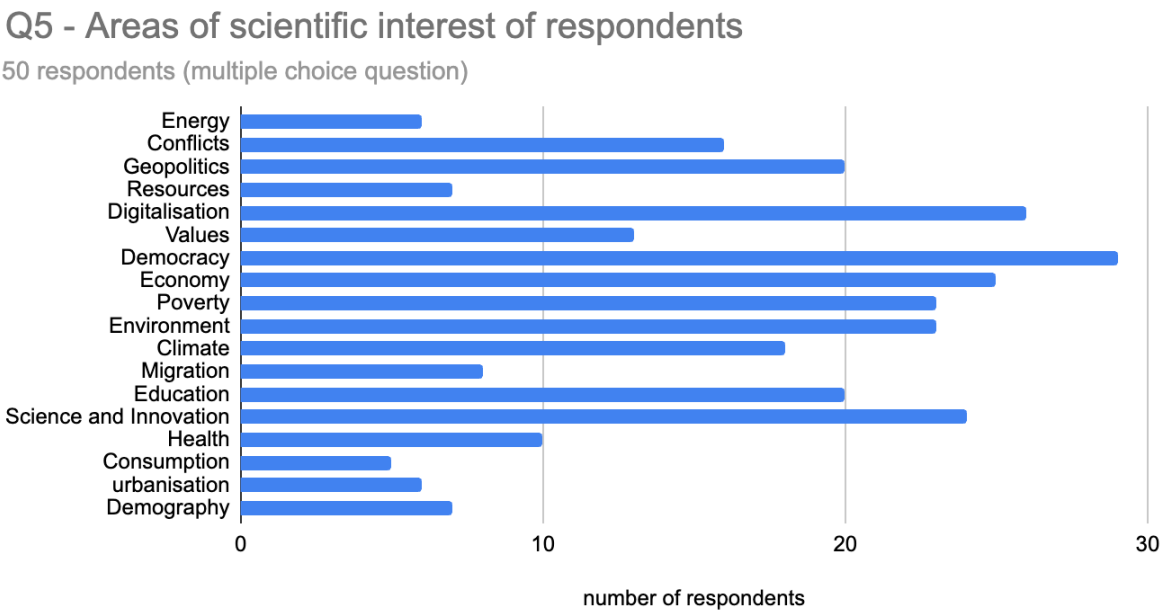

Figure 7 - Scientific interests of respondents (Q5)

For the analysis of data, answers indicating a slight increase or decrease were assigned +/-1 points, and answers indicating a notable increase or decrease were assigned +/-2 points. Responses indicating no change remained 0. Due to respondents indicating more increase in importance than decrease, on average, the data sample was then normalized to limit this discrepancy.

5.2.3 Evaluation results (Q5)

Figure 8 shows the resulting distribution. The standard deviation of the dataset is 1.08. For the subsequent analysis, I proceeded to use only the outliers from the standard deviation, represented by the top and bottom sextiles of the ranked megatrends (green and red items). These megatrends were, on average, estimated to have at least slightly increased or decreased rather than remaining the same (ranked higher than +/- 0.5).

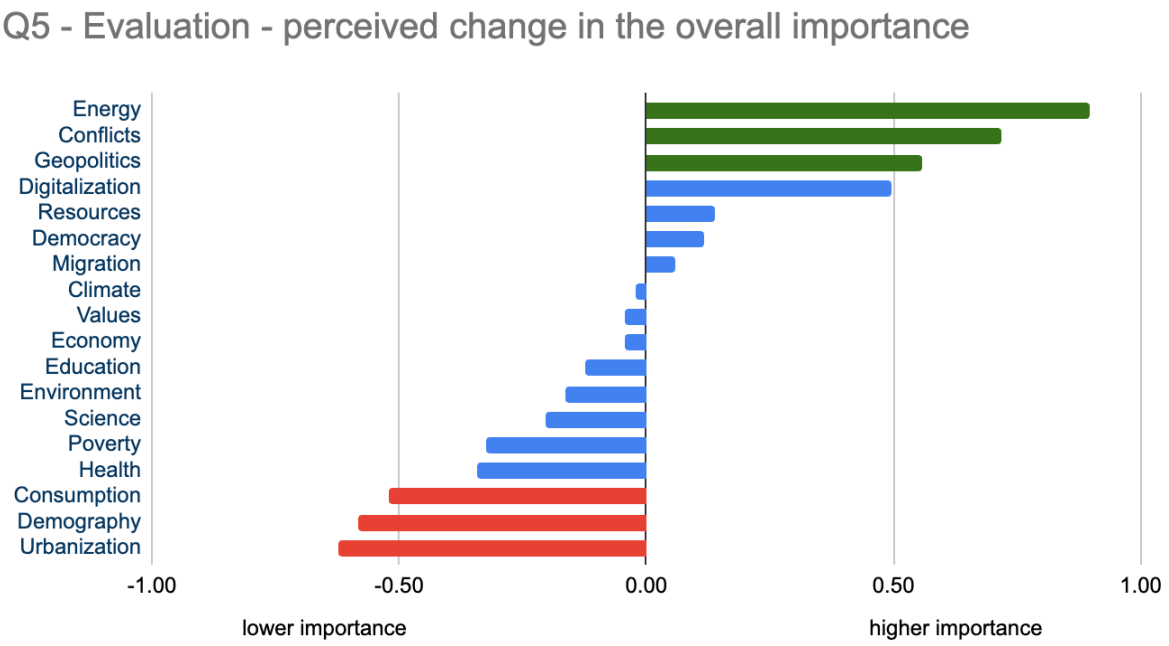

Figure 8 - Evaluation (Q5)

The largest increases in importance were indicated for the megatrends "Energy" (+0.9), "Conflicts" (+0.72), and "Geopolitics" (+0.56), all of which were likely caused largely by the effect of the war in Ukraine. The largest decreases were indicated for "Urbanization" (-0.62), "Demography" (-0.58) and "Consumption" (-0.52).

None of the highest-ranked megatrends were also ones with the highest (or the lowest) scientific interest reported by the respondents (Figure 7). This suggests, that the potential bias of respondents to overestimate the importance of their areas of scientific interest has not played a major role in this evaluation.

The data collected on questions Q1-Q4, which I proceed to evaluate using these estimates, are available in the online OSF repository (Kleňha, 2023). For potential replication purposes, the data collection process is described in detail in the previous study (Kleňha, 2022) and our FUTURE-PRO methodological report (České priority, 2021).

On top of the data regarding the types and numbers of respondents (Table 1), it is important to reiterate, that in the Questionnaire (Q1) as well as in the Delphi study (Q4), respondents were asked to assess the future importance of each megatrend by stating the strength of their agreement with the statement "*The area will have a very significant impact on the quality of life in Czechia in the next decades and, therefore, public funding should be preferentially allocated to understanding it and addressing it*". The 238 respondents to the participative Questionnaire (Q1) were recruited by a publicly open sign-up sheet distributed

primarily to students and various groups of people potentially interested in forecasting. The 24 experts for the Delphi study (Q4) were carefully selected mainly for their academic reputation and the diversity of expertise, and directly invited.

5.2.3.1 Comparison of rankings

To find out how accurate was the non-expert opinion (Q1) compared to the expert opinion (Q4) relative to the future evaluation (Q5), and therefore to what extent it could have been useful for experts in Delphi to be informed by the non-expert opinions, I compared the positions of these six megatrends in both rankings resulting from Q1 and Q4.

As figures 9 and 10 indicate, the three megatrends, that were claimed in the evaluation to have increased in importance the most, were on a 0.66 higher rank in the questionnaire (Q1) than in the expert Delphi (Q4).

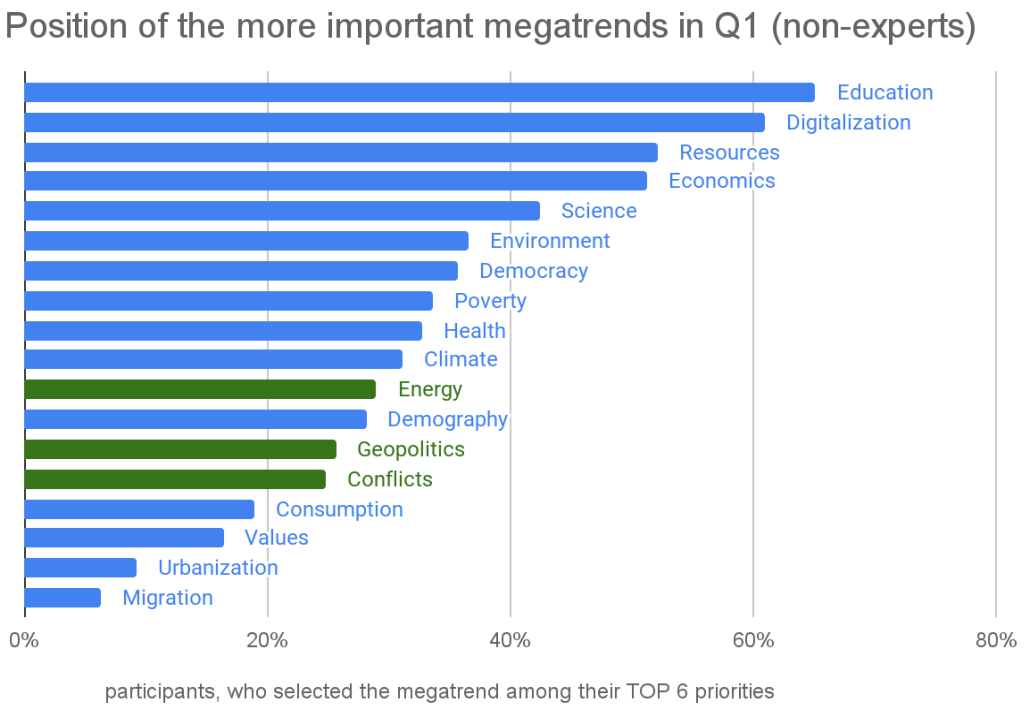

Figure 9 - Comparison (Q1)

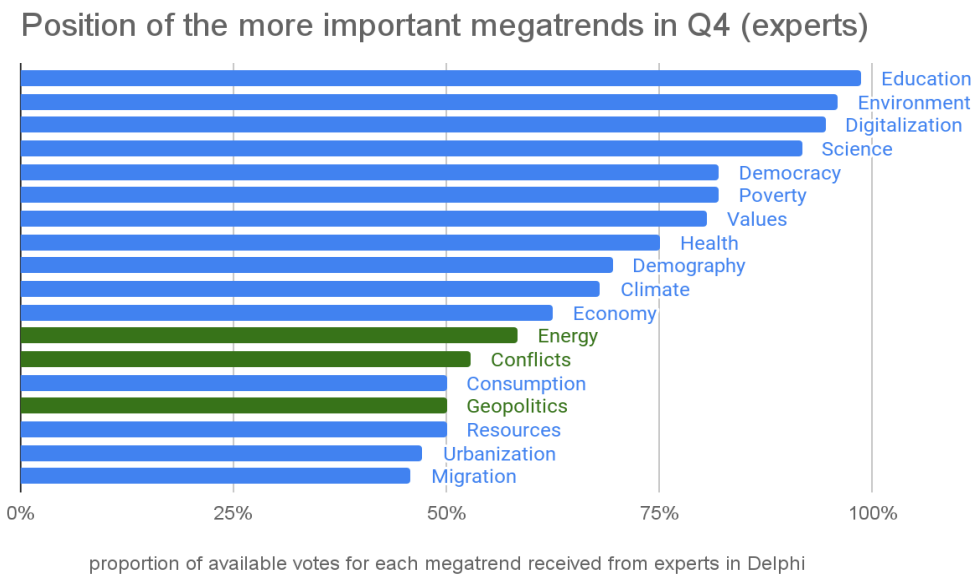

Figure 10 - Comparison (Q4)

Similarly, the three megatrends, that were claimed to have decreased in importance the most, were, on average 1.33 positions lower in the Q1 ranking than in the Q4 ranking (Figures 11, 12).

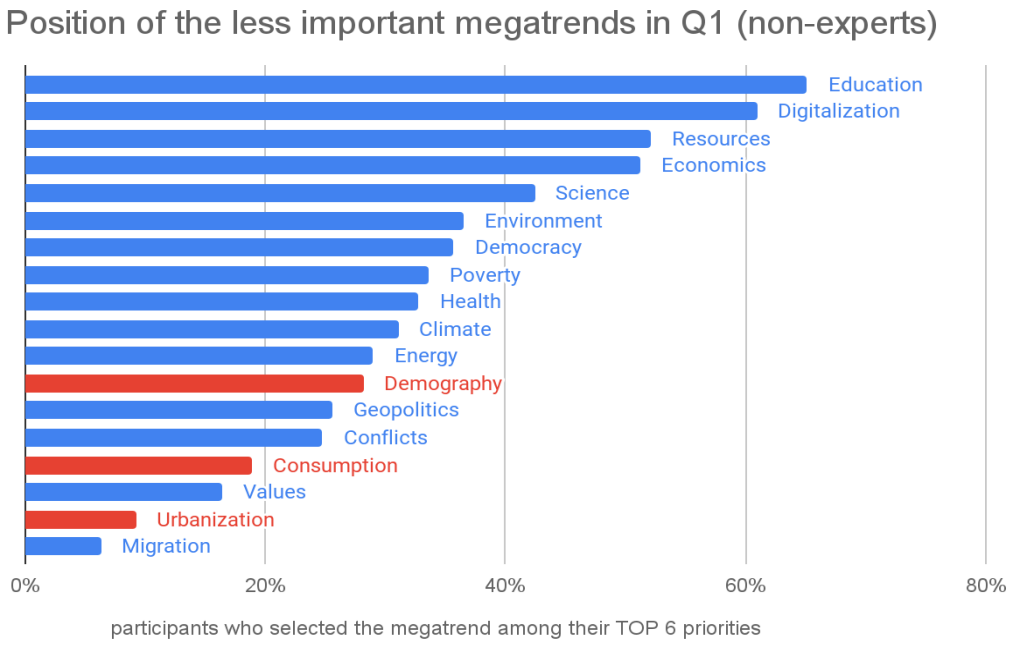

Figure 11 - Comparison (Q1)

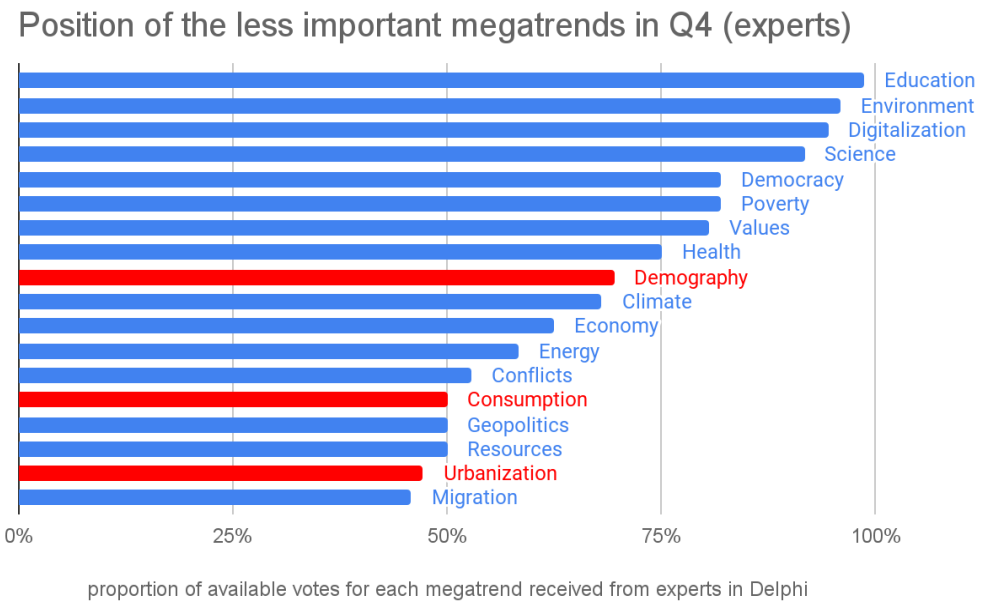

Figure 12 - Comparison (Q4)

Comparing the full rankings (including all 18 megatrends) provides a similar result. The seven megatrends that were reported to have increased in importance over the last three years were, on average, 2 positions higher in the participatory, non-expert ranking (Q1) than in the expert Delphi ranking (Q4). Conversely, the eleven megatrends that decreased in importance were, on average, 1.3 positions lower in Q1 than in Q4.

If we consider the evaluation dataset to be a proper representation of the true change in the importance of the megatrends over three years, it suggests that the ranking of 238 non-experts using a simple questionnaire was more accurate than the ranking of 24 selected experts deliberating in a multiple-round Delphi study. Consequent evaluations are necessary, but these results seem to indicate with confidence, that it is not unreasonable to provide experts with non-expert rankings from participatory methods because these rankings are unlikely to be systematically misleading.

It can be validly argued that the experts are considering a longer time frame, and the upcoming years may validate their perspectives. Studying this potential effect will require more time, additional rounds of evaluation, and similar case studies in the coming years. If it is eventually proven that the outcomes produced by wide, low-barrier participation methods are consistently more accurate than those by experts, however, it would be a transformative finding, questioning the very role of formal academic expertise in strategic foresight.

5.2.3.2 Surprising popularity

One additional analysis conducted with the results was a "surprising popularity" analysis inspired by Prelec et al. (2017), as also described in my previous publication (Kleňha, 2022).

Asking participants in a forecasting tournament to predict the opinion of a group of respondents is an empirically credible academic approach based on the theory behind peer-prediction elicitation. For example, Karger et al. recently found that forecasts elicited using the Reciprocal Scoring method outperformed a control group without incentives (Karger et al., 2021). Other authors explore the theory behind predicting the opinion of another group of participants compared to predicting the opinion of a group of experts (Sempere, 2022). Surprising popularity is currently being used (under the term Bayesian Truth Serum) in a few tournaments on the forecasting platform Hypermind as an experimental method to instantly financially reward participants for making predictions on long-term forecasting questions that will otherwise be resolvable beyond 2030 (Hypermind, 2024).

To assess the "surprising popularity" of each megatrend, I calculated the "prediction-normalized vote" (V) for each discrete answer to determine whether the most up-voted megatrends also have the highest V. Using these approximations, I computed V for each answer i

$$\boldsymbol{V(i)} = p(i) \times \sum_{j \neq i}^{j} \frac{predict(j|i)}{predict(i|j)}$$

Where:

- *p(i)* is the percentage of participants who voted for answer i;
- *predict(i|j)* is the proportion of predictions for answer i among those who voted for answer j. (Prelec, 2017, 541).

In the analysis, I compared each respondent's answers to each megatrend in Q1 and Q2 and then used the formula to calculate all the cases where the response was not the same. As a result, two megatrends emerged as the most “surprisingly popular” - Urbanization (V = 5.75)[3] and Values (V = 3.94)[4], as visualized below (Figure 13). This means, that in case of these two priorities, many respondents selected it among the TOP 6, while also expected,

[3] 19 respondents selected this item, but expected, that the group will not, only 3 predicted vice-versa
[4] 33 respondents selected this item, but expected, that the group will not, only 7 predicted vice-versa

that it will not be among TOP 6 according to the group opinion, and only very few respondents predicted vice versa.

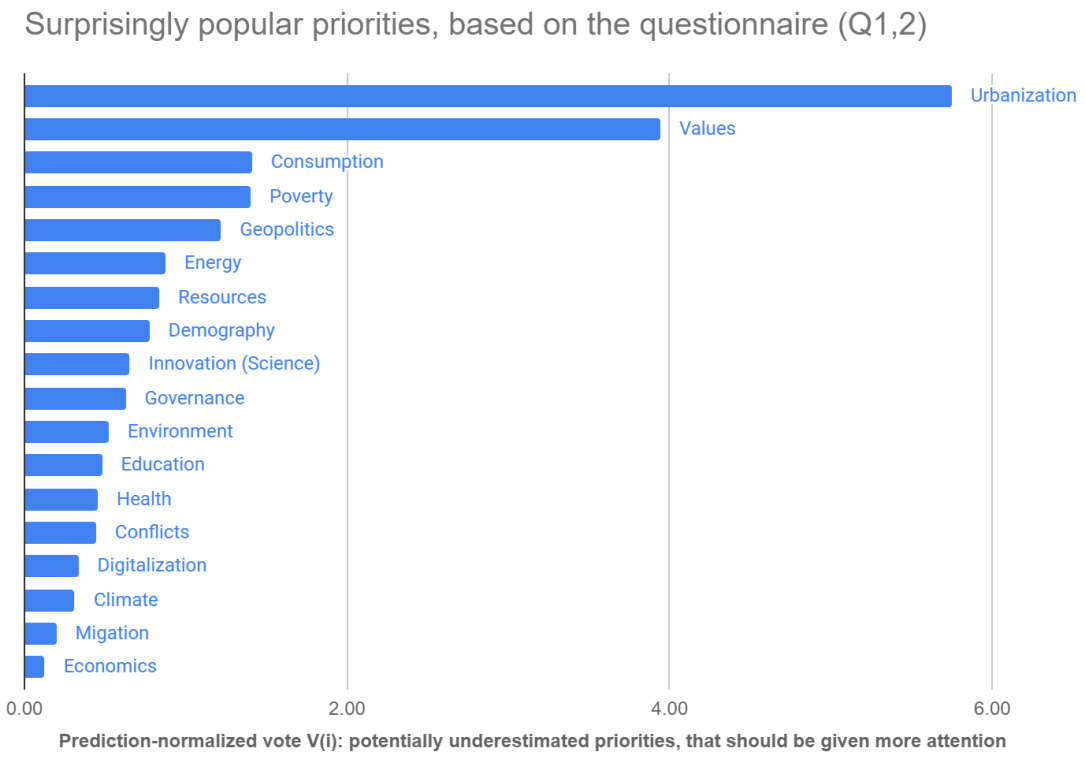

Figure 13 - Surprisingly popular priorities

Statistically significant results were not found using this analytical method. While the values slightly increased, Urbanization notably decreased in importance according to the evaluation, meaning that experts would be misled if they relied on the results of this calculation.

The inaccuracy of this method cannot be definitively claimed either, as the perceived importance of megatrends can still change in the future. Another possible limitation of this data sample is that the calculation, in the case of Urbanization and Values, was based on relatively low numbers (19:3 and 33:7), which might have introduced a bias. Despite these limitations, experimenting with the use of surprising popularity in foresight remains an interesting avenue for future research.

5.2.4 Forecasting survey (Q6)

Building on all the findings from this case study (the ones mentioned above, as well as the ones from the previous publication), I proceeded to explore a new design, in which

participants in forecasting tournaments are offered rewards for predicting a later distribution of opinions of a large group of non-experts about the same topic. Specifically, I explored whether the motivations of this "proxy resolution" would remain attractive. If not, multiple unique benefits of forecasting tournaments (prestige, rewards, and empirical feedback) would be lost.

To explore this, I conducted a survey (Q6) asking to distribute hypothetical funding to a different set of five public funding areas. To explore the motivations of respondents, I provided three motivational factors to participants and later asked them to distribute 100% between them, according to how was each factor important in their distribution of the funding in the survey.

1. Help the Ministry
2. Predict the distribution
3. Donate money

To deliver on the first motivation, I arranged a cooperation with the Czech Ministry of Industry and Trade and secured their interest in receiving this external opinion on the allocation of the National Recovery Fund´s additional US $650 million (NPO, 2023) to these five areas[5] and potentially using this input in the planning of the actual allocation of funds.

"Predict the distribution" was a second motivational factor that would be used in the suggested design. The rule was presented to the respondents, that one year later, exactly the same survey will be conducted and five respondents, whose current distribution will be closest to the average distribution according to the respondents in the next year, will win 2,000 CZK (~US$100). I also promised that as a reward for their time, I will distribute 200 CZK (~US$10) to a relevant charity in each area on behalf of each respondent according to the ratios in their distribution between the five areas.[6]

53 respondents participated in the survey in February 2023. The distribution of the survey was conducted by email to respondents, who, in previous months, had expressed their interest in participating in a forecasting tournament and other foresight activities conducted by researchers from Czech Priorities and Charles University. Most of them were between

[5] The five areas are Digital transformation; Education and labor market, Institutions, regulation, and business support in response to COVID-19; Research, development, and innovation; Population health and resilience.
[6] The full description of the rules is available as part of the Underlying data (Kleňha, 2023). We distributed the funding to five different charities in May 2023.

30-40 years of age, academically educated researchers from a wide range of disciplines, who have not participated in the previous parts of this case study.

In the aggregated distribution, most funds (31.6%) were allocated to Education and labor, and the least funds (6.5%) to Institutional support in response to COVID-19. Many participants wrote comments explaining their reasoning, the summary of which was also later sent to the Ministry. Most importantly, however, the graph below (Figure 14) shows, that the motivation to "Predict the distribution" of a future group opinion accounted for 30.8% of the total motivations.

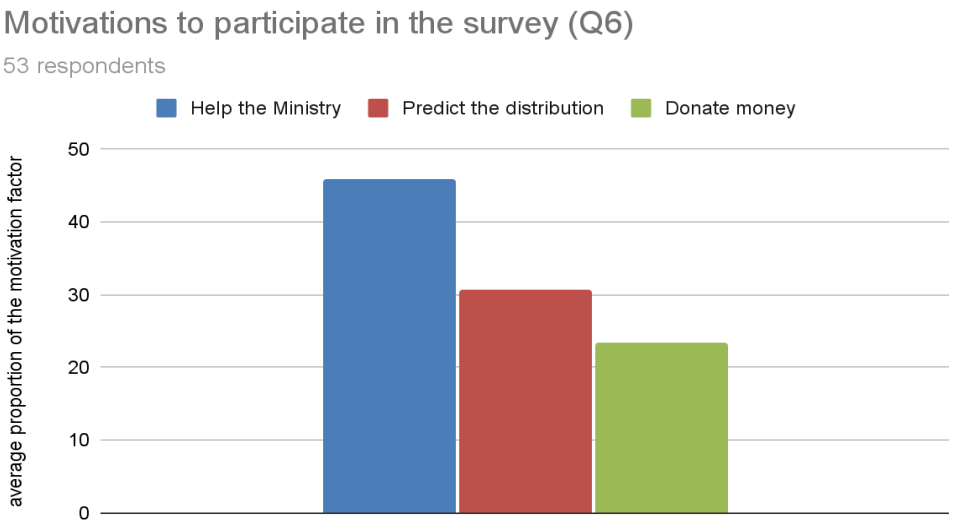

Figure 14 - Motivations to participate in the survey (Q6)

This shows that novel designs such as the one suggested above should work with the combination of all these motivations and keep utilizing the standard forecasting financial motivation, as it seems attractive to participants even when the resolution (and the reward payoff) is 1 year ahead. This motivation accounted for nearly ⅓ of the overall motivation of participants, which is a positive finding since this type of motivation has been shown to be effective in increasing the effort of forecasters and the quality of the aggregate predictions (DellaVigna, 2018).

This is a self-reported motivation that could be slightly different from the true motivations of participants, which might be a limitation. The respondents were also probably more educated than the average participants in large-scale participatory methods. This could mean, that they were disproportionately concerned with the intellectual skill of predicting

the future consensus, but they could also be less interested in the chance of winning the financial rewards.

The motivation to distribute small amounts of funding to the selected cause areas right now created over 20% of the aggregate motivation, which is notably higher than the 5%, that was my pre-registered expectation of the results (Kleňha, 2023). This suggests that the use of credits similar to the Democracy Vouchers used since 2016 in Seattle (Democracy Voucher Program, 2023) could be an appropriate enhancement of this method.

5.2.5 Limitations

The main limitation of the evaluation (Q5) is that it might have been overly influenced by the effects of the war in Ukraine, a topic heavily discussed by experts and in the media during the time of the first round of evaluation (2022), and that the second round of evaluation did not provide sufficient correction for this influence. According to the data, the standard deviation was relatively low in the ranking of the megatrend "Energy" (0.64) - suggesting an increased chance of bias - but close to the standard deviation of the full dataset in the case of the megatrends "Conflicts" (0.81), "Geopolitics" (0.99), "Consumption" (1.08), "Demography" (0.98), and "Urbanization" (1.01).

On the other hand, "Digitalization" and other AI-related megatrends were heavily discussed in the media during the second round of data collection for evaluation (2023), but their importance increased only slightly. This suggests that the method of collection and aggregation of inputs is relatively robust to external factors such as media bias.

Using the same optics, it is possible that the importance of megatrends relevant to public health (due to the COVID-19 pandemic) was exaggerated in the initial Delphi, and that we were not able to fully control for this influence, even though mitigating this bias was one of the main reasons for using a combination of multiple foresight methods in the first place. In a more longitudinal study, this limitation could be minimized by conducting larger hindsight evaluations over time and using their average values (as done with the two separate rounds of evaluation) to evaluate which foresight outcomes delivered by which methods were consistently more accurate.

It is also important to note that a large majority of foresight studies, some of which were described in the previous chapters, do not account for the fact that even an aggregate opinion of a large, diversified group of experts can change considerably over time,

depending on currently trending topics. Recognizing this potential bias in the data (even when not rigorously proven) can be a useful input for future research and applications.

A potentially inaccurate evaluation due to the suboptimal diversification of respondents might be another possible concern. I attempted to mitigate this concern by involving more respondents than similar significant studies[7], while also actively reaching out to experts with a wide variety of expertise (as shown in Figure 1), not only to university students, for example. A comparison of rankings Q2 and Q3 against Q4 was not conducted because the respondents in both Q2 and Q3 were asked to predict the current consensus (Q4), not the future importance of megatrends.

[7] For example the original "Surprising popularity" study published in Nature (Prelec, 2017) worked with the inputs from 51 (study 1a), 32 (study 1b), 33 (study 1c), 39 (study 2) and 25 (study 3) respondents.

6. Forecasting tournament design analysis

Judgmental forecasting tournament is a method, that can itself take a variety of different designs and forms, and be used for many different purposes in public policy-making. This method was introduced in Chapter 3 and it's benefits and limitations were further discussed in Chapter 4.3. In the fist part of the Case study (chapter 5.1), I applied a specific design of this method, and then elaborated on the limitations of it's specific combination with the Dephi method for analyzing global megatrends in Chapters 5.1.4 and 5.2.3.

In this chapter, I conduct an analysis of the most important design elements to be considered during a more general process of designing a forecasting tournament. I have identified these elements based on the international expertise gathered before my case study and then revised them based on the practical evidence.

These five design elements of forecasting tournaments appear most relevant for many different purposes of improving policymaking, not only for identyfying global trends. The remainder of this chapter is structured according to these five consequent design elements:

1. Risk assessment of the use of forecasting tournament
2. Design of the rules of forecasting tournament
3. Design for recruiting forecasters
4. Facilitation and oversight design
5. Design of the final report

Aside of its constribution to the scholar research on the design of foresight methods, this analysis can provide some guidance for researchers, who intend to use forecasting tournaments in strategic foresight. There are a number of studies, guidelines and resources available regarding the proper facilitation of a Delphi method, but judgemental forecasting is a novel method that currently lacks such resources, which was the reason why this design analysis could serve as a theoretical base for further research and practical applications.

6.1 Risk assessment of the use of forecasting tournament

In general, as summarized by Chambers et al. (1971), “the selection of a [forecasting] method depends on many factors - the context of the forecast, the relevance and availability of historical data, the degree of accuracy desirable, the time period to be forecast, the cost/benefit (or value) of the forecast to the company, and the time available for making the analysis.” This is very relevant also for selecting the right forecasting tournament design.

Before deciding to use a variation of the judgmental forecasting method, a few risks that come with the implementation of this method should be considered. Most of these risks usually revolve around producing suboptimal forecasting outputs. This can be caused by unsuccessful participant recruitment or by participants underestimating the required time commitment. The latter issue can be mitigated by slightly altering the tournament rules, like offering extra incentives, even while the competition is ongoing (Codi et al, 2022).

Suobtimal outputs can be produced also due to the incorrect or misleading phrasing of the forecasting question in the first place. To minimize this risk, it has been claimed, that it is recommended to involve the policymakers who will use the final outputs, as they can help "formulate the forecasting problem properly and can therefore have more confidence in the forecasts provided and use them more effectively." (Chambers et. al, 1971).

Risks related to participants who might actively sabotage or trick the competition can be resolved by disqualifying them. This risk can further be diminished by engaging forecasters from an already-established group who have proven their dedication and ability to participate conscientiously in a previous pilot competition. The potential inclusion of individuals who have access to relevant insider information, in cases where these types of information exist, should usually be seen as beneficial for the results. These participants can indeed use this advantage to win the rewards, but their forecasts based on non-public data might shift the collective predictions towards more accurate predictions.

6.2 Design of the rules of forecasting tournament

Before the tournament, it has proven useful to systematically describe and analyze the overall intention of the forecasting tournament and then look for the most appropriate tools for the technical and organizational implementation. There are several questions that have been answered in this phase in past projects, that affect the complexity of the tournament preparation. It is important to first come to a consensus with the user of the ultimate foresight results (ideally the leadership of that organization) on what foresight outcomes or which individual predictions they actually need and how exactly they will use them in their decisionmaking. This step can increase the pressure for the final results to be practically utilized, but can also substantially help to improve the formulation of the questions.

Choosing the right forecasting platform is also crucial in this part of the designing process. It is possible to use commercial or open-source platforms to organize a forecasting

tournament. When choosing a platform, one should pay attention to the cost of the platform and its technical features, especially the types of forecastable questions and a scoring mechanism available to be used on the platform.

In relation to the costs, most commercial platforms may charge relatively high fees, but the facilitator has a benefit of being able to contact the IT support of the provider with issues. Open-source platforms, on the other hand, can be free, but own IT experts should be readily available to deal with possible technical problems. When negotiating a collaboration, it is useful to be aware of how the data obtained on the platform can be exported and used after the tournament (Kleňha et al., 2022).

There are currently two main designs of making predictions. Some platforms use the design allowing the input of predictions using an arbitrary probability distribution within a given range. In contrast, others only allow splitting the responses into “bins”, where forecasters predict the probabilities of each bin. Both designs have some benefits and some limitation, of which most important aspect is the granularity, with which it is desired to receive the predictions. In general, the second design using “bins” is less difficult to understand from the perspective of the participant, but it allows users to provide less granular information.

Analyting the various designs of the scoring of predictions, platforms use different ways to evaluate the resulting predictions and then calculate a score. The two most common ways of calculating the score are Brier scoring (Brier, 1950) and logarithmic scoring (Bikel, 2007). In case of the Good Judgement forecasting tournament, for example, the authors of the subsequent study used the Brier score and claimed, that “the specificity of the tournament’s questions enabled accountability, the feedback provided by Brier scores enabled learning, and learning ultimately improved accuracy.” (Tetlock et. al, 2017).

The Brier score is calculated by averaging over all squared differences between predictions and the actual outcomes to produce a number between 0 and 1, where a lower number indicates a better prediction. The Brier score is more “moderate” than the logarithmic score, which gives much more weight to extreme predictions, so if a forecaster answers a question very confidently (close to 0% or 100%) and turn out to be wrong, they will lose enough points to not be able to come back to the leaderboard and win rewards.

Another important design choice is whether participants will see predictions of other participants or the current aggregate during the tournament, or whether this information will be hidden from participants. The desired length of the tournament and the number of

questions (and therefore the amount of work required from participants) seem to have been other important aspects to consider especially while designing the motivational factors such as financial rewards or other kinds of reimbursements, or reputational rewards such as public leaderboards or public announcements or endorsements of the best forecasters.

Public leaderboards motivate the best forecasters to compete against each other but strongly discourage forecasters who underperformed and have low scores at the beginning of the tournament. Similarly, public rankings can strongly discourage participation by senior staff or, for example, colleagues from the same institution or department who may fear for their reputations if others outperform them (Horowitz, 2021). This effect may significantly reduce the number of participants who complete the tournament. Over all, proper tournament rules are a crucial element, required to ensure adequate quality of the results.

6.3 Design for recruiting forecasters

Most previous tournaments in the field of public policy have shown, that is is an essential condition for success to recruit a large enough number of participants. According to the OPTIONS forecasting tournament (OPTIONS, 2021) as well as the Salem/CSPI forecasting tournament (Hanania, 2023), both of which lasted for approximatelly 6 months, the drop-off during the tournament was around 75% of participants.

In shorter tournaments such as those periodically run by Metaculus or the Good Judgement Open, the retention rate can be higher. Nonetheless, if the facilitator aims at obtaining thoughtful responses and predictions from over 10 participants, which has been approximated as a relevant minimal threshold over which the aggregate Brier score usually increases slowly (Dillon, 2021), they should aim at recruiting at least 50 participants at the start of the tournament. Aiming to recruit over 150-200 forecasters is advisable, however, as evidence shows, that in case of the Metaculus platform, “increasing the number of forecasters seems to not only improve performance on average, but also seems to decrease the variability of predictions, making them more stable and reliable.” (Bosse, 2023)

Good forecasters can be found in almost any field of expertise and the main motivation to participate in a forecasting tournament is often reported to be the opportunity to self-develop and test one's own skills. Participants can therefore be sought, for example, among students and at universities, in both the natural sciences and the humanities.

The salient advantage of forecasting tournaments lies in their capacity to aggregate many diverse inputs, thereby advocating for a relatively expansive recruitment process to ensure a broad spectrum of viewpoints and opinions. Nevertheless, if the end-user expresses interest in participants with specific skills or abilities, the recruitment parameters can be adjusted accordingly. For instance, the Cosmic Bazaar project, inaugurated in 2020 within the British Civil Service, exclusively permits the participation of civil servants.

Research indicates that only a fractional subset of those intrigued by forecasting exhibit exceptional forecasting proficiency without prior instruction. Therefore, it is beneficial to facilitate preliminary probability training before the tournament. Although untrained participants may provide valuable predictions through the creation of insightful commentary that may influence other forecasters, a brief introductory training appears to be a highly cost-effective strategy to enhance the quality of the final outputs. Competent forecasters can respond to queries across various disciplines and alert domain experts to potential non-intuitive consideration or possible cross-sectoral consequences, so it makes sense to recruit participants with no expertise in areas relevant to the questions being asked.

Simultaneously, it is vital that at least a few forecasters with core area expertise participate in the tournament. Judgmental forecasting fundamentally seeks not to supplement expertise with crowd wisdom, but to mitigate potential cognitive and other biases of experts concerning highly specialized topics by effectively aggregating multiple judgments, each based on a distinct information sources and knowledge. Therefore, most part tournaments made a design choice to recruit a combination of participants with and without the expertise on the particular subject of the study.

Recruitment materials often highlight the competitive nature of the tournament, the rewards and the absence of the need to bet own money (which is a common attribute of prediction markets). My experience suggest, that the option of anonymity and the ability to exit the tournament at will is also important to mention in the recruiting materials. Finally, it should mention the tournament's duration, the time commitment for any obligatory training, and the anticipated participation intensity or the expected time needed to respond to questions. Throughout the whole project, adherence to General Data Protection Regulation (GDPR) principles concerning personal data management is mandatory.

As discussed above, the evidence shows that the group of forecasters does not need to be representative of the population or scientific disciplines, but it needs to be sufficiently diverse in opinion to include minority views, specific experiences, knowledge, and different

backgrounds. This can be achieved through broad recruitment at diverse institutions, across demographic groups, age categories, and regions. (Kleňha et. al, 2022). Suitable mediums for circulating recruitment details may include social media groups relevant to the subject matter, or newsletters originating from universities and educational establishments. Past forecasting tournaments also usually created its own dedicated website.

The possible influx of insufficiently skilled applicants can be mitigated by selecting participants based on their disclosed motivation. From my experience, one way to test the motivation could be by mandating that all forecasters participate in the initial calibration training. Ensuring the option of anonymity for all participants is also important, and this point should be underscored in all recruitment materials.

The effect of different types of initial training on individuals' ability to make accurate predictions has been the subject of several academic studies and research projects. (Chang, et. al, 2016; Mellers et. al, 2014; Muelhauser, 2020) In order to ensure a basic ability to provide predictions, training should at a minimum teach the basics of working with probability, explain the fundamentals of proper calibration of individual judgments, and explain to participants, through demonstrations, how the scoring mechanism works.

6.4 Facilitation and oversight design

During the tournament, the facilitators post the questions on the platform and are usually advised to actively monitor new comments, especially in the first days of the tournament to see if the participants understand the question correctly. They clarify or modify questions if necessary, and later resolve the questions according to the pre-arranged resolution criteria.

Most platforms provide the opportunity for participants to publicly report an ambiguity in a question to the tournament administrators during the tournament, while clarifications by administrators can be provided also without prior reporting. The first few days after the questions are asked can be very time-consuming for the administrators, due to the high volume of comments which must be read, which in turn requires the administrator to track down information and provide clarification. The design choice can be made to save resources by not providing clarifications and relying on the ability of the group to correctly converge to the most likely intended merit of the question, but the facilitators of most past tournaments did activelly provide clarifications.

The final termination of the tournament usually occured immediately after the event thatwas required to resolve the question. The tournament facilitator fills in the correct answer on the forecasting platform and thus completes the prediction of the question, which on most platforms will automatically calculate the scores for the participants, send notifications and adjust the leaderboard positions on the platform (Kleňha et. al, 2022).

6.5 Design of the final report

In most cases, a relativelly short final report from the forecasting tournament is written and distributed accordingly. It is recommended that the report be formulated with the specific needs of the institution in mind; some institutions may be particularly interested in raw data while others, for example, may want a summary of all the sources cited. The final report is usually prepared by the the analysts from the facilitating team. Ideally, this analyst have monitored the activity of participants throughout the tournament and later reflects on potentially interesting moments that occurred during the tournament in the final report.

The final report usually includes information such as the exact wording of the question asked, the number of forecasters involved in the prediction and the resulting aggregate prediction. The evidence from the forecasting project OPTIONS (České priority, 2021) shows, that it is beneficial to the outcomes, if the final report also presents the aggregate prediction developed over time, shows the best comments written by forecasters, and aids with the interpretation of the resulting data. This report can be a part of a larger study, if the forecasting tournament is only one of multiple foresight methods applied in the project.

Over all, the analysis of the main five design elements conducted in this chapter draw on the findings from previous forecasting tournaments and academic studies and reports, and from the empirical experience from my case study. It provided insights into the potential risks to be preemptively mitigated in the designing process, the main practical principles of how to design the rules and recruiting mechanisms before the forecasting tournament, how to facilitate the tournament, and also which forms and means of presenting the final results have been empirically proven most appropriate. More practical policy advice may be distilled from these findings in the future. Currently, a relevant policy advice are discussed in detail, for example, in the manual “A Roadmap to Implementing Probabilistic Forecasting Methods” (2022) published by the Perry World House at the University of Pensylvania.

7. Foresight process analysis

In this chapter, I use a similar approach and conduct a design analysis of the most important design elements, that should be considered during the creation of a foresight process. I return to the higer level of generalization and analyze the main design elements in the initial process of planning and conducting a foresight study. This chapter expands mainly on the general findings of the use and relevance of foresight methods, written about in Chapter 3.

As mentioned above, Forecasting tournament and a Delphi method, the combination which was explored in Chapter 5, is not suitable for all foresight purposes, and even though it offers promising results, it should not be used to fulfill every foresight demand. The chapter builds on that premise and analyzes the elements stemming from the existing evidence-based recommendations. The aim here is to enhance the existing literature by systematizing, outlining and discussing the main elements elements of the process of designing a foresight study.

Overall, as noted in the Chapter 3, the policymakers and foresight practitioners has been advised by experts to design their foresight study to combine multiple foresight methods within the aforementioned UAP framework consisting of the three phases of foresight study - Understanding, Anticipating and Planning (České priority, 2022; Voros, 2003). The visualization below (Figure 15) results from the research described in Chapter 3 and can serve as a useful initial guide for researchers as well as practitioners on the viability of various combinations of foresight methods.

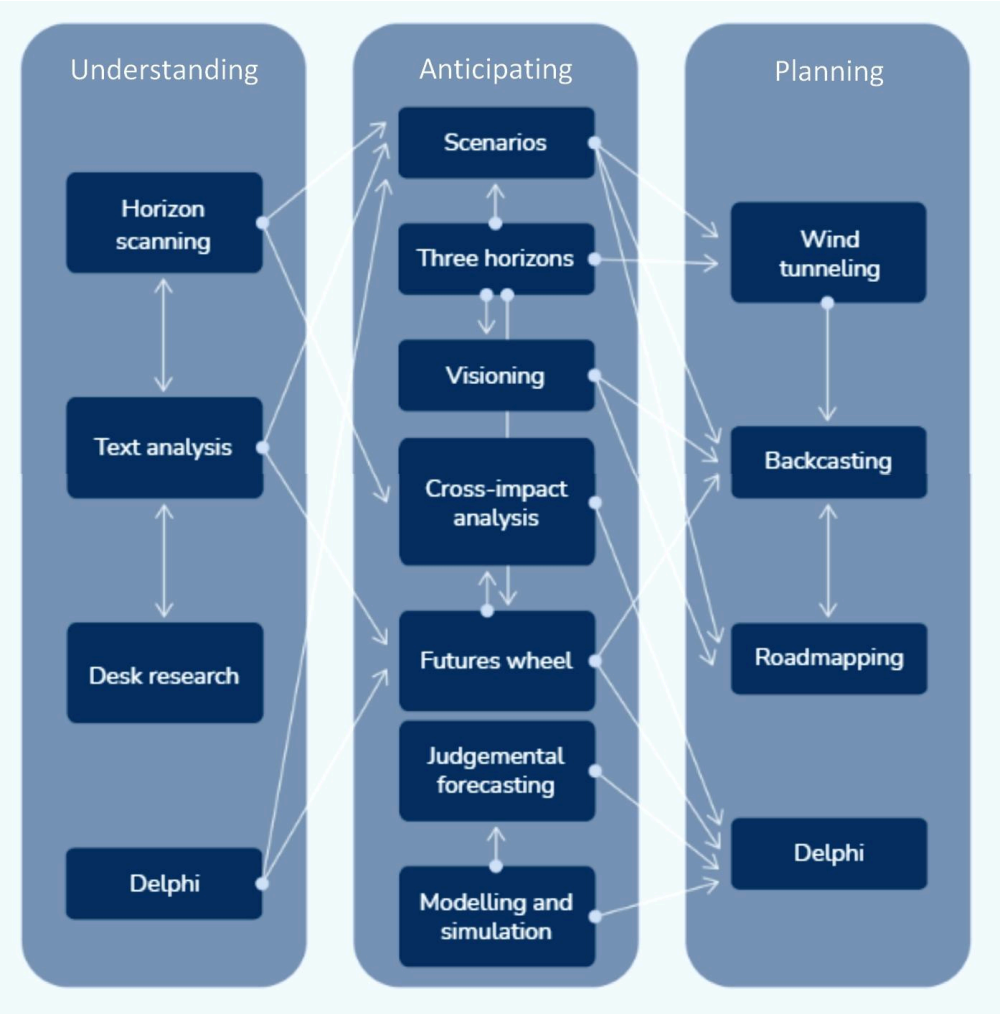

Figure 15 - Phases and combinations of foresight methods

Knowing this framework and the benefits and limitations of all the individual methods, is, however, in itself not sufficient for arriving at the most relevant design of a foresight study. To do so, I claim that it is important to consider these four design elements as the most important considerations before starting a foresight process designed according to this framework. As in Chapter 6, these elements should be answered in a chronological order:

1. Designing the objectives (based on a proper assessment of needs)
2. Designing the engagement of stakeholders
3. Designing the methodology
4. Designing proper assessment and evaluation

7.1 Designing the objectives

The assessment of needs and a consequent clear formulation of the objectives of the study should be a concern of the first group of design elements to decide on in a foresight study. To illustrate the importance of this step, I explore five possible needs for foresight and how the realization of each of these needs translates into formulating the objectives of the study.

Sometimes, the objective of foresight is to identify where to make relatively safe bets. If a policymaker or a public organization needs, for example, to create a strategy for future public investments into research and innovation, it´s objective should be to use foresight to robustly identify the landscape of general global or national trends that are relatively likely to appear. This ensures that the majority of public resources will be spent on relevant directions and that the funding for science is relatively predictable in the 10-20 year horizon, which is especially important for fields of science that require longitudinal approaches. FUTURE-PRO (2021) study of global megatrends relevant to the future of the Czech Republic can be noted as an example of a project fulfilling such objective.

On the other hand, if an organization, region or a country wants to become a leader in a highly competitive environment, it should use strategic foresight methods to identify a few more risky bets. The objective for this purpose would be to focus on specific opportunities that might appear in the future and then combine this with the assessment of existing comparative advantages. This can result in an active monitoring system of emerging trends and in prepared plans for how to move early to take advantage of these upcoming trends. This objective is aimed for in some foresight studies commissioned by VC funds, but also by foundations aiming to focus on few high-impact targets, such as Open Philanthropy (2023).

Other times, foresight is needed for the better management of relatively likely risks that will occur in the future. This can be the case if a policymaker needs, for example, to decide on the distribution of social benefits for citizens according to the outlook on the broad societal developments such as aging or likely loss of jobs due to novel Artificial Intelligence tools, in order to prepare the social system and prevent the risks from being too disruptive. This is likely the most usual objective focused on by the majority of aforementioned studies.

The management of potentially great, but unlikely risks is also critical in some situations. For that, it is important to aim to see all possible risks and then try to assign probabilities to their occurrence and potential severity, in order to increase societal resilience by increasing the effectiveness of preparing the right strategies to prevent or swiftly react to these risks. “Existential Risk and Rapid Technological Change” study by the UN Office for Disaster Risk Reduction (Stauffer et al., 2023) is an example of a recent study based on this objective.

The last main objective of foresight can also be the participation itself, and the benefits it carries. The proper and efficient involvement of citizens in foresight exercises, in these cases, requires using widely participative methods, keeping the foresight process wide and maximally transparent, and the discussions open to unusual arguments and novel insights.

As part of this first element of the designing process, general questions such as what is the expected timeframe for the foresight study (at least whether it is a short-term, medium-term, or long-term foresight) or what is the geographical scope of the study are also usually answered.

7.2 Designing the engagement of stakeholders

The next important design element deals with the engagement of relevant stakeholders and the planning of their involvement in the foresight process, aiming to mitigate the risks of disapproval of the outcomes and to increase the likelihood of the outcomes being adequately used in the policymaking process.

In multiple studies described in Chapters 2 and 3, the stakeholder mapping process, even though probably not conducted with completely adequate rigor, started with brainstorming and listing possible stakeholders, which usually included government departments and agencies of multiple levels of government (municipal, regional and national), regulatory agencies, representatives of the private sector, research and academic institutions, civil society including community groups or advocacy organizations, members of the public, media and also, in some cases, representatives of international organizations.

Once potential stakeholders were identified, the next step in the studies involved assessing and categorizing them based on relevant criteria such as their level of interest, influence, power, or impact on the future implementation of the results. This can be visually represented in a stakeholder map or matrix, in order to understand who is most interested in maintaining the status-quo and who holds the most influence over the success of the strategy, legislative action or a regulation, that is going to be informed by the final foresight outcomes.

In theory, the information gathered in this process was often used to inform communication strategies of the outcomes, to engage stakeholders effectively throughout the foresight study and especially to manage their needs and expectations in the consequent policy or strategy implementation. It may be expected that some stakeholders will be apriori critical to the content or the process of the foresight study. For that, the organizers can prepare strategies for mitigating these negative inputs especially during workshops or public events.

I have not found enough reliable evidence to whether the studied international projects have created such materials or prepared any specific risk mitigation strategies in advance.

7.3 Designing the methodology

The consequent process of choosing the most appropriate foresight method or a combination of methods can be informed by the framework introduced above while taking into account the financial limitations, organization's capacities and the skills that can be used during the project, which may heavily depend on whether the foresight study is conducted internally or contracted or subcontracted to external organizations or foresight practitioners.

The approaches to dealing with uncertainty, as well as ethical questions are also important to consider. As in the previous design element, it is theoretically advisable to think about how will the study ensure that it considers the needs and views of all relevant sections of society, whether there are any potential negative impacts, and how can these be mitigated.

A detailed plan of the communication and the later use of the results should be outlined already before the beginning of the study. In some existing cases, it was necessary to communicate the partial results already during the process of the study, for which at least a general communication strategy was vital. Such strategy should contain answers to questions such as when and how the study's results will be communicated to other stakeholders or how specifically they can influence the formation, implementation, and evaluation of policies, directly and indirectly, and what are its communication implications.

Since the outcomes of foresight are, by its nature, not definitive, they need to be continuously updated even after the end of the study. For that, it is considered important to prepare answers to questions about how will the study incorporate learning and adaptation processes to ensure it remains relevant in a rapidly changing context, and how can feedback loops be established to allow the study's findings to continually inform policymaking.

7.4 Designing proper assessment and evaluation

Last important design element to decide in process of designing a foresight study is the ability to later monitor and evaluate all relevant foresight outcomes. It is important to start designing the assessment plan before the beginning of a foresight study and to develop evaluation questions in advance that will be later used to describe the benefits of the study.

Incorporating assessment into the foresight process most probably enhances the clarity and trustworthiness of the outcomes, as evaluators can observe how foresight is executed, the

data employed, and scrutinize the underlying assumptions. As a continuous improvement of foresight methods is a primary principle of monitoring and evaluation, the assessment should outline and address the study's risks and limitations (Piirainen et al., 2012). Failing to do so may result in future studies replicating past errors.

Monitoring and evaluation is a comparatively intricate and resource-intensive process that requires adequate allocation of financial, human, and temporal resources Piirainen et al. (2012) also claim that assessments of foresight initiatives should consider three important aspects: the utility of the outcomes, the technical execution, and the ethical aspect. Regarding the utility of the outcomes, it is useful to expect assessment questions such as “Was the perspective the one that was needed?”, “Were the foresight results satisfying to the stakeholders?” or “Were the consequent strategies feasible and were they based on foresight?”.

Technical execution should be done with the expectation of future questions such as “Were the interpretations reasonable and balanced given the data?”, “Was the conceptual model solid and convincing enough to enable successful foresight?” or “Did the research design handle data robustly?”. To take into account the ethical level of the study as well, practitioners should prepare to answer questions such as “Who is the client or beneficiary whose interests are served?”, “Are the intentions and agendas acceptable?” or “What resources and other conditions of success ought to be controlled by the stakeholders?”.

Most of the practical international examples of foresight studies, presented in previous chapters, have lacked a pre-designed evaluation plan, suggesting that this last design element has historically been underestimated, possibly due to the difficulty of any evaluation of foresight results or due to prevalent general tendencies to maintain a space for various interpretation of the accuracy of the results in the future.

Even more generally, an important learning from conducting the analysis in this chapter is, that a rigorous consideration of all four of these design elements historically was, and therefore probably still is likely to be underestimated in strategic foresight studies. The proposed design elements seem relativelly simple and widely applicable to the management of many research projects or policy studies, but in reality, there is often a lack of time,resources or highly skilled project management capabilities, especially in the initial designing phase, which is often the most difficult part of the project.

A detailed study on the reasons and solutions to this problem is not feasibly in the scope of the design analysis presented in this chapter, but the results amplify the fact, that even a relatively quick consideration of these four simple design elements can have outsided positive effects on the quality of the foresight outcomes.

8. Aspects of foresight institutionalization

Around the world, the application of foresight techniques in public decision-making processes is on the rise (Popper, 2010). Despite the growing interest from policymakers (SOIF, 2021) and the development of the profession of the "foresight analyst" (Hines & Gold, 2013), however, there still exist a number of fundamental obstacles to the robust and systematic institutionalization of strategic foresight in national public policymaking.

In the first part of this chapter, I conduct an analysis of seven different cases of foresight institutionalization in national policy. After analyzing the seven cases of Functioning foresight ecosystems, I summarized the most often cited aspects of non-functioning ecosystems and continue with a study of academic literature about potential improvements. Finally, I synthesize all these learnings into two specific directions, that, I claim, should be further studied and potentially implemented.

8.1 Functioning foresight ecosystems

I considered two general criteria when selecting countries for this case analysis. First, I selected democratically governed countries, that have a history of conducting foresight studies and that are considered developed in this regard by the international foresight community. I omitted countries governed by authoritarian regimes. They might produce relatively high-quality foresight outcomes (e.g. United Arab Emirates or Saudi Arabia), but they do not rely on foresight ecosystem institutionalized across a spectrum of public institutions ultimately responsible to the public.

Second, in order to produce more internationally generalizable findings, I selected countries with very different governance structures. USA, United Kingdom, Finland, Germany and Singapore have all widely different institutions and systems of governmental checks and balances, which makes it more cognitively difficult, but also potentially more useful to study to identify the most prevalent general aspects of functioning national foresight ecosystems.

8.1.1 Finland

The Finnish foresight ecosystem is very specific as it involves several entities working together. The maturity of the Finnish foresight ecosystem is evidenced by the fact that future studies are an essential part of the educational system. There are a number of research teams at universities. The Finland Futures Research Centre at the University of

Turku can serve as an example. Even at the primary school level, students regularly study the future. Foresight is a common practice among other entities, including the private sector. A highly significant position is held by an independent public foundation, SITRA, which operates directly under the supervision of the Finnish parliament.

As hundreds of entities in Finland are currently engaged in foresight, their activities need to be coordinated. This is managed by the Prime Minister's Office and SITRA as part of the National Foresight Network, which serves as a discussion and coordination forum and organizes various events for these entities. The themes of these events vary, but generally, they offer presentations of forecasts, educational events, and opportunities for networking.

At least once per electoral term, the Finnish government presents a Government's Future Report on long-term perspectives and government goals. The preparation of the report is divided into two parts. The first part is purely scientific-analytical and is prepared by a working group composed of members of foresight units from all ministries. Ministries engage in foresight not only in connection with the report, but also in their everyday agendas, including ongoing horizon scanning of their own perspectives. The working group deals with both common and individual threats and opportunities, and the key ones are reflected in the report. The second part is purely a political process. The government discusses findings from the first part and, based on its own decisions, focuses on one or more key issues and contemplates possible future directions.

Two important entities oversee the preparation of the report. The first is the Government Foresight Group in the Prime Minister's Office, an expert group that supports government foresight activities and the work of the National Foresight Network. Its members are foresight experts from various spheres and represent both creators and users of foresight outputs. The main goal of this group of experts is to develop and strengthen ties between foresight activities and decision-making processes. It also serves as an advisory body in the preparation of the report and in the future reports of individual ministries.

The second entity is the Committee for the Future of the Finnish Parliament, which serves as a think tank for the future, and scientific and technological policy in Finland. Its mission is also to develop a dialogue with the government about major future problems and opportunities. In connection with the Government's Future Report, the committee prepares a Parliament's Future Report, which is a response to the government document. In this way, the Finnish government and parliament can identify important political topics at such an early stage that various alternatives and political directions are still entirely open and developing. In addition to responding to the government report, the committee

independently decides on its own competencies and prepares responses to foresight studies as it sees fit.

The Government Foresight Group and the Committee for the Future are not subordinate to each other, even though the parliament is formally the highest entity in the Finnish political system. The work of both entities operates based on mutual agreement and control and independently from each other. If there are ambiguities or dissatisfaction with the key points of the Government's Future Report, the comments are iterated until a consensus is reached.

In an additional interview with a member of the Government Foresight Group, that was conducted as part of this research, several indirect outcomes were noted as key examples of good practice in Finland's approach. These include fostering a sense of community, initiating dialogue between influential development stakeholders and political decision-makers, reaching consensus concerning long-term objectives, keeping political representatives informed about potential future threats and opportunities, and strengthening forecast-related literacy throughout society.

On the other hand, the respondent pointed out a deficiency in the system, specifically the limited application of foresight insights, since factors beyond just scientific knowledge often play a part in political decision-making. The respondent claimed that the procedures for compiling the Government's Future Report are well organized and that individual entities, such as university research teams and organizations, handle specific analyses (GFG member, 2022).

8.1.2 United Kingdom

The United Kingdom's strategic foresight initiative has a lengthy past, originating in the aftermath of World War II. Approximately two decades ago, this gradually evolved into what is now known as the Government Office for Science (GOS). Directly subordinate to the UK government, this ministerial department is one among 42 entities under the Department for Business, Energy & Industrial Strategy.

The GOS does more than just conduct studies; it plays a crucial role in expanding foresight capabilities within public administration. It generates and shares a wide array of tools and methodologies through “The Futures toolkit” (Government Office for Science, 2017) and offers training for government officials. Additionally, the GOS has devised a framework for commissioning external foresight studies called the Futures Procurement Framework, currently comprising 27 companies eligible to provide services worth up to £50,000.

Furthermore, the GOS plays an important role in networking organizations across public administration. The GOS research team, Futures, Foresight and Emerging Technologies (FFET), focuses on identifying future development and formulating forecasts, assisting in integrating foresight into the steps of the UK government. Through another team, the Horizon Scanning Programme Team (HSPT), the coordination of work of individual units takes place, linking various experts and their work, and even conducting its own studies. The HSPT is managed by a government minister's advisory group and meets at least three times a year. Regular meetings are held between these institutions.

The activities of the FFET team are not exclusively focused on one topic. From an extensive portfolio of studies, examples include the Future of Cities, Future of Production, Future of Mobility, Future of Aging Population, or the report Migration and Global Climate Change. In terms of time, these are studies that try to predict future developments in a given topic over a horizon of 20 to 80 years.

A level below operates, for example, Scotland's Futures Forum, which was established by the Scottish Parliament. The main goal of this think tank is to ponder pressing issues outside of the electoral cycle and point out what impact political decisions can have in the future. The institution works directly in cooperation with members of the Scottish Parliament. Key projects include, for example, Scotland 2030: Future Education, Learning and Teaching (Scotland 2030, 2022).

Another example of implementing foresight studies at a lower level is the establishment of the Office of the Future Generations Commissioner in Wales in 2015, whose main goal is to assist public administration in decision-making in selected areas (skills, health and wellness system, adverse childhood experiences, spatial planning, housing, transport). Once every five years, a Future Generations Report (Future Generations Report, 2020) is published, which serves as a basis for political authorities.

Foresight is practiced at the local level within the public policy of the United Kingdom. Based on the statutory provision of 2000, local governments were instructed to develop a community strategy that will support and improve the economic, social, and environmental quality of life of residents over a 20-year horizon. A few examples of successful foresight studies that came from the UK´s foresight ecosystem were already explored in Chapter 2.

8.1.3 Germany

Germany is among the countries whose foresight ecosystem relies on individual ministries and a central coordination unit. The most prominent is the Federal Ministry of Education and

Research (BMBF), which, in cooperation with the Fraunhofer Institute for System and Innovation Research, creates foresight cycles looking 15 years into the future. Their goal is to identify weak signals of upcoming changes to incorporate into the strategy for German research and innovation.

The first foresight cycle, carried out between 2007 and 2009, had four objectives: 1) to identify new research and technology focuses, 2) to define areas for interdisciplinary activities, 3) to explore areas for strategic partnerships, and 4) to set priorities for research and development policy. Based on a methodological framework that included, among other things, questionnaire surveys, bibliometric analysis, and identification of young investors, 14 current fields and 7 new fields (e.g., human-technology cooperation or sustainable living spaces) were elaborated in detail, which can only be implemented if appropriate measures are ensured. Following this, strategic dialogues were held in 2010 to look at the identified new fields from different perspectives, which is crucial for ensuring the applicability of the results to grant policies. Another important impact of the project on political activity was the establishment of a new department of the BMBF: Demografischer Wandel; Mensch-Technik-Kooperation (Demographic Change; Human-Technology Cooperation).

The Futur Process project (Cuhls, 2003), also initiated by the BMBF with the aim of providing a basis for the strategic financing of BMBF research, also had a political impact. The output of the project was the formulation of four main visions, each of which was developed from the following perspectives: 1) definition of vision and objectives for the given area of development and research, 2) description of the significance of the area for society and the economy, and 3) identification of further possibilities. The project's results (i.e., visions) guide future BMBF research funding. To ensure the highest possible degree of usability of the results, BMBF departments and project management agencies actively participated during the project.

Other public institutions that use foresight in Germany include the Federal Foreign Office, the Federal Ministry of Labour and Social Affairs, or the Federal Ministry for Economic Affairs and Climate Action for issues related to the digitization of industry. Foresight units within these individual institutions vary, as do their tasks and the extent to which they are included in the decision-making process. In the economic field, the advisory body, the German Council of Economic Experts, presents an annual report to the Chancellor on the overall economic situation and its predictable development. Foresight is also being developed in Germany at the regional level, specifically in Bavaria, Rhineland-Palatinate, or Baden-Württemberg.

In addition to public institutions, foresight in Germany is also addressed by the project agency DLR Projektträger. It assists in strategic planning through the use of foresight for individual federal ministries, the European Commission, or research organizations. DLR Projektträger has expertise in the field of European and international integration, education and gender, health, technology and innovation, or the environment.

8.1.4 Sweden

The discussion about the integration of foresight into policymaking began in Sweden already in the 1970s, and in 1973 the Secretariat for Future Studies was created, which was directly responsible to the Prime Minister's office. In 1987, this secretariat was transformed into the independent Institute for Future Studies (IFS), which is still active today. The work of the institute is partially funded by government grants and partially by external funding from research councils and offices (IFS, 2023). The institute's board is appointed by the government.

The areas that the IFS focuses on vary over several years based on the research program framework. After its establishment in the late 1980s, emphasis was placed on topics of communication, culture, and art. At the turn of the millennium, social and demographic changes came to the forefront, and in the early 21st century, focus was placed on the functioning of the welfare state and political and economic values. The current research program is designed for the period 2021-2026 and focuses on topics such as the impact of technology on society, sustainable economics, or problems and challenges of democracy.

The country also has a tradition of technological foresight thanks to a project from the late 90s (Björn & Lübeck, 2003) This project was organized by four actors: the Royal Swedish Academy of Engineering Sciences (IVA), the Swedish National Board for Industrial and Technical Development (NUTEK), the Swedish Foundation for Strategic Research, and the Federation of Swedish Industries. Although the government supported this project, it was not under its name. Currently, for instance, the independent state research institute Swedish Research Institute (RISE) or the Swedish Innovation Agency (Vinnova) are dedicated to technological foresight.

The Swedish government agency Vinnova was established in 2001, focusing on the development of productive and innovative national systems in the fields of technology, transportation, communication, and work environment. Foresight is still practiced by the agency and its results help identify new innovative technologies and working methods where the Swedish innovation agency can play its role.

In recent years, the Council on the Future has been established in Sweden, which falls under the Prime Minister's office. This ministerial group is meant to serve as an advisory group for the formation of long-term strategic goals in the country. It consists of 6 members representing individual ministries, and this number can expand based on individual analyzed areas. The Secretariat for Strategic Development also works in the Prime Minister's office, whose goal is to support the government's work in ensuring the development of future-oriented ideas and policies.

At the turn of the millennium, the nationwide Swedish Technology Foresight project was implemented (Eerola & Jørgensen, 2002) with the aim to strengthen a future-oriented approach in companies and organizations; identify areas of expertise with strong potential in Sweden; and collect information and propose procedures for identifying high-priority areas in which Sweden should build expertise.

The work on the project was primarily in the form of expert panels: a total of eight panels, which included topics such as biological natural resources or social infrastructure, involved 130 people and, through seminars, conferences, etc., several hundred more people were incorporated. The process was funded, among other things, from public sources by Swedish government offices. The project results were presented at the final conference in the presence of the Swedish Prime Minister and in the following two years, they were also presented at many meetings, including at several regional conferences in Sweden.

In addition to the soft benefits of the project in the form of community building and networking of key actors in the Swedish technological environment, it also turned out that the results were used at the regional and micro level thanks to participants who used the knowledge in their own work agendas. As stated by Björn & Lübeck (2003), the project also achieved convincing success in the sense that in the bill submitted to Parliament in 2000, the government almost completely accepted the submitted recommendations and priorities.

8.1.5 USA

The National Intelligence Council (NIC) is an executive body that falls under the Office of the Director of National Intelligence, the main intelligence advisor to the president. The Council issues a so-called Global Trends Report every four years, at the time of the inauguration of a new American president. The latest published report titled Global Trends 2040: A More Contested World (2021) is divided into three parts: the first part describes the structural development of society in terms of social, technological, environmental, and economic

aspects. The second part discusses new dynamics of society, identifying potential problems. The third part then specifically describes possible scenarios of society in 2040.

The Intelligence Advanced Research Projects Activity (IARPA), like the NIC, falls under the Office of the Director of National Intelligence. The main activity of the office is investing in high-risk research programs with high returns, addressing some of the toughest problems of agencies and fields in the intelligence community. Unlike DARPA, IARPA's activity is not exclusively focused on technology but targets a wide range of topics including biology, political science, etc. The U.S. Department of Defense operates the Defense Advanced Research Projects Agency (DARPA), which was established as early as 1958. Its main goal is to make key investments in breakthrough technologies for national security. The agency is supposed to be the initiator of technological advancements.

According to Schmidt (2015), there are approximately 50 foresight units operating in the public administration of the United States. Non-governmental organizations also deal with foresight in the USA. One of them is RAND, a non-profit and non-partisan organization. In terms of financing, however, it is closely linked with the U.S. government. The organization's research is not limited, with a total of 12 thematic areas outlined, including technologies, science, security, and social issues.

The main consumer of foresight studies in the USA is the American army (Burrows, 2021). From 1997 to 2014, the Quadrennial Defence Review was published by the U.S. Department of Defense, which currently exists under the name National Defense Strategy. The main aim of this document is to support the long-term thinking of the Pentagon's top leaders. For the Pentagon to ask Congress to fund any significant weapons, the production of which often takes years, it must prove that they will be needed in 2030 or later.

As mentioned in the 2022 defense budget request, the Department of Defense has set priorities in five key areas where critical vulnerabilities pose the most urgent threat to national security - the research and development areas funded by the new budget include, for example, microelectronics or batteries and energy storage. The result of these processes are increased demands for foresight, with long-term perspectives becoming part of the department's environment. Given the nature of the defense sector, however, there isn't much information about specific steps and examples of direct use.

8.1.6 Singapore

The Ministry of Defense of Singapore began to use foresight methods in its strategic planning already in the 1980s. Subsequently, a unit for scenario building was created in the Prime Minister's Office, which today operates under the name Strategic Policy Office. Since

2009, the think-tank Center for Strategic Futures (CSF), which aims to focus on previously unidentified areas of possible change, has also been included under it.

In 2015, CSF began to function as part of a strategic group directly under the Prime Minister's office. Members of individual strategic groups across the Singapore government also regularly meet within the Strategic Futures Network. Foresight units also operate within all ministries (see, for example, the Ministry of Trade and Industry, the Ministry of the Interior, and the Ministry of the Environment and Water Resources). In some areas, such as regional security, the S. Rajaratnam School of International Studies (RSIS) also cooperates with individual ministries.

The second foresight body operating in the Prime Minister's Office is The National Security Coordination Secretariat (NSCS), which is responsible for planning and coordinating national security. NSCS collaborates with agencies and stakeholders in the development and coordination of strategies to address national security issues and also collaborates with agencies in anticipating and identifying emerging security risks and building capacities and resources to address them.

On a national level, national scenarios have been published every two years since 1997, which are created in line with Singapore's strategic and budgetary planning. Each issue focuses on specific areas, such as in 2017, when emphasis was placed on scenarios of the future in the field of space industry, the rise of China as a technological power, or climate change (Foresight, 2017). Two years later, the scenarios focused on the future development of work, extending the length of human life, and changing identities in the digital age (Foresight, 2019).

In addition to national scenarios, more participatory foresight was also used in Singapore, specifically in 2012 and 2013 as part of the Our Singapore Conversation initiative. Its aim was to involve the wider public in shaping visions and priorities until 2030. A total of more than 4000 respondents from 75 locations were involved. This initiative was originally announced by the Prime Minister and subsequently, its organization was taken over by a commission led by the Minister of Education.

The example of Singaporean good practice primarily lies in the creation of a foresight community, the proximity of foresight institutions to the government (and thus influence on political decision-making), and a generally developed foresight ecosystem, thanks to which it is possible to develop thinking about the future among key actors.

The CSF, for example, is committed to building a community, hosting foresight conferences, and actively meeting and collaborating with key individuals: Professor Mariana Mazzucato,

author of The Entrepreneurial State, who met with representatives of agencies involved in setting research, innovation, and entrepreneurial strategy for the years 2016 to 2020 for a total of 19 billion Singapore dollars. There is also cooperation with foreign foresight institutions, such as the Finnish Sitra or the Japanese NISTEP (Foresight, 2019).

The most significant example of good practice is the developed foresight ecosystem, which successfully implements future thinking directly into political processes. Generally, foresight in Singapore is credited with high flexibility and speed of decision-making by political representatives in crises, such as the economic crisis in 2008 or SARS (Lum 2011). Foresight thinking itself is an integral part of public administration employee training, and it is assumed that good reasoning about the future is also an important aspect of career growth. Education in foresight skills is not limited to initial training in public administration but is gradual and long-term (SOIF 2021).

The CSF takes care of stimulating the foresight ecosystem in two ways: the first is through courses called FutureCraft, which are attended by various public sector representatives, where attention is paid to how foresight tools and methods can be adapted and used for work in the field of forecasting various agencies. The second way is the Sandbox platform, where practitioners can share best practices and ongoing projects (Foresight, 2019).

The foresight ecosystem also reflects in the support of innovative activities, as evidenced by the high number of grants and projects in innovative fields. An example is the AI Singapore project, which aims to connect the private sector and educational institutions in developing artificial intelligence opportunities. Within this project, for example, the Grab company and the National University of Singapore were connected. In 2018, thanks to their cooperation, an initial investment of approximately $4.4 million was made into a joint research laboratory focused on mobility and livability in the region (Asian Development Bank, 2018).

8.1.7 Japan

Since 1971, comprehensive foresight reports have been released approximately every five years in Japan by the National Institute of Science and Technology Policy (NISTEP). The first foresight was created using the Delphi method, but over time, the spectrum of foresight activities expanded to include scenarios, technology maps, and expert panels. Initially, the emphasis was mainly on technologies, but since 2012, a wider spectrum of areas have been studied, including the impact of climate change, energy issues, and an aging population. NISTEP is a national research institute under the direct jurisdiction of the Ministry of Education, Culture, Sports, Science and Technology.

In addition to the national level, foresight is also used locally in Japan through the Futures Design method. In this regard, experts from universities engage with local officials and citizens in an effort to improve the strategic goals of individual areas. This method was developed by a team led by Japanese economist Tatsuyoshi Saijo from The Research Center for Future Design at Kochi University of Technology.

At the local level in Japan, the “Futures Design” method is used, which guides participants to look at the future from the perspective of future generations. This method was first used in the city of Yahaba in 2015 to prepare an official document in response to the Japanese government's policy aimed at overcoming population decline and revitalizing the local economy. All visions and measures identified during the seminar were therefore created for inclusion in the city's strategic document (Hara et al., 2019). The Futures Design method was again used in 2017 in the discussion of the Total Management Plan for Public Facilities and in addressing the increasingly difficult issue of maintaining water management facilities. This resulted in an agreement to increase water tax rates by 6% (Saijo, 2020).

Based on these simulations, the mayor of Yahaba subsequently opened the Future Strategy Office in 2019, which coordinates the use of the concept of the future in various areas of local decision-making. The city of Suita subsequently used the “Futures Design” method in creating a basic plan for environmental protection, as did the cities of Kyoto and Matsumoto.

In addition to individual strategic documents and decisions, Futures Design workshops can also influence individual participants. The results of questionnaires and interviews that followed these simulations show that the use of this type of foresight helps promote long-term thinking in people.

8.2 Non-functioning foresight ecosystems

Since non-functioning foresight ecosystems do not exist, and therefore are hard to study without a very country-specific knowledge of local initiatives that have failed in the past, I rely on the existing learnings mainly from relevant and reputable international institutions.

According to recent remarks by Dr. Epaminondas Chritophilopoulos, UNESCO Chairman on Futures Research Foresight Europe Network, challenges of integrating strategic foresight in governments include “lack of foresight capacity on the top government level, lack of consensus across ministries, inability to organically integrate strategic foresight in planning, the lack of future mindset, acknowledgment of methodological flaws, and difficult communication and transformation of the results into action.” (Chritophilopoulos, 2023).

From the study of variably functioning foresight ecosystems, it appears that one significant obstacle is the discrepancy between the supply and demand for strategic foresight. It has also been claimed by other scholars in the past, that the delivery of foresight studies often does not coincide with policymakers´ requirements concerning political cycles, thereby rendering the outputs not immediately applicable or pertinent (Da Costa et al., 2008). Kuosa (2014) also underlines that the communication of outputs needs to be less scholarly, more succinct, and incorporate visual components to be easily digestible by busy stakeholders.

Sometimes, there is a perceived lack of reliability and validity of foresight findings, which is mistakenly viewed as a hindrance, and it can result in skepticism from users and a hesitancy to invest time or public resources. A number of successful international examples show that foresight can be a valuable tool, the impacts of which are, however, often difficult to measure. Evaluation methods are being established that assess the technical performance of the study along with the long-term impacts on public policymaking, foresight awareness, and the networking of actors (Piirainen et al., 2012; Van der Steen, 2012).

A further reason is the suboptimal integration of foresight into public decision-making. This primarily stems from the varying time horizons of political thinking. According to Van der Steen (2013) and SOIF (2021), public policymakers often align their thinking to accommodate political pressures. Another factor is the dissimilarity in the type of knowledge and concepts employed in foresight compared to those policymakers are used to. Besides trends and other quantifiable indicators, foresight typically utilizes qualitative methods that might be unfamiliar to policymakers (scenarios or mind maps, for instance).

Structural barriers, including limited government adaptability or inadequate inter-ministerial collaboration, also exist. Foresight demands the cooperation of a diverse range of actors from various areas of policy. Most policy institutions, however, concentrate solely on their distinct areas of concern. The proprietorship or leadership of cross-sectoral agendas is often ambiguous or challenging to establish (SOIF, 2021). Another structural issue is the inconsistent and irregular funding for foresight programs and studies, which effectively hampers the long-term growth of the foresight ecosystem.

Finally, cultural aspects and organizational behaviors concerning the perceived advantages of foresight for public policymaking are also important. In Anglo-Saxon and Scandinavian countries, for example, foresight is usually seen as one of the knowledge sources that contribute to policymaking, but this view can significantly vary around the world. In general, Janzwood and Piereder (2019) list resistance to change, risk aversion, and a hesitancy to

think in alternative scenarios or in a complex and systemic manner (which is sometimes called “futures literacy”) as usual obstacles to the establishment of a foresight ecosystem.

8.3 Foresight institutionalization literature

Several implications for the institutionalization of foresight emerge from the conducted systematic review of academic literature. Highly relevant is the work by Schmidt (2015), who proposes the institutionalization of foresight activities in the form of a small central unit, which is further extended by the so-called “virtual team”.

He specifically defines the central unit as an independent small unit of qualified foresight experts - methodological experts, whose main task is to manage the foresight process, organize, facilitate, and monitor the foresight activities, and disseminate foresight outcomes. (Shmidt, 2015). The size of the unit could generally be between one to six employees. The structural placement of the unit is not clearly specified. It should be politically independent while staying in frequent contact with politicians, strategic planners, and policy analysts. Its activity should lie in guiding these stakeholders to create better foresight studies.

A virtual team is a working group with a consultative function, participating in the foresight processes of the central foresight unit, contributing to these processes, and directly utilizing their results. The essence of the virtual team is to ensure that all the aforementioned stakeholders correctly understand the purpose of foresight and have experience with foresight activities. However, other experts should also be involved in the process through the contacts of the virtual team members. The virtual team could also be complemented by experts in the private sector, who supplement the foresight unit.

Schmidt's proposals are mostly consistent with the recommendations of SOIF (2021). According to this organization, a central foresight unit, located close to the government, is needed to develop a foresight environment. It also encourages the involvement of various stakeholders including elected politicians in the foresight process, the development of foresight capabilities of policymakers and capacities of important departments and agencies, and the establishment of a group for coordination and sharing of information.

Without such coordination, there is a risk that some activities may be duplicated or not all relevant stakeholders will be involved. In both cases, this can negatively affect the efficiency of resources expended, as well as reduce the credibility and validity of the results. Generally speaking, the foresight ecosystem is effective if it generates demand for foresight, creates a quality supply, and develops a foresight community. These elements support each other if

the actors in the entire government system are coordinated by a central unit, the ecosystem is developed in phases, and it builds on the broader socio-cultural context in the country.

The necessity of a central foresight unit for an effective foresight ecosystem is also emphasized by the OECD (2019). It claims that the role of this unit should be in the promotion, implementation, and coordination of foresight activities within all government departments. The purpose of the central unit lies in ensuring specific actions such as regular meetings or coordination in the process of creating foresight reports, which enables effective integration of foresight into all government institutions and into central policymaking processes.

In Canada, for example, government departments utilize the work and capacities of the central unit, which simultaneously organizes workshops and other events to promote the development of foresight culture. Thanks to the setting of foresight processes by the central unit, other government bodies can easily process their own foresight studies for their own agenda. The OECD (2019), as well as SOIF (2021) also emphasize the importance of creating a foresight culture. Foresight should not be perceived as an isolated or optional addition to the usual policymaking process but as an integral part of it. Foresight should also be made available to the public, which will usually be affected by the results and which can bring an important and original view to the foresight study.

Janzwood and Piereder (2019) formulate five distinct strategies to overcome obstacles and develop a functioning foresight environment. The first strategy focuses on the identification of foresight champions, who improve the legitimacy, credibility, and perceived value of foresight processes. Unlike Schmidt, however, Janzwood and Piereder (2019) argue that the entire foresight ecosystem should not depend on a few individual foresight champions. The authors also emphasize that the institution that commissioned the study should usually involve external experts. The second strategy reflects the need for a culture of education that should focus on experimenting with innovative tools and methods, recognizing the importance of relationships, teamwork, and collective learning.

The third strategy also relates to education. It involves developing a better perception of foresight. Relevant actors should be aware of what foresight means and what it is useful for so that they are more likely to have a motivation to use it. The fourth strategy involves proper communication. Foresight managers should be able to identify suitable places for the use of foresight. To make this possible, foresight should be closely linked with political cycles and studies should be created in the earliest stages of policymaking. As a fifth strategy, the authors recommend balancing the significance, credibility, and legitimacy of foresight by selecting the individuals to participate in the processes. Managers should

balance the benefits and disadvantages of participation, partly by increasing literacy and transparently by informing about the purpose, value, and limitations of forecasting, and partly by choosing participants based on their knowledge and experience but also based on their skills such as teamwork or creativity (Janzwood and Piereder, 2019).

8.4 Synthesis of recommendations for institutionalization

The extent of centralization of foresight activities is the most general aspect, which is very important for all other design elements, but it interestingly varies widely across the countries with functioning foresight ecosystems. The British model is highly centralized. In Finland, on the contrary, the central foresight unit mainly connects supply and demand and coordinates the public procurement of foresight studies. In other countries, the central analytical unit actively cooperates on foresight studies led by individual ministries or only provides methodological support.

In each country, therefore, the practical steps towards better institutionalization of foresight should be primarily designed based on the existing political system and the distribution of competencies and responsibilities between all relevant stakeholders. By aggregating the findings from the case studies analyzed above, however, it is reasonable to distill a few general aspects that should improve most national foresight ecosystems.

In the following two chapters, I elaborate on two main suggested directions for the advancement of the foresight ecosystem in democratic countries. The first direction is that foresight studies should be conducted mainly by ministerial foresight teams and expert institutions. The second direction is to establish two formal structures, which I call the Central Foresight Unit and the Parliamentary Commission for the Future.

8.4.1 Ministerial foresight teams & expert institutions

The evidence suggests, that each ministry should have its own Ministerial foresight team and prepare studies that are most relevant to the activities of the institution. These units can exist as separate departments or be incorporated into existing strategic teams. There can also be inter-ministerial working groups composed of representatives of these units. These working groups are advised to discuss key issues and opportunities and feed these findings back to the Central Foresight Unit and the Parliamentary Commission for the Future.

In cases where it is appropriate for certain foresight studies to be produced externally (for example, because of the potential risk of bias or conflict of interest), having independent expert institutions that are able to meet this demand, would be useful. These institutions should also be active in the international expert community and, for example, actively

monitor and then communicate methodological innovations in foresight to the whole ecosystem. These institutions are likely to be maximally functional if they have direct access to groups of experts who are able to provide skilled estimates in an agile manner.

8.4.2 Central Foresight Unit & Parliamentary Commission for the Future

In order for the studies to be conducted methodologically consistently and often, the establishment of a Central Foresight Unit and a Parliamentary Commission for the Future appears the most promising. According to this strategy, the Unit would operate at the Office of the Government or on a similar level, and be politically independent. It would produce analyses and studies across disciplines. It would maintain three main functions: Methodological, Coordination, and Networking. The methodological function must be reflected in the Unit by providing methodological support to ministries and sending its own experts to individual ministries to actively participate in the production of foresight studies.

As for the coordination function, the Central Analytical Unit would coordinate and control the quality of the demand from the government, ministries, or local authorities. It would also be able to direct this demand toward the most relevant ministerial foresight teams and expert institutions. Finally, the networking function would help maintain contacts and establish links between experts and organizations (think tanks, consulting firms, research teams) of different fields. For this purpose, the Unit would also organize regular events such as conferences, lectures, or forums to discuss the findings of studies to date or opportunities for further research.

On a parliamentary level, it would be beneficial to establish a formal body called, for example, the Commission for the Future. It would be composed of at least 10 members of the parliament (as is the case in Finland, Iceland, or Austria), that ideally represent most of the political spectrum. This body would be in close contact with other parts of the foresight ecosystems (as in Estonia, for example) and its main agenda would be the transfer of foresight results from studies into the legislative process, usually through parliamentary discussions and feedback mediation. It would also have a role in suggesting topics for new foresight studies (as in Latvia), prioritization of the funding for foresight activities (as in Austria) or public communication of foresight outcomes (as in Chile). Especially this second direction seems important to further study and assess, and only then potentially implement.

9. Conclusions

The theoretical chapters of this dissertation research aimed to systematically explore the study of national strategic foresight. I researched various use cases of foresight (chapter 2), methods of foresight (chapter 3), and the viability of combining two of these methods within a foresight study, in order to improve its outputs (chapter 4).

In the empirical part of the study (chapter 5), I collected data and provided evidence to support the claims, that strategic foresight can benefit from wider participation and that forecasting tournaments is a promising method to effectively facilitate such participation.

In light of these empirical results, I then analyzed the most important design elements to be considered regarding the use of forecasting tournaments in foresight (chapter 6), the most important design elements for designing a rigorous foresight study more generally (chapter 7) and, finally, I analyzed the evidence on the most important aspects of institutionalization of strategic foresight in democratic governments (chapter 8).

In this concluding chapter, I summarize my two main research claims, their relevance for the contemporary academic literature, and their implications for further research directions:

- **Forecasting tournaments improve participation in foresight (9.1)**
- **Wider participation improves the quality of foresight results (9.2)**

I also suggest four other promising research directions to be focused on in future research:

- **Piloting forecasting tournaments as a stand-alone method of foresight (9.3)**
- **Improving the institutionalization of foresight (9.4)**
- **Using foresight to predict and mitigate global risks (9.5)**
- **Creating a national vision based on participatory foresight (9.6)**

Finding of this study regarding the quality and the benefits of participatory methods in foresight are in a general agreement with the research behind the Reciprocal Scoring method (Karger, 2021) as well as the empirical findings by Dr. Devlen (2020) or the methodological suggestions of experts on judgemental forecasting (e.g. Sempere, 2022).

Since the forecasting tournament as a participatory foresight method facilitates the effective

exchange of information and probability-weighted arguments, these findings should also be relevant to the Decision-making under deep uncertainty (DMDU) theories often used in the area of risk management, which are relevant specifically in cases when there is a lack of knowledge or agreement between relevant stakeholders on the likelihood of various future scenarios (Marchau et al, 2019).

Practically, this study contributes to the current research and the aforementioned findings especially by suggesting a novel combination of foresight methods to be further researched and potentially more widely implemented, by interpreting the collected empirical data to highlight new insights into the effectiveness, information flows, and revealed incentives of experts and non-experts participating in foresight studies, and finally by proposing new research directions regarding methodology improvements, planning the whole strategic foresight process or systematization of strategic foresight processes in democratic countries.

Overall, it seems appropriate to claim that since improving the methods of strategic foresight promises unusually large, long-term societal benefits, more research in this field has the potential to be very impactful. As such, increasing the capacity for high-quality strategic foresight should be among the top priorities of democratic national governments and international organizations that understand the importance of decision-making based on robust predictions of future risks and opportunities, even when the study of the future is inherently difficult and the uncertainty of any future developments is high.

9.1 Forecasting tournaments improve participation

In this case study, forecasting tournaments produced better predictions of a group opinion than a questionnaire, as expected. The average group prediction distilled from a forecasting tournament was more accurate than the average group prediction from a questionnaire.

Technically, the forecasting tournament seems to have helped participants, on average, to disregard their personal opinions and values more strongly in favor of accuracy. From the point of view of every individual participant, the ability to assign probabilities rather than binary (yes/no) predictions and to update their own predictions based on the discussion and reading the comments of other participants helped to make more accurate predictions.

On average across the four highest-ranking megatrends, 56.4% of respondents updated their opinion relative to their prior prediction of a group consensus submitted through a

questionnaire. Among those who did, 2.2x more respondents updated in the right direction than those updating in the wrong direction. This finding is in agreement with the hypothesis that forecasting tournaments can effectively reduce bias and noise by, on average, improving the individual ability to correctly predict an outcome (Kleňha, 2022).

By using the framing of a "tournament" with multiple types of rewards, I provided participants with better incentives that cannot be provided by different questionnaire-based methods. Financial rewards for the best predictions incentivize participants to conduct more research in order to provide more accurate predictions. Rewards for the best comments provided incentives to write high-quality rationales behind the predictions or to identify potential biases of experts in Delphi.

Another incentive was represented in the fact that the anonymized inputs were later provided to the experts in Delphi, making it possible for a participant in the tournament to influence the opinion of experts (and therefore the "resolution" of the tournament) by providing high-quality and persuasive arguments. These inputs were welcomed by experts in Delphi as a useful resource of information as well as hints, about which cognitive and other biases to be especially aware of.

These results suggest that a forecasting tournament is a better method for facilitating wide participation in strategic foresight than other questionnaire-based methods. Moreover, it is an important indication that has not yet been described in the academic literature, that forecasting tournaments works even for such complex and cross-sectoral questions such as the importance of global megatrends or, more precisely, the future opinion of a group about the importance of global megatrends.

9.2 Participation improves foresight results

By including a forecasting tournament in the FUTURE-PRO foresight study (České priority, 2021), I enlarged the pool of participants who provided predictions and written inputs by 500% compared to using only a Delphi study with 24 experts. The online nature of the forecasting platform lowered the barriers to participation. It self-selected only motivated respondents and increased the diversity of inputs by providing space even for minority voices and unusual ideas. It also attracted young people, whose participation is especially important in case of long-term foresight of trends that will affect mainly the lives of younger generations.

To evaluate the actual epistemic quality of the participation, however, this case study elaborated on the first ex-post evaluation conducted in two rounds 1.5 and 3 years later. It was carried out to evaluate the reliability of using participation in strategic foresight in general. According to this evaluation, the megatrends that increased in importance over the last three years were, on average, ranked 2 positions higher in the non-expert ranking than in the ranking of experts in a Delphi study, while the megatrends evaluated to have decreased ranked 1.3 positions lower.

By including methods for wider participation in this foresight case study, I produced two main positive effects. First, the pool of participants who provided predictions and written inputs was enlarged by 500% (compared to using only a Delphi method with 24 experts) which effectively increased the diversity of inputs and the chances that minority voices and unusual ideas could be represented, which is important for the quality of the outcomes.

Second, the online format of the forecasting platform lowered the barriers to participation. It attracted mainly young people, whose participation is especially important in case of long-term foresight of trends that will disproportionately affect the lives of younger generations. The barriers were lowered also by not preselecting by academic titles or publications, but simply by relying on the self-election of participants, who are genuinely interested in thinking about the future and who manifest their interest by fulfilling our 1-hour mandatory online training of working with probabilities and using a future mindset.

From a consequent interim evaluation conducted 1.5 and 3 years later to evaluate the reliability of using participation in strategic foresight in general, it appears that a large group of 238 non-expert participants has performed quite well in the prioritization of megatrends. Three megatrends, that were claimed in the evaluation to have increased in importance the most, were on a 0.66 higher rank in the questionnaire (Q1) than in the expert Delphi (Q4). Three megatrends, that were claimed to have decreased in importance the most, were, on average 1.33 positions lower.

Similarly, according to the comparison of the full rankings (18 megatrends), seven megatrends claimed to have increased in importance over the last three years, were, on average, 2 positions higher in the participatory, non-expert ranking (Q1) than in the ranking from the expert Delphi (Q4). 11 megatrends with decreased importance were 1.3 positions lower, on average, in Q1 than in Q4.

These results show that it would be reasonable to provide experts with non-expert rankings from participatory methods because they are not significantly worse. It remains to be seen after additional evaluations and after more similar case studies, whether the outcomes produced by wide, low-barrier participation methods are actually robustly better than the rankings by experts, which could be a transformative finding, questioning the role of formal academic expertise in foresight.

This finding should not be interpreted as proving the inadequacy of formal expertise in foresight, but it does strengthen the case for using widely participatory methods in foresight, even if only as an auxiliary method. This finding aligns with the recent European trend of increasing citizen participation in many activities of public administrations. For example, in the Czech Republic, where these case studies were conducted, the most recent OECD Public Governance Review recommends "setting up a community of practice in participation, creating mandatory training in participation for public officials, establishing a government-wide participation portal, or starting to pilot new approaches to participation" as one of the top national priorities (PGR, 2023).

The last two recommendations can be particularly well fulfilled by exploring the space of using forecasting tournaments as a stand-alone method that involves large groups of citizens in the pursuit of predicting the importance of future trends, as I describe in the following chapter.

9.3 Piloting forecasting tournaments as a stand-alone method

Based on these findings, two interesting additional research questions could be posed:

1. What if we asked participants in the forecasting tournament to predict an opinion of a group that will be collected next year, instead of today?

2. What if it will be a group opinion of hundreds of self-selected non-experts, instead of tens of pre-selected experts?

The first question is grounded on the premise that forecasting tournaments are able not only to aggregate guesses but also to predict future outcomes, and that megatrends do not evolve very rapidly, so the change in their importance is predictable on a yearly basis. The second question is derived from my finding, that the aggregate opinion of hundreds of non-experts seems to be of similar quality as the opinion of tens of experts, and therefore

experts, that are often scarce, unavailable, or expensive, would not have to be mobilized.

Answering these questions would support the case for piloting a forecasting tournament, where the participants are predicting the aggregate opinion about the importance of global megatrends, that will be present on the very same forecasting platform one year later.

This mechanism could produce predictions of sufficient quality while being much more cost-effective and easier to facilitate. It could also help with limiting potential biases of smaller groups of experts, especially in certain fields or where expertise is limited and the experts can exhibit an academic bias. It can also be seen as one possible solution to the bottleneck of judgmental forecasting with predicting long-term or unresolvable questions.

This design would introduce some new challenges. The participants in the tournament would be able to participate in the following year, contributing to the resolution of their own predictions. This could present misaligned motivations for voting and writing comments. The effect of this problem, however, decreases with the size of the group. With hundreds or thousands of participants, the ability to influence the resolution would become marginal.

This brings up the question of whether it remains plausible to predict the opinions of a group that consists of thousands, tens of thousands, or even hundreds of thousands of people. I have recently explored this question as well, and, in accordance with the hints derived from existing research and practical applications, forecasting tournaments seem to be able to predict the opinions and sentiments of societies and representative samples of citizens.

In a case study by STEM and České priority, over 50 participants in a forecasting tournament were predicting the opinions of a representative sample of the Czech population, which was to be collected three months later. The questions concerned opinions on national security, the level of interpersonal trust, and the assessment of one's own economic situation. All aggregates predicted the right direction of the change, while the two predictions were very close to the actual reported societal sentiments as measured in March 2023 (STEM, 2023).

There are two potentially more important problems with the suggested mechanism. First, participants would not predict the state of affairs in the next year, but actually next year´s predictions of the consequent year´s predictions, and so on. This could lead to an extremization of the predictions but could be mitigated by introducing other incentives and thus involving participants, who would not be motivated primarily by making accurate

predictions, but, for example, by helping to distribute part of this year's public budget to solve urgent problems. Even though the quality of the outcomes should remain high since predictions of global trends generally follow from the understanding of current trends, the seeming difficulty of this task could make some participants hesitant to even participate.

Second, the effectiveness of motivations used in forecasting tournaments, such as financial rewards, prestige, or useful feedback, rapidly decreases if the resolution is further in time. Even though the financial motivations would indeed fade away for some participants, this could be supplemented by enhancing the social rewards such as public enforcement and media presentation or highlighting the written comments of the most accurate participants.

To contribute to the understanding of the magnitude of these two problems, I conducted the consequent forecasting survey (Q6) in the second part of this case study and found that the participants were not discouraged by the “revolving” nature of the mechanism. For some participants, it was actually more intellectually interesting to predict questions formulated in this way regardless of rewards, because it became a question of “how will the world develop” rather than “what today's experts think”. The current forecasting platforms such as Metaculus or Good Judgement Open contain similar long-term questions and many people predict them simply for the sake of providing advice or stating their opinions for the purpose of peer-to-peer learning and collaborative intellectual discussions.

The motivations used in forecasting tournaments remained over 30% of the overall distribution of reported motivations of respondents, while the motivation to distribute small amounts of funding to the selected cause areas right now created over 20% of the aggregate motivation, which is much higher than I expected (Appendix 3). This suggests that the use of credits similar to the Democracy Vouchers used since 2016 in Seattle (Democracy Voucher Program, 2023) could be an appropriate enhancement of this method.

In general, both of these initial findings are promising and support the case for further piloting and testing the feasibility of this method. There are some other foreseeable problems such as the possibility of “waves” of advocacy campaigns persuading citizens to distribute their credits to particular areas, which could be mitigated by making the mechanism ongoing and providing credits to citizens on their birth dates. But precisely the exploration of these problems and solutions should be the topic of pilot studies. Before any large-scale or nationwide application of such methods, a number of consequent research studies and small and medium-scale trials have to be conducted and rigorously evaluated.

9.4 Improving the institutionalization of foresight in the CZE

In the following paragraphs, I briefly summarize the recommendations from Chapter 8 regarding the most promising next steps that should be taken toward more effective institutionalization of foresight in policymaking, and I apply these recommendations to the case of the Czech Republic. Even though these recommendations are distilled from academic literature and existing case studies from other countries, the creation of the suggested foresight ecosystem has not yet been done in this systematic manner elsewhere. Therefore, following these steps could not only improve the foresight ecosystem in the Czech Republic but also provide valuable learnings from the process that could be very relevant to researchers and practitioners from other democratic countries, aiming for similar goals. For this purpose, the process of political negotiations, designing of the units, and its initial work should be monitored in detail.

In the suggested foresight ecosystem, foresight studies should be conducted mainly by ministerial foresight teams, and only sometimes supplemented by or sub-contracted to external institutions specializing in foresight. This could be useful in cases with increased risks of the ministerial foresight team being biased to produce a specific outcome or unable to concentrate enough external expertise. To establish these teams, an initial intensive training in foresight should be provided and inter-ministerial working groups established in order to share information, especially in the first few years of their operations.

A “Central Foresight Unit” should be established. It should be politically independent while maintaining a relevant degree of power and close ties with the Office of the Government. It should inform all stakeholders including the public about ongoing and planned foresight activities, provide up-to-date methodological support and practical help to ministerial teams, and coordinate and conduct or contract strategic, cross-sectoral foresight studies. It should be in close contact with local researchers and international practitioners in foresight.

“Parliamentary Commission for the Future” should also be created. It should be composed of politicians across the political spectrum and transfer new foresight results from studies into the legislative processes, suggest their own topics for foresight studies, decide on the funding allocations for foresight, and support education about the importance of foresight. The establishment of this Commission also specifically seems to require medialization and systematic communication towards politicians about the large benefits of foresight.

9.5 Using foresight to predict and mitigate global risks

The scale of potential positive benefits of using better foresight methods increases, if we consider the international use of foresight, especially to predict and mitigate global risks.

International relations and geopolitics are the fields of study where future developments are often the result of a large number of complex processes that are highly difficult to predict using statistical methods, but judgemental methods such as forecasting tournaments or a Delphi can be used. Foresight can help to strengthen the ability of nations to formulate more robust foreign policies, but it should be also used by international institutions to understand likelihood of different scenarios of global risks and their impacts (Kleňha, 2022).

Orchestrating rigorous international activities to strengthen the willingness and ability of governments to conduct high-quality strategic foresight is also a crucial element in the effort to solve the "fundamental problem that governments and international organizations lack anticipatory capacity" (Stauffer et. al., 2023, 34). Without such capacity, the ability of strong international coordination in light of potential global existential risks will remain minimal, which can be a critical problem for humanity in the coming decades and centuries.

In the recent study published by the United Nations Office for Disaster Risk Reduction, the authors discuss various foreseeable existential risks to humanity and, based on 38 expert estimates of the risk of collapse, near extinction, or full extinction of humanity resulting from human activity compute, that an existential risk has a total probability of 1.9 - 14.3% this century, which indicates that existential risk should be an "extremely important priority for governance right now" (Stauffer et. al, 2023, 12). For that, strategic foresight is critical.

9.6 Creating a national vision based on participatory foresight

Last and the most ambitious recommendation is for democratic governments to devote more resources to the creation of long-term national visions. This should be done by using the best available methods of foresight to identify emerging opportunities and use the participative foresight process to establish a wider public consensus on a few priorities, that the society should invest its resources in across political cycles.

A national vision, in particular, can be perceived as a set of long-term strategic goals to which a society aspires. Its attainment should be non-trivial but at the same time realistic. Most of the important stakeholders should be able to identify with the vision and have an interest in striving to achieve it. This approach lays the foundation for genuine deep changes that might be crucial in order to overcome future risks and seize future opportunities.

An important advantage of the vision is that it creates space for long-term planning and the creation of a system less susceptible to populist fluctuations. Particularly in the current geopolitical and volatile socio-economic situation, as countries grapple with the aftermath of the pandemic and react to the impacts of the war conflict in Ukraine, the need for a purposeful vision is further emphasized. It acts as an important element of defense against the emergence of anti-systemic tendencies, which can disrupt the pillars of a stable and progressive society. The existence of a national vision should support two elements that are key for maintaining cohesion and sustainability of democracy: Cooperation and Trust.

The impact of a strong vision should be to increase the sense of belonging among citizens and their motivation to engage civically, thus enhancing social cohesion, the maintenance of which is critical and increasingly complicated with incoming innovations. The existence of a long-term vision based on social consensus also has the potential to increase the resilience of the country's strategic management against short-term changes in political moods, thus increasing citizens' trust in the competence and robustness of state leadership.

The vision should be broadly defined but must not be vague. Ideally, it would be elaborated at multiple levels of generality. Directions and measures to fulfill the vision should evolve, adapt, and effectively penetrate all levels of public administration and sectoral strategies. The vision must gain legitimacy, and therefore it should arise from a participatory process of nationwide discussions in which a large part of society participates.

Evidence shows that the sustainability of the vision is significantly influenced by the process by which it is created, and also by proper communication during and after this process. Current international experience (Chapter 2.4.1) shows that the process should probably last at least two years and start with creating a framework based on expert analysis and inputs. This first phase should be built on a good understanding of the nation's current comparative advantages, historical experiences, and generally accepted values.

The process should continue with prioritization based on foresight and citizen participation. Both foresight and participation should use the best existing methods, be rigorously planned in advance, and be thoroughly monitored and evaluated during and after the process. In the final phase where individual goals are prioritized are prepared to be

strategically communicated, the involvement of the maximum number of various stakeholders is vital. This whole process should be finalized by transferring into a continuous phase of public communication and implementation of the resulting steps.

During the creation of the vision and in its subsequent communication, a value-recognized leader of the final vision would likely play an important role. This leader should be in the position of a facilitator asking questions and clearly communicating outputs. These should be generally synergistic with their own views on the direction of the country, so as to be able to credibly present the resulting vision as the vision of the leader and the entire nation.

The resulting vision should be effectively communicated to be sustainable across political cycles. A leader, who is not a partisan politician and who espouses the values embodied in the vision can be seen as a guarantee of long-term fulfillment of this vision even in difficult times. The leader could use the vision to answer society's questions such as “Who are we?”, “What matters to us?” and “Where are we heading?”. They should ideally embody and personally experience strong stories that emerge from or are related to the vision.

Such a vision would likely consist of positive aspirations, which, if properly combined with other applications of foresight to effectively prepare for and then rapidly respond to future risks, could be a very powerful use of strategic foresight for long-term societal benefits.

List of references

Asian Development Bank (2020). “Futures Thinking In Asia And The Pacific: Why Foresight Matters for Policymakers.” ISBN 978-92-9262-181-0. Available at www.adb.org.

Berg, Joyce E., Forrest D. Nelson, and Thomas A. Rietz. “Prediction market accuracy in the long run.” International Journal of Forecasting 24, no. 2 (2008): 285-300.

Bickel, E. J., "Some Comparisons among Quadratic, Spherical, and Logarithmic Scoring Rules", Decision Analysis, 2007, no. 4, 2, pp. 49-65.

Björn, L., & Lübeck, L. (2003). Swedish technology foresight—a successful project with many lessons learned. The second international conference on technology foresight (1-11).

Bolger, Fergus, and George Wright. “Improving the Delphi process: Lessons from social psychological research,” Technological Forecasting and Social Change 78, no. 9 (2011): 1500-1513,doi.org/10.1016/j.techfore.2011.07.007.

Bosse, Nikos (2023). Wisdom of the Crowd vs. The Best of the Best of the Best. https://forum.effectivealtruism.org/posts/akn2BFhhM9CzwpLEA/wisdom-of-the-crowd-vs-the-best-of-the-best-of-the-best.

Boston, Jonathan, et al. “Foresight, insight and oversight: Enhancing long-term governance through better parliamentary scrutiny.” (2019), victoria.ac.nz/__data/assets/pdf_file/0011/1753571/Foresight-insight-and-oversight.pdf.

Boyd, E., Nykvist, B., Borgström, S., & Stacewicz, I. A. (2015). Anticipatory governance for social-ecological resilience. Ambio, 44, 149-161.

Bosse, Nikos (2023). “More Is Probably More - Forecasting Accuracy and Number of Forecasters on Metaculus”, Metaculus Platform Notebook. Available at www.metaculus.com/notebooks/14951/more-is-probably-more--forecasting-accuracy-and-number-of-forecasters-on-metaculus/.

Brier, Glenn W. "Verification of forecasts expressed in terms of probability." Monthly Weather Review 78, no. 1 (1950): 1-3.

Brown, Alasdair, J, et al. “When are prediction market prices most informative?” International Journal of Forecasting 35, no. 1 (2019): 420-428.

Budescu, David V., and Eva Chen. “Identifying expertise to extract the wisdom of crowds.” Manage. Sci. 61 (2014): 267-280.

Burrows, Mathew, “How the US Does Foresight: The United States’ difficulty in accepting multipolarity” (March, 2021). European Union Institute for Security Studies. Available at www.iss.europa.eu.

Calof, J. & Smith, J. E. (2012). Foresight impacts from around the world: a special issue. Foresight, 14(1), 5–14. doi.org/10.1108/14636681211214879.

Chambers et. al (1971), “How to Choose the Right Forecasting Technique”, *Harvard Business Review*, available at hbr.org/1971/07/how-to-choose-the-right-forecasting-technique.

CIMULACT (2016). Citizen and Multi-Actor Consultation on Horizon 2020. http://www.cimulact.eu/wp-content/uploads/2016/06/D1.3final.pdf

Codi, Allison, at al. (2022), “Aggregating human judgment probabilistic predictions of COVID-19 transmission, burden, and preventative measures”, Lehigh University, available at https://arxiv.org/pdf/2204.02466.pdf.

Cuhls, Kerstin (2003), “Government Foresight Activities in Germany: The Futur Process.” Institute for Systems and Innovation Research, Karlsruhe. Available at https://www.nistep.go.jp/IC/ic030227/pdf/s3-2.pdf.

Cultivate Labs. www.cultivatelabs.com (accessed October 2021).

České priority (2021), “Forecasting project OPTIONS”, Available at www.predikce.org.

České priority (2022a), “Foresight: Methodical guide”, Prague. 978-80-11-02663-9.

České priority (2022b), “Foresight v české veřejné správě a zahraničí”, Prague.

České priority (2023). “Klimaticko-společenské scénáře rozvoje Česka - Foresightová studie pro aktualizaci ČR 2030”, České priority, Ministry of the Environment of the Czech Republic.

ČR 2030 (2017). Strategický rámec Česká Republika 2023”. Ministerstvo životního prostředí. www.mzp.cz/cz/ceska_republika_2030

Da Costa, O., Warnke, P., Cagnin, C., & Scapolo, F. (2008). The impact of foresight on policy-making: insights from the FORLEARN mutual learning process. Technology Analysis & Strategic Management, 20(3), 369-387.

Dalkey, Norman C. and Daniel L. Rourke. “Experimental assessment of Delphi procedures with group value judgments.” Studies in the quality of life: Delphi and decision-making, eds. Norman C. Dalkey, et al. (Lexington: Lexington Books, 1972): 55-83.

Dalkey, Norman C., and Olaf Helmer (1963). “An experimental application of the Delphi method to the use of experts,” Management Science 9, no. 3: 458-467.

Dana, Jason et al. “Are markets more accurate than polls?” Judgment and Decision Making 14, no. 2 (2019): 135-147.

Dane, E., & Pratt, M. G. (2007). Exploring intuition and its role in managerial decision making. Academy of Management Review, 32(1), 33-54.

Department of Health. (2010). Healthy lives, healthy people: Our strategy for public health in England (Vol. 7985). The Stationery Office.

Dator, J. (2019) “A Noticer in Time: Selected Work”, 1967–2018. New York: Springer Nature. doi.org/10.1007/978-3-030-17387-6.

Defila, R., Di Giulio, A. & Schweizer, C. R. (2018). Two souls are dwelling in my breast: Uncovering how individuals in their dual role as consumer-citizen perceive future energy policies, Energy Research & Social Science, 35, 152–162. https://doi.org/10.1016/j.erss.2017.10.021

DellaVigna, S., & Pope, D. (2018). What motivates effort? Evidence and expert forecasts. The Review of Economic Studies, 85(2), 1029-1069.

Democracy Voucher Program (2023), Seattle, USA, www.seattle.gov/democracyvoucher.

Dreber, A., Chen, Y., Johannesson, M., Nosek, B., Pfeiffer, T., & Siegel, A. (2019). Using prediction markets to predict the outcomes in DARPA’s Next Generation Social Science program. SSRP, 21, 114.

Edermann, Drew, Bernardo Sichel, and Luk Yeung. “Overcoming obstacles to effective scenario planning.” McKinsey Quarterly 55 (2015), https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/overcoming-obstacles-to-effective-scenario-planning#.

Dillon, Charles (2021), “How does forecast quantity impact forecast quality on Metaculus?” Available at

forum.effectivealtruism.org/posts/xF8EWBouJRZpRgFgu/how-does-forecast-quantity-impact-forecast-quality-on-1.

Eerola, A., & Jørgensen, B. H. (2002). Technology foresight in the Nordic countries. Risø National Laboratory. Denmark. Forsknings Center Risoe.

Estonian's digital agenda (2030). Ministry of Economic Affairs and Communications, Republic of Estonia. Available at https://www.mkm.ee/media/6970/download.

European Commission (2022). After the new normal: Scenarios for Europe in the post Covid-19 world, Directorate-General for Research and Innovation, https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/after-new-normal-scenarios-europe-post-covid-19-world_en

Flick, C., Zamani, E. D., Stahl, B. C. & Brem, A. (2020). The future of ICT for health and aging: Unveiling ethical and social issues through horizon scanning foresight, Technological Forecasting and Social Change, 155. https://doi.org/10.1016/j.techfore.2020.119995

Butland, B., Jebb, S., Kopelman, P., McPherson, K., Thomas, S., Mardell, J., & Parry, V. (2007). Tackling obesities: future choices-project report (Vol. 10, p. 17). London: Department of Innovation, Universities and Skills.

Foresight Future Flooding (2004), The UK Government - Foresight Directorate, London. Available at assets.publishing.service.gov.uk.

Foresight Mental Capital and Wellbeing (2008). Final Project Report – Executive summary. The Government Office for Science, London. Available at assets.publishing.service.gov.uk.

Foresight (2017): 9th Issue. Centre for Strategic Futures. Singapore. Available at: https://www.strategygroup.gov.sg/images/PublicationImages/foresight-2017.pdf

Foresight (2019): 10th Issue, Centre for Strategic Futures. Singapore. Available at: https://www.csf.gov.sg/files/media-centre/publications/CSF_Foresight_2019.pdf

Future Generations Report (2020). Future Generations Commissioner for Wales. Online at https://www.futuregenerations.wales/wp-content/uploads/2020/07/Intro-Chap-1-Exec-Summary.pdf.

FUTURE-PRO (2021). “FUTURE-PRO: Megatrends and grand societal challenges with a significance for the Czech Republic”. České priority, z.ú. Available at www.megatrendy.cz.

FUTURE-PRO Methodology (2021). “FUTURE-PRO: Challenges and Megatrends Methodology”. České priority, z.ú. Available at www.megatrendy.cz.

FutuRIS - Závěrečná zpráva z projektu (2022) Pražský Inovační Institut Praha. Available at https://www.prazskyinovacniinstitut.cz/files/futuris_10_4_22.pdf.

Gaissmaier, W., Marewski, J. (2020), “Forecasting elections with mere recognition from small, lousy samples: A comparison of collective recognition, wisdom of crowds, and representative polls.” Judgment and Decision Making 6: 73–88.

Galton, Francis. “Vox populi.” Nature 75 (1907): 450-451.

Georghiou, L. (2003). Evaluating Foresight and Lessons for Its Future Impact. https://www.nistep.go.jp/IC/ic030227/pdf/p6-1.pdf

Georghiou, L. (2003). Evaluating Foresight and Lessons for Its Future Impact. https://www.nistep.go.jp/IC/ic030227/pdf/p6-1.pdf

GFG member, 2022 - Interview with the anonymous member of the Finnish Government Foresight Group, conducted online on October 24, 2022.

Global Trends 2040: A More Contested World (2021). The National Intelligence Council–NIC. Office of the Director of National Intelligence, USA.

Gordon, Theodore J. “The Delphi method.” Futures Research Methodology - The Millenium Project (1994), https://eumed-agpol.iamm.fr/private/priv_docum/wp5_files/5-delphi.pdf.

Gössling, S., & Peeters, P. (2015). Assessing tourism’s global environmental impact 1900–2050. Journal of Sustainable Tourism, 23(5), 639–659. https://doi.org/10.1080/09669582.2015.1008500

Government Office for Science (2017). “The Futures Toolkit.” Tools for Futures Thinking and Foresight Across UK Government. Available at assets.publishing.service.gov.uk

Government Office for Science (2017). The Futures Toolkit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/674209/futures-toolkit-edition-1.pdf

Government Office for Science (2021). A Brief Guide to Futures Thinking and Foresight. https://www.gov.uk/government/publications/futures-thinking-and-foresight-a-brief-guide

Government Report on the Future (2017) Prime Minister's Office - Finland, Part 1. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/80120/13c_17_tulevaisuusselonteko_osa1_EN.pdf?sequence=1&isAllowed=y

Greenberg, Spencer, "Arguments For and Against Longtermism" August 30, 2022. https://www.spencergreenberg.com/2022/08/arguments-for-and-against-longtermism/.

Grilo, Vasco (2023). Metaculus predictions are much better than low-information priors. https://forum.effectivealtruism.org/posts/JN6wm6u5MMmqwdnEs/metaculus-predictions-are-much-better-than-low-information.

Gruetzemacher, Ross, Florian E. Dorner, Niko Bernaola-Alvarez, Charlie Giattino, and David Manheim. "Forecasting AI progress: A research agenda." Technological Forecasting and Social Change 170 (2021): 120909.

Hanania, Richard (2023). "Results for the Salem/CSPI Prediction Tournament", The Center for the Study of Partisanship and Ideology (CSPI). Available at www.cspicenter.com/p/results-for-the-salemcspi-prediction.

Hanson, Robin. "Could gambling save science? Encouraging an honest consensus." Soc. Epistemol. 9 (1995): 3-33.

Hanson, Robin. "Decision markets for policy advice." Promoting the general welfare: American democracy and the political economy of government performance (2006): 151-173.

Hara, K., Yoshioka, R., Kuroda, M., Kurimoto, S., & Saijo, T. (2019). Reconciling intergenerational conflicts with imaginary future generations: Evidence from a participatory deliberation practice in a municipality in Japan. Sustainability Science, 14, 1605-1619.

Hines & Gold, (2013), "Professionalizing foresight: Why do it, where it stands, and what needs to be done" Journal of Foresight studies. Available at www.jfsdigital.org.

Hines, A. (2019). When Did It Start? Origin of the Foresight Field. World Futures Review, 12(1), 4–11. https://doi.org/10.1177/1946756719889053

Höjer, M., Gullberg, A. & Pettersson, R. (2011). Backcasting images of the future city—Time and space for sustainable development in Stockholm. Technological Forecasting and Social Change, 78(5), 819–834. https://doi.org/10.1016/j.techfore.2011.01.009

Horowitz, Michael, et al. "Keeping Score: A New Approach to Geopolitical Forecasting." Perry World House (2021), available at

https://global.upenn.edu/sites/default/files/perry-world-house/Keeping%20Score%20Forecasting%20White%20Paper.pdf.

Hsu, Chia-Chien, and Brian A. Sandford. “The Delphi Technique: Making Sense of Consensus.” Practical Assessment, Research & Evaluation 12, no. 10 (2007), https://doi.org/10.7275/pdz9-th90.

Hypermind (2024). The Bayesian Truth Serum. Hypermind Prescience. Available online at: prod.hypermind.com/prescience/en/guide.html?symbol=bts.

Chang, W., Chen, E., Mellers, B., Tetlock, P. (2016), Developing expert political judgment: the impact of training and practice on judgmental accuracy in geopolitical forecasting tournaments, Judgment and Decision Making, Vol. 11, No. 5, September 2016, pp. 509-526.

Chen, K., Ren, Z., Mu, S., Sun, T. Q. & Mu, R. (2020). Integrating the Delphi survey into scenario planning for China's renewable energy development strategy towards 2030. Technological Forecasting and Social Change, 158. Available at doi.org/10.1016/j.techfore.2020.120157.

Chritophilopoulos, E. (2023), “Think Tanks as New Actors of Strategic Diplomacy, Symposium The State Of Foresight Studies in the World”, Policy Center for the New South. Recording available at policycenter.ma/events/symposium-state-foresight-studies-world, Day 1, time 2:42.

IAP2 (2007). International Association of Public Participation - IAP2 Spectrum of Public Participation. Available at iap2.org.au/resources/spectrum.

IARPA, “Aggregative Contingent Estimation program” (2013). Accesible at https://www.iarpa.gov/research-programs/ace.

IFFS - Institute for Futures Studies. Sweden. Website accessed on May 5, 2023. Available at https://www.iffs.se/en/about-us/funding/.

Jacobs, Alan. “Policy Making for the Long Term in Advanced Democracies.” Annual Review of Political Science 19 (2016): 433-454.

Januschowski, Tim, et al. “Criteria for Classifying Forecasting Methods (Invited Commentary on the M4 Forecasting Competition).” International Journal of Forecasting 36, no. 1 (2020): 167-177.

Janzwood, S., & Piereder, J. (2019). “Mainstreaming” foresight program development in the public sector. foresight, 21(5), 605-624. Available at www.emerald.com/insight/content/doi/10.1108/FS-11-2018-0093/full/html.

Jemala, M. (2010). Evolution of foresight in the global historical context. Foresight, 12(4), 65–81. doi.org/10.1108/14636681011063004.

Johnston, R. (2012). Developing the capacity to assess the impact of foresight. Foresight, 14(1), 56–68. https://doi.org/10.1108/14636681211210369.

Johnston, R. (2012). Developing the capacity to assess the impact of foresight. Foresight, 14(1), 56–68. https://doi.org/10.1108/14636681211210369

Jordan, J. (2021). The future of unmanned combat aerial vehicles: An analysis using the Three Horizons framework, Futures, (134). https://doi.org/10.1016/j.futures.2021.102848

Judd, Robert C. “Use of Delphi methods in higher education.” Technological forecasting and social change 4, no. 2 (1972): 173-186.

Kahneman, D., Sibony, O., & Sunstein, C. R. (2021). Noise: a flaw in human judgment. Hachette UK.

Kahneman, D., Slovic, S. P., Slovic, P., & Tversky, A. (Eds.). (1982). Judgment under uncertainty: Heuristics and biases. Cambridge University Press.

Karger, E., Monrad, J., Mellers, B., & Tetlock, P. (2021). Reciprocal scoring: A method for forecasting unanswerable questions. Available at dx.doi.org/10.2139/ssrn.3954498.

Kleňha, J., Brynych, V., Havrda, M. (2022). “Methodology for the use of judgmental forecasting in public decision-making.” Praha. České priority, z.ú.

Kleňha, Jan (2021). “Improving National Strategic Foresight.” OSF. October 27. doi:10.17605/OSF.IO/94SVE.

Kleňha, Jan (2022). “Improving national strategic foresight with the use of forecasting tournaments and its implications for the study of international relations.” Stosunki Międzynarodowe–International Relations, 2(4), 4.

Kok, K., Pedde, S., Gramberger, M., Harrison, P. A., & Holman, I. P. (2019). New European socio-economic scenarios for climate change research: operationalizing concepts to extend the shared socio-economic pathways. Regional Environmental Change, 19, 643-654.

Křikava, J., Kleňha, J., Fruhauf, L. (2021) “Prioritizace ve veřejné politice v ČR”. České priority: Praha. ISBN 978-80-11-02671-4.

Kuosa, T. (2014). Towards strategic intelligence: foresight, intelligence, and policy-making. Dynamic Futures.

Linstone, H., Turoff, M. eds (2002). The Delphi Method - Techniques and Applications. Universitas Muhammadiyah Purworejo, Indonesia. Available at repository.umpwr.ac.id.

Lintonen, T., Konu, A., Rönkä, S. & Kotovirta, E. (2014). Drugs foresight 2020: a Delphi expert panel study. Substance Abuse Treatment, Prevention, and Policy, 9. https://doi.org/10.1186/1747-597X-9-18

Lum, Kwa Chin (2011). “Foresight and crisis preparedness: the Singapore experience”. Global is Asian. Lee Kuan Yew School of Public Policy, National University of Singapore.

MacAskill, William. “What We Owe The Future” (2022). Basic books. United Kingdom.

Markley, O. (2011). A new methodology for anticipating STEEP surprises. Technological Forecasting and Social Change, 78(6), 1079-1097.

Marchau, V. A., Walker, W. E., Bloemen, P. J., & Popper, S. W. (2019). Decision making under deep uncertainty: from theory to practice. Springer Nature: 405.

Megatrends. SITRA (2020), https://www.sitra.fi/en/topics/megatrends/.

Mellers, B., Ungar, L., Baron J., (2014), Psychological strategies for winning a geopolitical forecasting tournament. Psychological Science 25: 1106-1115.

Merton, Robert K. “The self-fulfilling prophecy.” The Antioch Review 8, no. 2 (1948): 193-210.

Mid-term review (2012). Tackling Obesities: Future Choices - Mid-Term Review. Foresight .org, URN 12/1210. Available at assets.publishing.service.gov.uk.

Miles, I., Saritas, O. & Sokolov, A. (2016). Foresight for Science, Technology, and Innovation. Springer Cham. https://doi.org/10.1007/978-3-319-32574-3

Morgan, M. Granger. “Use (and abuse) of expert elicitation in support of decision making for public policy.” Proc. Natl Acad. Sci. USA 111: 7176-7184.

Muelhauser, L. (2020). Efforts to Improve the Accuracy of Our Judgments and Forecasts. Open Philanthropy. September 20, 2022. Available at www.openphilanthropy.org.

Muiderman, K., Gupta, A., Vervoort, J., & Biermann, F. (2020). Four approaches to anticipatory climate governance: Different conceptions of the future and implications for the present. Wiley Interdisciplinary Reviews: Climate Change, 11(6), e673.

Neuvonen, A., Kaskinen, T., Leppänen, J., Lähteenoja, S., Mokka, R. & Ritola, M. (2014). Low-carbon futures and sustainable lifestyles: A backcasting scenario approach, Futures, 58, 66–76. https://doi.org/10.1016/j.futures.2014.01.004

OECD (2016). An OECD Horizon Scan of Megatrends and Technology Trends in the Context of Future Research Policy. Available at www.oecd.org.

OECD (2020). "How's Life: Measuring Well-being". OECD Better Policies for Better Life. Available at www.oecd.org.

OECD (2022). "Government at a Glance 2021", OECD Publishing, Paris. 10.1787.

Open Philanthropy (2023). Open Philanthropy - Cause selection. Available at www.openphilanthropy.org/cause-selection.

Our Common Agenda (2023). United Nations. Available at un.org/en/common-agenda.

Page, Michael, "Crowd Outperforms Projections from Historical Data in Early Results." CSET-Foretell (March 2021), available at https://www.cset-foretell.com/blog/crowd-performance-analysis.

Page, Michael, and Alex Barker. "Forecasting Conflict in the South China Sea." CSET-Foretell (October 2020), available at https://www.cset-foretell.com/blog/forecasts-south-china-sea.

Panula-Ontto, J. et al. (2018). Cross-impact analysis of Finnish electricity system with increased renewables: Long-run energy policy challenges in balancing supply and consumption. Energy Policy, 118. 504–513. https://doi.org/10.1016/j.enpol.2018.04.009

Pazour, M., Pokorný, O. & Valenta, O. (2017). Foresight – efektivní nástroj veřejné správy. Technologické centrum AV ČR.

Peña-López, I. (2020). Innovative citizen participation and new democratic institutions: Catching the deliberative wave. OECD publishing. Available at www.oecd.org.

PGR (2023). "Public Governance Reviews: Czech Republic. Towards a more Modern and Effective Public Administration". OECD. Available at www.mvcr.cz/clanek/hodnoceni-vykonu-verejne-spravy-v-cr-a-doporuceni-pro-budouci-strategicky-rozvoj.aspx.

Piirainen, K. A., Gonzalez, R. A. & Bragge, J. (2012). A systemic evaluation framework for futures research. Futures, 44(5), 464–474. https://doi.org/10.1016/j.futures.2012.03.008

Popper, R. (2008). Foresight Methodology, in Georghiou, L., Cassingena, J., Keenan, M., Miles, I., and Popper, R., The Handbook of Technology Foresight: Concepts and Practice, Edward Elgar, Cheltenham, 44–88.

Popper, R. (2010). Mapping Foresight: Revealing how Europe and other world regions navigate into the future. Publications Office of the European Union.

Programme of Action (2019). Child and Youth Wellbeing. New Zealand: New Zealand Government, Department of the Prime Minister and Cabinet. Available at https://childyouthwellbeing.govt.nz/resources/current-programme-action.

Přelec, Dražen, H. Sebastian Seung, and John McCoy. “A solution to the single-question crowd wisdom problem.” Nature 541 (2017), 532-535.

Raworth, K. (2012). A safe and just space for humanity: can we live within the doughnut?. Oxfam.

Read, S. A. K., Kass, G. S., Sutcliffe, H. R. & Hankin, S. M. (2015). Foresight Study on the Risk Governance of New Technologies: The Case of Nanotechnology. Risk Analysis, 36(5), 1006–1024. https://doi.org/10.1111/risa.12470

Rhisiart, M., & Jones-Evans, D. (2016). The impact of foresight on entrepreneurship: The Wales 2010 case study. Technological Forecasting and Social Change, 102, 112-119.

Rhisiart, M., Störmer, E., & Daheim, C. (2017). From foresight to impact? The 2030 Future of Work Scenarios. Technological Forecasting and Social Change, 124, 203-213.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., ... & Foley, J. (2009). Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society, 14(2).

Roonemaa, Mari (2017) “Global lessons from Estonia’s tech-savvy government”, The UNESCO Courier. Available at en.unesco.org/courier/2017-april-june/global-lessons-estonia-s-tech-savvy-government

Rosa, A. B., Gudowsky, N. & Repo, P. (2021). Sensemaking and lens-shaping: Identifying citizen contributions to foresight through comparative topic modeling, Futures, 129. https://doi.org/10.1016/j.futures.2021.102733.

Rutchick, Abraham M., et al. “Does the surprisingly popular method yield accurate crowdsourced predictions?” Cognitive research: principles and implications 5, no. 1 (2020): 1-10.

SAFIRE: Strategic Intelligence Foresight System for European Union Research and Innovation (R&I) Framework Programmes (2021). Luxembourg: Publications Office of the European Union. 10.2777/545661.

Saritas, O., & Smith, J. E. (2011). The big picture–trends, drivers, wild cards, discontinuities, and weak signals. Futures, 43(3), 292-312.

Saijo, T. (2020). Future design: Bequeathing sustainable natural environments and sustainable societies to future generations. Sustainability, 12(16), 6467.

Scoblic, J. Peter, and Philip E. Tetlock. “A better crystal ball: The right way to think about the future.” Foreign Affairs 99 (2020): 10, https://www.foreignaffairs.com/articles/united-states/2020-10-13/ better-crystal-ball.

Scotland 2030 (2022). “Schooling, Education and Learning 2030 and Beyond”. Available at: https://www.scotlandfutureforum.org/wp-content/uploads/2023/04/SchoolingEducationLearning_2030Beyond_ProjectReport_WebVersion.pdf.

Sempere, Nuno (2022), “Amplify a Bayesian: Probably a Better Method for Forecasting Unanswerable Questions”, Quantified Uncertainty Research Institute, working paper available at github.com/SamotsvetyForecasting/optimal-scoring.

SFR (2022). Strategic Foresight Report: Towards a Green and Digital Future. Joint Research Center. European Commission. Available at knowledge4policy.ec.europa.eu/foresight_en.

Shulman, Carl, Elliott Thornley, “How Much Should Governments Pay to Prevent Catastrophes?” in Jacob Barrett, Hilary Greaves & David Thorstad (eds.), Essays on Longtermism. Oxford University Press (forthcoming). https://philpapers.org/rec/SHUHMS.

Schiller, Ch., Hellmann, T., Schüle, H., Heller, S., Gasster, E. (2021). Just How Resilient are OECD and EU Countries? Sustainable Governance in the Context of the COVID-19 Crisis Bertelsmann Stiftung: Gütersloh. DOI 10.11586/2021123.

Schmidt, J. M. (2015). Policy, planning, intelligence and foresight in government organizations. Foresight, 17(5), 489-511.

Siegel, Adam. “Tracking the Outcome of Strategic Questions with Crowd Forecasting.” Cultivate Labs blog (2021),

https://www.cultivatelabs.com/posts/tracking-the-outcome-of-strategic-questions-with-crowd-forecasting.

SITRA (2016). Leading the cycle Finnish road map to a circular economy 2016–2025. https://www.sitra.fi/app/uploads/2017/02/Selvityksia121.pdf

Social Science Prediction Platform (2020) - An interview with Stefano DellaVigna, UC Berkeley Social Science Matrix, available at https://live-ssmatrix.pantheon.berkeley.edu/research-article/social-science-prediction-platform/.

SOIF (2019). The Future Is Ours: Strategic Foresight toolkit – making better decisions. https://resourcecentre.savethechildren.net/pdf/strategic_foresight_toolkit_online.pdf/

SOIF (2021). Features of effective systemic foresight in governments around the world. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/985279/effective-systemic-foresight-governments-report.pdf

Spain 2050 (2022). National Office of Foresight & Strategy. Gobierno de Espana. Available at https://futuros.gob.es/en/our-work/spain-2050.

Stauffer et al., (2023), “Existential Risk and Rapid Technological Change: Advancing Risk-informed Development.” United Nations Office for Disaster Risk Reduction.

Stauffer, M., Seifert, K., Amman, N., Snoeij, J. P. (2021). “Policymaking for the Long-term Future: Improving Institutional Fit.” Simon Institute for Longterm Governance, Geneva. 10.13140.

STEM (2023), “Forecasteři z projektu FORPOL ve spolupráci se STEM dokázali úspěšně predikovat vývoj nálad ve společnosti”, STEM & České priority, z.ú. Available at: www.stem.cz/forecasteri-z-projektu-forpol-ve-spolupraci-se-stem-dokazali-uspesne-predikovat-vyvoj-nalad-ve-spolecnosti/.

Sunstein, Cass. Infotopia: How Many Minds Produce Knowledge. Oxford: Oxford University Press, 2006.

Surowiecki, James. The Wisdom of Crowds. New York: Anchor, 2005.

Ševčovič, Maroš (2021) “Speech by Vice-President Šefčovič at the launch of Spain 2050”, European Commission. ec.europa.eu/commission/presscorner/detail/en/speech_21_2582.

Taleb, N. (2007). Black swans and the domains of statistics. The American Statistician, 61(3), 198-200.

Tetlock et. al (2017). “Bringing probability judgments into policy debates via forecasting tournaments”, Science 355/6324, 481-483. Available at science.org/doi/full/10.1126/science.aal3147.

Tetlock, Philip, et al. “Forecasting tournaments: Tools for increasing transparency and improving the quality of debate.” Current Directions in Psychological Science 23, no. 4 (2014): 290-295.

Tetlock, Philip. Expert political judgment (Princeton: Princeton University Press, 2009).

The Economist (2021), “How spooks are turning to superforecasting in the Cosmic Bazaar.” April 17, 2021, available at https://www.economist.com/science-and-technology/2021/04/15/how-spooks-are-turning-to-superforecasting-in-the-cosmic-bazaar.

The Living Standards Framework (2019). Dashboard Update. New Zealand: The Government of New Zealand. Available at www.treasury.govt.nz.

Tõnurist P., and Hanson, A. (2020) “Anticipatory innovation governance: Shaping the future through proactive policymaking.” OECD Working Papers on Public Governance. Available at https://doi.org/10.1787/cce14d80-en.

Trainauskienė, Sigita (2022), Interview conducted online on October 7, 2022. Project Lietuva 2050, Vilniaus universitetas, Latvia.

Tversky, Amos, and Daniel Kahneman. “Loss aversion in riskless choice: A reference-dependent model.” The Quarterly Journal of Economics 106, no. 4 (1991): 1039-1061.

UKCES (2014). The Future of Work: Jobs and Skills in 2030. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/303334/er84-the-future-of-work-evidence-report.pdf

UN (2023). United Nations´ Sustainable Development Goals (SDGs). Available at sdgs.un.org/goals.

UNPD (2018). Foresight Manual - Empowered Futures for the 2030 Agenda, Global Centre for Public Service Excellence. United Nations Development Programme.

Van der Steen, M. & van Twist, M. (2012). Beyond use: Evaluating foresight that fits, Futures, 44(5), 475–486, https://doi.org/10.1016/j.futures.2012.03.009

Van Dorsser, C., Walker, W. E., Taneja, P., & Marchau, V. A. (2018). Improving the link between the futures field and policymaking. Futures, 104, 75-84.

Voros, J. (2003). A generic foresight process framework. Foresight, 5(3), 10–21. https://doi.org/10.1108/14636680310698379.

Wales 2010: Creating our future (2010). Institute of Welsh Affairs. Available at https://archives.library.wales/index.php/wales-2010-creating-our-future-summary-report.

Walker, B. (2020). Resilience: what it is and is not. Ecology and Society 25(2):11 doi.org/10.5751/ES-11647-250211.

Well-being budget (2019b). “Budget 2020: Budget Policy Statement”. New Zealand: The Government of New Zealand. www.treasury.govt.nz/system/files/2019-12/bps2020.pdf.

Witkin, Bell R., and James W. Altschuld. Planning and conducting needs assessment: A practical guide. Thousand Oaks: Sage Publications, 1995.

Additional information

Data availability

This study contains two datasets.

The dataset for part 1 of the case study is available at "OSF: Improving National Strategic Foresight." https://doi.org/10.17605/osf.io/94sve (Kleňha, 2023). It contains the following data:

- Data EN.xlsx - participants' responses to Q1, Q2 and Q3 (responses to Q1 are listed as "MTPP_Preference", Q2 as "MTPP_Prediction" and Q3 as "MTPR"),
- Participants' demographic data and textual questionnaire responses,
- Forecasting tournament output as provided to the experts in Delphi.pdf
- Questions EN.pdf
- Comments CS, EN.xlsx
- Overview of 18 cards EN.pdf

The dataset for part 2 is available at "OSF: Participation in Strategic Foresight." https://doi.org/10.17605/osf.io/5fxmt (Kleňha, 2023) and contains the following data:

- Q5 - Full dataset - participant´s responses to Q5
- Q6 - Rules for respondents (English translation)
- Q6 - Full dataset - participant´s responses to Q6

Dedication & partnerships

This dissertation research was conducted by Jan Kleňha at the Institute of International Studies at Charles University in Prague and supported by the SYLFF program (the Ryoichi Sasakawa Young Leaders Fellowship Fund). Parts of the data were collected in cooperation with the non-profit organization České priority, z. ú., particularly during the joint research projects FUTURE-PRO (TITDUVCR946MT01) and OPTIONS (TL04000315), supported by grants by the Technological Agency of the Czech Republic (TA ČR).

List of tables and figures

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Appendix no. 1

Interviewed experts during the initial research about foresight and global megatrends. This list is also presented in the FUTURE-PRO Methodology manual (2022).

- Alexander Sokolov - HSE University Moscow
- Anita Pirc Velkavrh - European Environmental Agency
- Axel Zweck - Aachen University
- Ben Martin - University of Sussex
- Danièle Réchard - European Parliament - Global Trends Unit
- Duncan Cass Beggs - OECD Foresight Unit
- Ed Dammers - PBL Netherlands
- Edgar Goll - IZT - Institute for Futures Studies and Technology Assessment
- Filippo Artuso - Oxfam
- Florence Gaub - EUISS
- Florian Klein - Deloitte
- Hordur Haraldsson - Naturvardsverket - Swedish Environmental Protection Agency
- Irene Guijt - Oxfam
- Jamal Shahin - Vrije Universiteit Brussel
- Jerome C. Glenn - The Millennium Project
- Jochen Markard - ETH Zurich
- Jonathan Boston - Wellington School of Government
- Karlheinz Steinmuller - Z_punkt The Foresight Company
- Kerstin Cuhls - Fraunhofer Institute for Systems and Innovation Research ISI
- Klaus Kammer - FOEN - Federal Office for the Environment (CH)
- Kuniko Urashima - NISTEP
- Laurent Bontoux - European Commission - Strategic foresight
- Lorenzo Benini - European Environmental Agency
- Maciej Krzysztofowicz - European Commission - JRC (Policy Lab)
- Marleen Van Steertegem - VMM - Flanders Environment Agency
- Mathias Weber - Austrian Institute of Technology
- Michael Clemence - Ipsos Mori
- Michael Jackson - Shaping Tomorrow
- Michael Keenan - OECD - Directorate for STI

- Mikko Dufva - SITRA
- Nikolaos Kastrinos - European Commission - DG for Research and Innovation
- Olivier Desbiey - AXA
- Osmo Kuusi - University of Turku
- Owen White - CEP - Collingwood Environmental Planning
- Patricia Lustig - LASA Insight Ltd
- Peter C. Bishop - Teach the future
- Radu Gheorghiu - Institutul de Prospectiva
- Scott Smith - Changeist
- Tatiana Chernyavskaya – formerly UNIDO
- Ulrich Lorenz - Federal Environmental Agency (GER)
- Ward Munters - Leuven Centre For Global Governance Studies

Appendix no. 2

A short overview of the 18 cards of Megatrends and grand societal challenges that were distributed to participants in the questionnaire (Q1,2) and the forecasting tournament (Q3) and later prioritized by experts in Delphi (Q4) in the project FUTURE-PRO. The full-length cards of Megatrends and grand societal challenges (each consisting of 6-12 pages) are available online in the Czech language at megatrendy.cz.

1. Economics

In the absence of major technological breakthroughs in the use of AI and automation, the upcoming decades may be characterized by lower economic growth which could be politically unsustainable. The relative economic dominance of the West may decline significantly and the center of the world economy may shift to the Indo-Pacific region, with a growing number of participants and no single state being the economic hegemon. There will be the possibility of a middle-class upswing, pressures on the sustainability of growth across social classes, the growing assertiveness of China, or overall increasing pressure on the existing institutional frameworks of the world economy.

2. Demography

The world population is expected to reach almost 10 billion by 2050, but the growth will be asymmetric and in some areas, the population will decline. At the same time, there may be asymmetric growth in the urbanized population, which may cause, for example, disease transmission due to population density or new challenges in food security, access to water, and energy availability. The process of reducing extreme poverty and deepening economic inequalities may be slowed or halted. There will be pressure on the sustainability of pension systems and an increasing emphasis on social security. Aging, migration, and weakening of social cohesion may have significant political implications and determine the geopolitical position of many countries.

3. Natural resources

Global demand for natural resources has increased tenfold during the 20th century and is expected to grow by a further 100% by 2050 compared to 2010. Global production and consumption is dependent on the use of natural resources in a way that is unsustainable and has destructive impacts on the planet. The amount of renewable freshwater is deteriorating, the predictability of water availability is worsening and water abstraction for industry may continue to grow. Problems related to food shortages, the disparity in access

to quality food, and obesity may grow in importance. Further development of mineral resource extraction, the spread of hazardous waste, and declining agricultural yields may also be a problem.

4. Urbanization

The population living in cities with more than 50,000 inhabitants has doubled from 1.5 billion (1975) to 3.5 billion (2015) and is expected to grow to 5 billion by 2050. However, global urbanization growth is slowing and the vast majority of people will live in cities of less than 1 million inhabitants. Urbanization is one solution for sustainable economic development, but today's cities still create environmental pressures and may be vulnerable to climate change. The growing political and economic importance of large metropolitan areas can promote uneven growth and deepen inequalities. Increased population density can create new health risks, additional pressure on infrastructure, and risks associated with informal forms of housing.

5. Digitalization

Digitalization and automation of human work are accelerating both quantitatively (more jobs are being automated) and qualitatively (more complex tasks are being automated). This trend promises a major increase in economic productivity, but it also brings new societal challenges and concerns. The unequal impact of automation on different segments of the economy, widening economic inequality between nations, and rising technological unemployment may play a major role. Digitalization may also have important implications for private and social life. With digitalization, cyber-security risks are increasing and the advent of general artificial intelligence brings possible existential risks for all mankind.

6. Energy

Energy consumption is likely to grow by almost 50% by 2050, with most of the growth occurring in Asia. The energy sector now accounts for around 60% of total global greenhouse gas emissions, contributing to both climate change and water scarcity. At the same time, 1.3 billion people still do not have access to electricity. Future demand for energy may come mainly from non-OECD countries and may also grow due to population growth. Demand for conventional oil may continue to grow, coal consumption may slow down and coal may be replaced by gas, and the overall concept of countries as energy exporters may change. The rate of increase in the use of electric vehicles will be an important issue, as well as the development of new fuels for aviation and ship transportation. Decarbonization of the energy sector also requires behavioral change at the societal level. The growth of renewables may also cause increasing geopolitical instability.

7. Health

The level of health is at an all-time high, but in the future, it will be necessary to push the field of health and pharmacology forward. In particular, there will be a need to reduce the growing inequalities in access to health care and ensure adequate care for physical and mental health, equal access to drinking water and also to a quality and balanced diet, reduce the number of starving people, and proactive health solutions for an aging population.

8. Values and culture

Changes in societal values are observed, in particular the continuing shift from collectivism to individualism, changes in family structures, society's declining trust in institutions, and the transformation of the arts. Changes in the world order, conflicts, instability, climate, and environmental crises may lead to existential threats to some cultures or their homogenization. In the field of ethics, artificial intelligence and information technology in particular will bring new challenges, as the recognition of truth and falsehood will become increasingly difficult.

9. Education

The importance of education will grow in the upcoming years. The challenge will be to avoid increasing inequalities in access to education. Ensuring a holistic approach for the development of individuals as ethical, creative, cultural, and critical thinkers, as well as their participation in civic life in a society that will face many challenges, will be an increasingly pressing issue. In terms of the future of work, the main challenge will be to adapt the education system to be able to prepare students in terms of knowledge and skills for the new demands of the labor market, and digitalization and to offer the possibility of lifelong learning. The functioning of organizations and society is likely to face the challenge of what form human collaboration should take, given the increasing role of technology and the need for sustainability.

10. Poverty and inequality

In emerging countries, the number of people living in extreme poverty has been significantly reduced, leading to the upswing of the global middle class. However, it remains at risk of poverty, as national inequalities increase as well as international migration. More effective social policy mechanisms and social innovation will be needed to reduce income and gender inequalities that threaten for example the economic growth or the environment. The process of adapting society to new technologies may promote the growth of inequalities, but the

same technologies bring opportunities for more efficient redistribution of social support, reduction of barriers, or new possibilities for integrating peripheries.

11. Consumption

Increasing global consumption, population growth, and waste of food, materials, clothing, and other resources are some of the causes of increasing environmental stress. Due to changing consumption patterns and client demands, it will be crucial to ensure that consumption is met in ethical, environmental, and economically sustainable ways and that the risks of increasing debt are reduced.

12. Geopolitics

In the future, the trend of changing the form of power and its shift away from several major centers of power (the US, EU, China, and Russia) towards greater interdependence and multipolar relations between states. Such a world will bring economic and security challenges, instability, asymmetric conflicts, intensified competition in new areas, and more frequent attacks in cyberspace. There is likely to be an increase in the importance of the Indo-Pacific region and a pivot to new regions (e.g. increased interest in the Arctic). The effectiveness of development cooperation and the pressure for a greater role for the EU and a change in its institutional structure will be crucial.

13. Environment

Most terrestrial and marine environments are affected by human activities with negative impacts on ecosystem stability, biodiversity, and environmental quality. These impacts of human activities continue to increase. The trend continues toward the degradation of the Earth's ecosystems and the reduction of their provisioning, regulating, cultural, and supporting services, which will negatively affect the life and living standards of society. Beyond the primary biological damage, impacts such as the accumulation of waste and toxic substances, damage to human health, land degradation, increased risk of natural disasters and growing inequalities, poverty, and migration are expected.

14. Migration

The absolute number of migrants is expected to increase in line with population growth. Migration to North Africa and West Asia, regional migration, as well as other new migration flows will increase. The situation will be complicated by unpredictable factors such as armed conflicts, geopolitical changes, natural disasters, and the impact of the climate crisis. Chronic instability will put further pressure on migration. Affected starting countries may be at risk of future outflows of skilled workers. Destination countries can expect positive

economic benefits and opportunities in the competition for global talent, but they are also likely to face high costs and many challenges associated with migrant integration.

15. Conflicts

The future conflicts will be fought for new reasons, by new participants, with new weapons and they will be asymmetric. The threat of cyber-attacks and cyber-organised crime can be expected to increase in the future. A possible consequence of the changing nature of conflict will be a blurred line between war and peace. Another related challenge is the deterioration of the information infrastructure, which collapse would cause chaos. Future security threats also include climate change, international conflicts, migration, the misuse of biological, chemical, or nuclear technologies, or the collapse of institutions due to global instability.

16. Innovation

Technological developments are accelerating and opening up new possibilities and opportunities for countries and companies. Combined with advances in scientific knowledge in areas such as synthetic biology or artificial intelligence, these developments will challenge not only the breadth but also the potential speed of change and the associated societal impacts (e.g. the effects of robotics on employment, environmental pressures, resources and energy consumption). There is a risk of increased misinformation, manipulation, and polarization of society due to hyperconnectivity, but on the contrary, the quality of various services may increase (e.g. smart cities).

17. Climate

Global climate change has long been one of the most pressing policy issues of our time. The effects of climate change are intensifying, with extremely higher temperatures in the mid-latitudes, warmer coldest days, more hot days, and rising sea levels. In the absence of a societal response, such as a change in human behavior, decarbonizing the energy sector, or reducing greenhouse gas production, there will be unavoidable impacts that threaten life on Earth (increase of natural disasters, pressure on migration, internal displacement, health risks).

18. Democracy

The current institutional framework of liberal democracy and existing way of governance is coming under pressure, which could (in the absence of reforms) result in its gradual erosion. That may represent both a threat and an opportunity to reform the current governance. The rise of anti-system parties, cooperation between the private and public sectors, the

emergence of new social groups, and pressure for social cohesion are expected. The steadily declining voter turnout will also be problematic.

Appendix no. 3

Prediction about reported motivations	**respondents, %**
Help now - advise the Ministry on how to distribute the available funds	35
Help now - donate ~$10	5
Predict next year´s distribution - win ~$100, prove skills, show off	60

For the purpose of calibration and learning, I have pre-registered this research hypothesis before the beginning of the Q6 survey on OSF: doi.org/10.17605/OSF.IO/KAJB4.