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GLOBAL DRIVING FORCES SHAPING THE FUTURE OF THE FINNISH CADASTRAL SYSTEM BY 2035: A DELPHI STUDY

Master´s Thesis
in Futures Studies

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1 INTRODUCTION

1.1 Background

When we intend to start an activity that would occur at someone's territory or to buy a parcel, we need to know the name of the owner, our rights, responsibilities and restrictions regarding this land. Such information "provides legal protection, makes it safe to invest in and purchase land" (Bogaerts & Zevenbegren 2001, 325-326). However, in order to get this information, we need to have access to it.

Cadastral system, which can be considered as a constituent of the land administration system, is a method of recording the physical location of real properties and listing real property rights. In other words, it is 'where' component of the property rights system that secures the legal status of real properties and effective land tenure transactions. According to estimations made by KTI Property Information, 70 % of the national wealth in Finland is assigned to property and land, an efficient and reliable cadastral system is therefore highly useful. (Krigsholm el al. 2017, 133.)

The pace of change in modern world has been accelerating rapidly. All public and private systems are involved in this process as well as geographic information systems. Many anticipated global political, economic, social, technological and environmental changes interconnect with data in geographic information systems, including cadastral system. For instance, automatic transport, smart cities and 3D land use planning all require high quality and up-to-date spatial data in order to function properly.

As can be seen from the evolution of the topic and theory outlined in the literature, the role of cadastral systems as a constituent of land administration domain is continually evolving together with significant shifts in society's attitudes and relationship to land. While the range of rights, restrictions and responsibilities expands, the relationship between people and land becomes more complex. Consequently, as highlighted by many authors (Williamson 1999, Enemark et al. 2005, Bennett et al. 2008, Kalantari et al. 2008), our land administration systems that support decision-making and the course towards sustainable development, must also adapt to remain relevant.

The need for redesigning cadastral systems and understanding new social requirements has been recognized by specialists all over the world (Dale & McLaughlin 1999; Ting & Williamson 2001; Riekkinen 2014; Oryema & Mono 2016; Riekkinen et al. 2016; Krigsholm et al. 2017). Marking territory has always been a vital activity for organizing society, ensuring justice and keeping the peace. As history knows, from the primitive tribes during the ages of hunting and gathering to the periods of expansionist colonialism plotting land has always been a vital routine activity. Following the creation of states in the form, we know them today, land surveying has become a crucial factor with respect to property ownership. (Swisstopo 2014.)

1.2 Research gap

According to Williamson & Ting (2001), cadastral systems tend to transform under the enormous impact of global drivers and this is why studying these changes and their connection to the land management is of a higher interest for parties who stay in charge for its development. Authors took a closer look to such global drivers of change as sustainable development, globalization, urbanization, economic reform and technology influence in relation to land management and concluded that since these macro phenomena change all the spheres of human activities then they also affect relationship between humankind and land. Therefore, society needs a more comprehensive approach to land administration system including the consideration of various political, economic, social, technological and environmental trends.

Different governmental entities and research institutes all over the world have been working on the modernization of the cadastral system for decades. All over the world, there are signals that those cadastral systems, which are traditionally seen as well functioning also, need to be renewed as society changed at a rapid pace (Riekkinen et al. 2016, 1). However, according to Williamson and Ting (2001), the biggest challenge is to tackle this problem holistically, i.e. to see the relation between land and all the spheres of human activities, including socio-cultural and environmental tendencies.

Global drivers of change, which we also call megatrends in this thesis, frame the new order that sets the parameters for new land administration systems, which have to be much broader and integrated than the approaches of the past, it is important

therefore to design land administration systems for this future scenario (Williamson & Ting 2001, 4). As the researchers claim, change in the land administration should be implemented from three related perspectives. The relation between global drivers and cadastral systems must be studied. An analysis of the impact of these drivers on the design of the cadastre is required. Further, cadastre should be adapted to the new conditions shaped by these global drivers, such as spatial data infrastructure and the Internet. (Ibid., 9.) The current thesis will focus on the first two perspectives on the future development of the cadastral system in Finland. Technical aspects will be left aside.

1.3 Research questions and structure of the thesis

The purpose of the present study is twofold. Since it is assumed that megatrends are changing the way people relate to land, it is vital to build new strategies to adapt to these transformations. A better understanding of emerging phenomena that drive the future development of Finnish cadastral system is therefore necessary. (Krigsholm et al. 2017, 133.) The thesis pursues to recognise and increase knowledge of megatrends shaping the cadastral system and to study how these megatrends may affect the future of cadastre in the Finnish market by 2035. The expected outcome of the thesis is to provide answers to the following research questions:

- What are the global drivers shaping the operational environment of the cadastral system in Finland by 2035?
- What are the alternative scenarios of the operational environment of the cadastral system in Finland?

In order to answer these questions a Disaggregative Delphi study, which will be further described in Chapters 3 and 4, was conducted. The survey was organized in two anonymous rounds according to the principle of collective knowledge to ensure the validity of subjective opinions and mitigate Bandwagon effect. The core plot of the questionnaire consisted of twenty-one global megatrends that shape the modern reality and geographic information system as well (see Appendix 1 & 2). Respondents were invited to estimate relevance, probable and preferable impact of these megatrends on the development of cadastral system in Finland by 2035. The relevance of the megatrends to the cadastral system will be used to answer the first re-

search question. The answers of the second round of the questionnaire will be used to answer both research questions.

The thesis consists of six chapters, starting with an introduction to the research topic, introducing and providing background information about the motivation and key concepts of the thesis, and defining the purpose of the research and the research questions. The second chapter focuses on land administration system and cadastral system as its constituent, providing basic conceptual understanding about cadastre, its purposes and evolution and, additionally, views of the Finnish cadastral system. The third chapter covers methodological background of the thesis, focusing on futures studies and related concepts, tools and techniques. The fourth chapter composes the Delphi study design. Chapter 5 presents the results of the Delphi study. Chapter 6 discusses findings and analyzes the research quality and reliability. The last chapter presents conclusions.

2 CADASTRAL SYSTEM

Before going deeper into the subject, with the purpose of setting the context, it is vital to give a background information regarding the phenomenon of land, its value for the society, and to track relationships between humankind and land. Another crucial element vital for the present theory is an overview of what is land information system and the cadastral system as its subsystem. Further, we will move close to the region of Finland and consider what kind of land information system is used there currently. Conclusively a range of the previous attempts to envision the future cadastre will be presented.

Furthermore, it is important to clarify that the scientific basis of this thesis lies in two domains, cadastral research and futures studies. Accordingly, theoretical framework of this paper has been splitted into two parts, Chapter 2 and Chapter 3. The first one provides grounds on the need to study future operational environment of the cadastral system based on the literature review. Chapter 3, instead, discusses concepts and research approach applied in this thesis.

2.1 Relationship between land and society

As it was already specified in the introduction, the relationship between human beings and the land is of crucial importance in every society. This relationship has a long history from full state control, through communal forms of tenure, to the individual property rights. (Dale & McLaughlin 1999, 1). Every state has its own land regulation depending on the national system; the rights vary from country to country (Riekkinen 2014, 17).

Ting & Williamson (2011) suggest that the relationship of humankind to land in all societies has developed under the influence of global driving forces such as globalization, sustainable development, urbanisation, economic reform and technological development. Ting and Williamson (2011) identified four stages of the dynamics of this relationship:

1. Human settlement during the agricultural revolution through to the feudal system, which tied human beings to land in a physical way. Land was the primary sym-

bol and source of wealth. In this phase, the main role of the cadastral system was to publicly record ownership as well as it was used for fiscal purposes.

2. The Industrial Revolution in the 18th century, which influenced almost all the aspects of a daily life in urban and rural areas, entailed a process of breaking strong physical tie to land by turning it into more of a commodity, albeit the most valuable commodity and primary source of capital. This environment gave birth to land markets and so cadastre took on another focus – a tool to support land transfer and land markets.

3. In the 20th century, in a new environment shaped by the post-World War II reconstruction and the population boom land became a scarce resource and its amount was not sufficient for the needs of a growing world population, which was becoming more mobile at the same time. These tendencies created a need and demand in planning, particularly urban and regional planning. Planning in turn created another application for the cadastre.

4. The 1980s have seen a different twist in the problem for the scarcity of land. The focus shifted to environmental degradation, sustainable development and social equity. This change the cadastre in a way that planning issues included more interests of the citizens and more detailed issues on land use. The call for more comprehensive information about land and the rules of its use has been set. Thus, the plan to create a multi-purpose cadastre started being broadly discussed. (Ibid.)

The significance of land for the humankind is difficult to underestimate. Land exists in a tangible form as a surface to which constructions are attached and in an intangible form as a proclamation in which its value and rights to its use are declared. “Access to land and security for credit are vital components of sustainable development and good land management practice; every State needs to ensure that efficient and effective land administration mechanisms are in place” (Dale & McLaughlin 1999, 1).

The interdependence between land and society can be also demonstrated on the example of land degradation. For instance, rapid population growth can, under cer-

tain conditions, affect economic development and consequently, the living standards of the majority of the population. Backwards, many aspects of poverty lead young couples to have large families, and thus encourage a high population growth rate. Similarly, land degradation can slow down economic growth, while low levels of economic development can affect land degradation. These interconnections can be traced through time. A period of rapid degradation may reduce the usability of land, affect the utilization of the land for present generation but also for the future ones. If these future generations are not able to migrate to other territories due to close borders as in the case of Sotho of Lesotho, South Africa, the problem of land degradation may have seriously damaging effects for the development of the local community. (Blaikie & Brookfield 1987, 14.)

Land is also a highly important financial asset. Land and property are very attractive for investors. Every investment is dependent on land and property. Without land no shop, school, hospital or plant can be built and no railway constructed. Without the security of title to land or building the obtainment of investment funds and venture capital is problematic. Poor land administration imposes higher risks and costs (Dale & McLaughlin 1999, 4-5). Good land administration on the contrary contributes to economic development in numerous ways. It provides security to investors and, allows governments to raise taxes on the basis of the value of land and property, and has a capacity to ensure sustainable development. (Williamson & Ting 2001, 3.)

Solid land administration system has positive effect on taxation making the collection of taxes more feasible. It gives assurance in defending property rights against the claims of other candidates. More sufficient land information and higher revenues from taxes enable governments to provide services that are more effective. Undoubtedly, this increased information about land allows public and private entities to plan the management of resources more effectively and implement environmental politics more efficiently. Accurate land administration has a great long-term importance for the social development as a whole. (Dale & McLaughlin 1999, 2-3.)

The existing literature distinguishes two approaches to managing property in land. The original approach (Figure 1) is more limited and deals with the rights to ownership. Thus, according to this logic, cadastral system should provide information about the owner, the location of parcel, and sometimes the worth of land and description of what is situated on it.

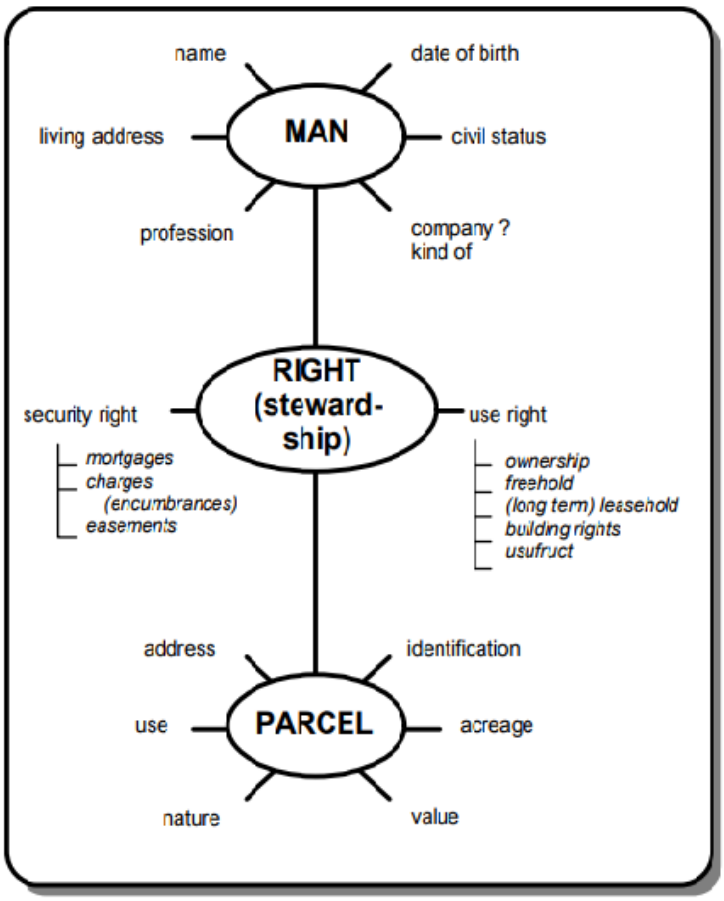


Figure 1 Relationships between man and land (taken from Henssen 1995, 6)

The modern approach illustrated takes a more complex view of the dual nature of rights, restrictions and responsibilities (RRRs). In addition to providing typical information about the parcel and its owner, land administration systems should also uncover information regarding RRRs of the owner, citizens and government, thus adding a second party of interest. Thereby, in the new model a more human-centric approach is reflected, i.e. a shift from managing physical assets to managing people's behavior in relation to their assets. Pursuant to this model, a right is not a relationship between an owner and land, but it is a relationship between an owner and other benefiting parties such as citizens and government. (Williamson et al. 2010, 88.) Interestingly, Williamson et al. (2010) finds similarities between this shift in land administration systems and the philosophical notion suggested by Peter Drucker (1946), who advocated an idea that individuals are the major resource of a company. Illustrative comparison between original and modern approaches for relating people to land is shown in Figure 2.

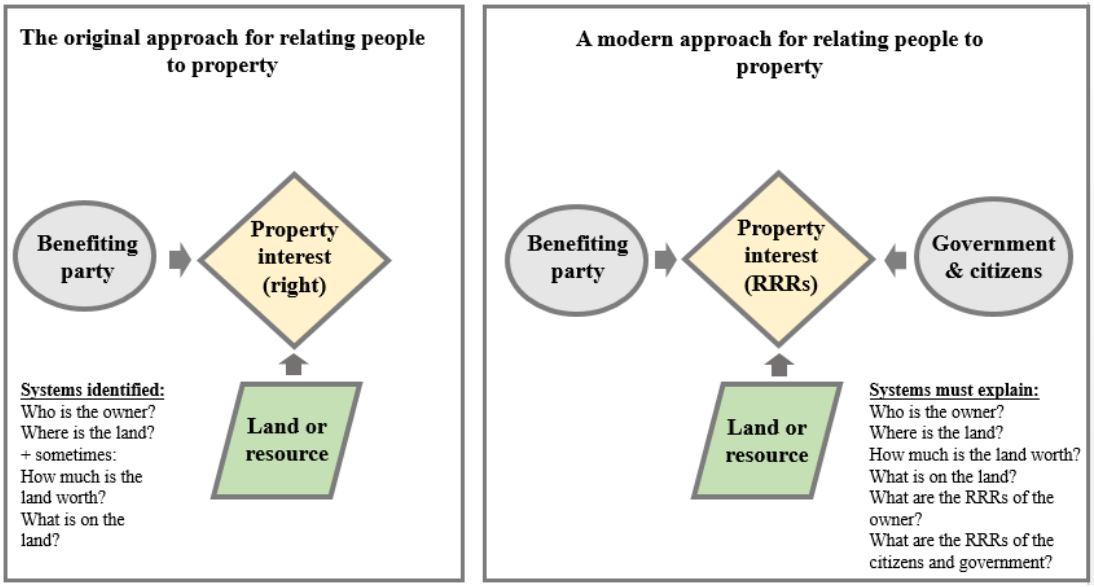


Figure 2 (adapted from Bennett et al. 2008, 134 & Williamson et al. 2010, 88-87)

According to Bennett et al. (2008, 134), the types of benefiting parties impacted by property objects today include private, public / government, communal and common space. Benefits for the public sector and the state include the opportunity to establish an efficient and equitable system for justified levying of land and tax, which needs information on location, size, ownership of the land. This also may reduce speculation with unused and underdeveloped land on the market by taxing it highly. It ensures better land management planning mechanism. It provides opportunity to control land transactions. For individuals, citizens and private sector land registration offers legal land security and protection whether this come to the owner of the land or the party interested in it. The extent of confidence and lack of insecurity results in possibilities of making long-term investment on land. Land records enhance the transactions between the interested parties making it easier, less costly and more secure. (Oryema & Mono 2016, 50-52.)

2.1.1 General characteristics of a cadastral system

This section will provide a deeper overview on what the cadastral system is and how it is organized in Finland. The field of land registration or land administration suffers from the lack of clarity in terminology throughout the world. Especially such terms

as land registration and cadastre have no universal definition. (Oryema & Mono 2016, 47.) Cadastre from the French language means a public register of quantity, value and ownership of real property. This phenomenon of cadastre and land records have long history dating from the Egyptians around 3000 BC where land records based on surveys were kept in a royal registry. Maps, description of land boundaries and written records on land were kept together. Historically, these records had two purposes, i.e. taxation purpose when land information was kept by the state to generate money from taxation. This type of system was known as cadastre, and conveyancing purpose: when the records of land contained information on the private persons and ownership and other land rights data in order to secure the land ownership and creditors' interest. This type of register was known as the land register. Based on these purposes, it is clear that the content of both cadastre and land register were strongly related however some countries kept the data separately in order to protect private needs prior to public ones. (Ibid., 48.)

Briefly, cadastral system is a constituent of the land information system. Dale and McLaughlin define at least four types of land information system (Table 1): environmental systems relevant to rural land management, infrastructural systems focusing on engineering and utility structures, socio-economic systems incorporating statistical and census type data, and cadastral systems recording land rights, planning restrictions, and land values. The former one is the main subject of the present thesis. (Dale & McLaughlin 1999, 95.)

Table 1 Four types of land information system (taken from Dale & McLaughlin 1999, 95)

Spatial Data Sets

Environmental Information	**Infrastructure Information**	**Cadastral Information**	**Socio-economic Information**
Soils	Utilities	Tenure	Health
Geology	Building	Valuation	Welfare
Watercourses	Transport	Land Use	Population
Vegetation	Communications	Law Use	Marketing
Wildlife		Law and Order	

Normally, a cadastre is understood to be a parcel-based and up-to-date land information system that contains a record of interests in land, a geometric description of land parcels linked to other records describing the nature of the interests, ownership or control of those interests, and often the value of the parcel and its improvements. It is used for fiscal purposes (valuation and taxation), legal purposes, to assist in the management of land and land-use planning (planning and administration), and it potentiates sustainable development. (FIG 1955, Enemark et al. 2005, Riekkinen 2014.)

At the beginning, land and property data were held in manual form, however with the era of technological advancements and digitalization almost all land related records started being computerized for ease of storage and retrieval. In reality, computerization does not necessarily improve efficiency – there is no benefit in computerizing the mistakes and errors of the past. However, it can also act as a catalyst to improve existing procedures. (Dale & McLaughlin 1999, 98.)

Nowadays cadastre does not serve only one purpose but instead is multi-purpose aiming to control land use, secure legal land rights and help in regulating and implementing development on land (Oryema & Mono 2016, 49). Modern cadastres tend to be under influence of macro drivers such as globalisation, technological advancement, urbanisation and micro-economic reform incorporating decentralisation, privatisation and quality assurance. Another significant macro process in regard with cadastral system is sustainable development that raises up a demand for a multi-purpose cadastre with more comprehensive data on the environmental conditions combined with other legal aspect related to land and property. (Enemark et al. 2005, 55.)

2.1.2 Cadastral system in Finland

Cadastral systems differ from country to country. Around the world, every state has its own form of a cadastral system, developed for the particular needs of that region and legal system and adapted for their social, political and economic standards (Williamson et al. 2010, 26). Normally, cadastral systems can be classified into the English type (e.g. England, Ireland, some Canadian provinces, Nigeria), the German/Swiss type (e.g. Germany, Austria, Alsace-Lorraine, Switzerland, Egypt, Tur-

key, Sweden, Denmark), the Torrens type (e.g. Australia, New Zealand, partially USA, Canada, Morocco, Tunisia, Syria). Nevertheless, these different systems have the same principles but differ mainly in procedures and maintenance (Henssen 1995, 8).

The Finnish cadastral system is based on the German model, which is considered to be the first in the world. In the German cadastral system, the cadastre and land register constitute an integrated entity that complement each other. The two entities are developed by different institutions, i.e. cadastre is developed by cadastral authorities and land registers by legal authorities. (Niukkanen 2014, 45-46.) This system is based on registering rights and the property division in the land register is based on property division in the cadastre. Thus, the Finnish cadastral system consists of a cadastre, which functions as a real property register, and a land register. In addition, it includes cadastral map. The National Land Survey is responsible for maintaining these registers. The main objects of the Finnish cadastral system are basic property units, parcels, their boundaries and right-of-use units. (Ibid., 63-63.)

Cadastral system has always been under influence of other macro transformations in the society. Understanding the present system requires an analysis of the process that has entailed the current situation. (Ibid., 55.) The financial crisis in Europe hit Finland as well in 2009 and has had an effect on the cadastral activities. New concerns such as ubiquitous digitalization, rationalization of functions, citizens' needs and decreasing tendency of using public cadastral services by them started arising. (Riekkinen et al. 2016, 705.)

2.2 Towards a future cadastral system

Over time, there have been several attempts to envision the future of cadastre in different countries and to understand its upcoming needs and shifting operational environment. The range of the European and non-European countries published the sets of national strategies how to anticipate the future of the cadastral system and enhance its use and value. The most prominent strategic plans include the ones produced by the International Federation of Surveyors (FIG), the Land Information Institute of New Zealand (LINZ), and Intergovernmental Committee on Surveying and Mapping in Australia. This is not an exhaustive list of relevant sources. Almost every civilized

country today initiates parallel projects to explore needs for the development of the cadastral system. However, these reports were chosen for a closer analysis since they were produced by the prominent and leading organizations in the field of land management on the international level. Conclusively, a recent academic study conducted by Riekkinen et al. (2016) aiming at identifying tendencies determining the future society and what this society will demand from the cadastre, will be discussed. The listed publications will be presented further.

2.2.1 International examples of development strategies for cadastral system

”Cadastre 2014” and ”Cadastre 2014 and Beyond” by FIG

The aim of the first project initiated by the International Federation of Surveyors in 1994 was to envision the future needs of the cadaster by 2014. The publication was prepared by Commission 7 led by Williamson and Dale as a fundament for solving societal problems that can be linked together with the more efficient cadastral system. FIG is the leading international organization representing the interests of surveyors all over the world. Cadastre 2014 was a result of a working group attempting to identify trends in the cadastral field to envision in which direction the cadastre might develop in the next 20 years. (FIG 2014, 1.) In order to accomplish the goal two questionnaires made for cadastral experts in different countries were conducted and six vision statements were elaborated. Four aspects of the cadastral system were taken into consideration: legal and organisational characteristics, levels of planning and control, aspects of multi-purpose cadastre, and responsibilities of public and private sectors. (Niukkanen 2014, 25.) The publication outlined those six vision statements on technical, institutional, conceptual and financial issues and suggested some new definitions in order to implement these visions in practice. (FIG 2014, 1.)

Based on the respondents’ answers, the strengths and weaknesses of different cadastral systems were analyzed. Finally, the six key features of Cadastre 2014 were identified. First, cadastre should show the complete legal situation of land, including public rights and restrictions. Second, it is recommended to unite maps and registers. Third, the cadastral mapping should be replaced by long live modeling. Fourth, paper and pencil – cadastre will cease to exist. Fifth, new cadastre should be more privat-

ized and partnership between private and public sectors should grow. Lastly, the new cadastre should be costly recovering. Thus, a new cadastral vision recognized the shifting role of governments in society, the evolving relationship between humankind and land, the striking influence of technology on cadastral reform, the changing role of surveyors in society and the growing role of the private sector in the operation of the cadastre. (Kaufmann & Steudler 1998, 15-25.)

When the year 2014 has arrived, envisioning the future of the cadastral system was challenged again. It was decided to review the statements of the previous publication of 1998, to evaluate them and to put them in the present context. Consequently, the next report "Cadastre 2014 and beyond" was published. (FIG 2014, 1). The new publication reviewed and evaluated the previous six statements, and puts them in a present-day context.

Authors of the new report stated that most of Cadastre 2014's six visionary statements remain highly relevant nowadays, but should be complemented by new issues and topics. Six new challenges were raised in the new report. Land grabbing was the first one. It was questioned whether cadastres should play a role in recording spatially the land rights conflicts generated by large-scale land purchase or not. The problem of food security and recording of the right to food (use, access, and availability) in cadastres was raised as well. Other identified critical issues included climate change and the need to record climatic dependent land rights in cadastre, and crowd-sourcing concerns such as, which cadastral procedures the crowd should be allowed to provide. Finally, adjudication, recording and surveying of the ecologically driver property boundaries in green cadastre and global cadastral network were considered in the report. (Ibid., 58.)

"Cadastre 2034" by Land Information of New Zealand

The strategy paper published in New Zealand (2014) pursued the goal to address the cadastral system as part of a broader property rights system that is the essential component of the former one and enables it to function properly, and to guide further development of the geodetic system as the foundation infrastructure for all spatial information. As stated in the report, the New Zealand strategy intends to fill the gap between the modern world-class cadastre and the one needed in the future. Similarly to the FIG's Cadastre 2014, the motive to elaborate the new strategy derived from

the rapidly changing society, especially regarding easiness of accessibility to information and technological advancement. The modern system, according to the authors of the brochure, does not satisfy the needs of the future users due to the lack of clear information and complicated access to it, which consequently affects the actions of government and private sector and inhibits New Zealand's economic growth and development. (LINZ 2014, 4.) The study resulted in a clearly stated vision that is a "…cadastral system that enables people to readily and confidently identify the location and extent of all rights, restrictions, and responsibilities related to land and real property" (Ibid., 25).

In order to achieve this vision the authors represent five requirements to be fulfilled: the need in accurate spatial positioning, easy access to rigorous and reliable spatial information on all relevant boundaries, information technology that enables users to visualize this boundary information relative to the real world or spatial information about the real world, the match between the spatial accuracy of information about boundaries and the needs of landowners and others for the definition of boundaries, and, lastly, the appropriate level of confidence. (Ibid., 26.) These requirements are supposed to be implemented with the help of advanced technologies. Further, the report also unleashes strategic goals and gaps for the cadastral system in New Zealand and ends with the concrete strategic action plan.

"Cadastre 2034" by Intergovernmental Committee on Surveying and Mapping

Similar to FIG reports and New Zealand Strategy, the Intergovernmental Committee on Surveying and Mapping (ICSM) designed the vision of the future cadastre in Australia, "Cadastre 2034", to support the reform of the cadastral system in the country. The objective of the project as stated constitutes the promotion of an organised and coherent approach to managing changes occurring in many facets of life including cadastral environment to support both jurisdictional and national interests. The aim of Australian Cadastre 2034 is to fill the gap emerging between what we have at our disposal now and what will be needed. Cadastre 2034 responds to upcoming societal demands and the challenges they represent. It builds on the achievements of Cadastre 2014 published by FIG that proclaimed the creation of digital cadastres and continues the journey to link cadastral information with broader social and legal interests on land. (ICSM 2014, 4.) The vision of the future cadastral system is stated as fol-

lows: “A cadastral system that enables people to readily and confidently identify the location and extent of all rights, restrictions and responsibilities related to land and real property” (ICSM 2014, 5). ICSM published a national strategy brochure which in general resembles in many aspects the one produces by Land Information New Zealand, just extrapolating the goals and objective in the Australian context.

The strategy identified five goals to achieve (ICSM 2014, 18-26):

- A cadastral system that is fundamental to land ownership and managed sustainably;
- A cadastral system that is accessible, easily visualized and readily understood and used;
- A cadastral system linked with broader legal and social interests on land;
- A digital cadastre that is 3-dimensional, dynamic and survey accurate;
- A federated cadastral system based on common standards.

2.2.2 Future themes in the operational environment of the Finnish cadastral system

The National Land Survey of Finland (NLS), the major authority that coordinates development and maintaining the cadastral system in the country (Riekkinen et al. 2016, 704), has taken the future of the cadastral system under into consideration. Riekkinen et al. (2016) conducted a study aimed at revealing “future themes” affecting the operational environment of the cadastral system in Finland based on environmental scanning analysis. Knowing the possible themes for the future, as authors claim, the actors of the system may change their own actions based on possible effects of the drivers. The term “future themes” together with “events” and “phenomena” constitute components of the environmental scanning analysis and its definition can be explained in the comparison to other two elements. While detecting future themes, different events and phenomena were collected and analysed. Events represent happenings such as piece of news or a topic in the news. They serve as the basis of the environmental scanning process. After analyzing, events can be recorded as phenomena, which is a recognizable happening without limitations regarding its breadth or distribution. Future themes are different broader processes behind the phenomena that are created by one or more events. They create the base for phenom-

ena; they describe a wider scale and views that affect other more visible phenomena in the operational system. (Riekkinen et al. 2016, 703-704.) Besides, according to the researchers, future themes have ubiquitous nature and each theme may influence all the dimensions of the operational environment of the cadastral system, socio-cultural, political, economic, and ecological.

Ultimately, Riekkinen et al. (2016, 705) detected 14 future themes in the operational environment: economic pressure, demographic changes, development of technology, transparent society, safety, environmental values, globalization, digitalization, know-how, quality, political change, soft values, public-private partnership and crowd sourcing. Intricacy of these themes is shown in Figure 3. The study revealed that there are many diverse agents driving change in the operational environment of the cadastral system. The significance and impact of the phenomena relative to these 14 future themes identified by Riekkinen et al. (2016) from the perspective of relevant stakeholder groups will be explored next in the present Delphi study.

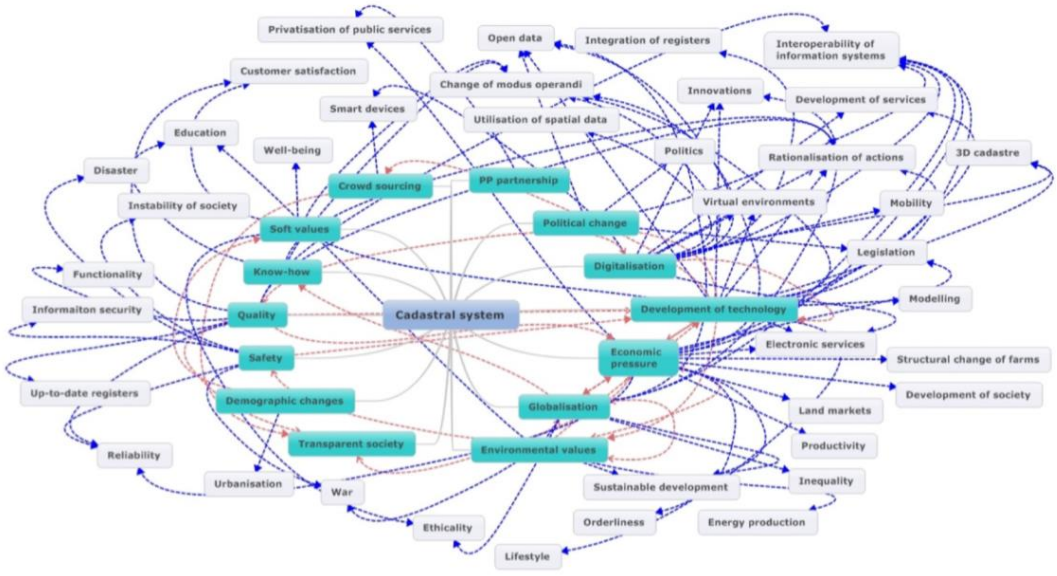


Figure 3 The complexity of future themes and phenomena occurring in the operational environment of the Finnish cadastral system (taken from Riekkinen et al. 2016, 706)

The above discussed publications and reports aim at the successful management of the cadastral system and risk avoidance on the national or international level as in the case with FIG report, in order to meet the needs of future users and to enhance

the potential of cadastral system to support decision-making processes in governmental or private entities. The necessity to study the future potential developments of the cadastral system has been shaped by the constantly changing external environment and society. This statement has been confirmed by many experts around the globe. The problem of redesigning current cadastre has been tackled from the perspectives of various theories such as systems theory, actor-network theory, and institutional economics. (Çağdaş & Stubkjær 2011, 86.) However, the combination of the futures studies perspective and cadastral research as it takes place in the present study can be partially considered as a novelty. Previously only Riekkinen et al. (2016) applied environmental scanning, a method often assigned to futures studies, to the context of land administration.

3 CONCEPTUAL FRAMEWORK

A fundamental question is to choose a strategy how to gather the data and find answers to the research questions, or in other words, to choose a method. The problem of choosing the right method depends on the purpose of a study one is going to conduct. In the field of futures studies, "methods are chosen based on fundamental elements and conditions influencing the foresight process; in other words, foresight process needs matter" (Popper, 2008, 64). In addition to the purpose of a research, such elements as time horizon, target groups, the number of available participants and other practical details are important to consider while choosing a method. (Ibid.).

Another challenge is to distinguish such terms as method, approach, technique and tool. On one hand, all these concepts seem to have vague and synonymic meanings. Some methods can be considered as a general frame for a study involving various practical techniques and tools used in order to accomplish a goal, when some cannot be applied separately without being combined with other techniques. As an example, we can look at the process of futures workshop, during which a facilitator can use brainstorming method/technique, futures wheel method/technique or relevance tree. In other words, it is a matter of researchers imagination and available resources which method to choose, how to combine it with others or how to modify already existed techniques.

This chapter will provide a methodological background of the thesis by introducing the general idea of futures studies, the concept of megatrends, the Delphi technique and scenario building.

3.1 Futures Studies

The present research has been designed following the principles of futures studies. In order to understand the core research framework of this study it is worth to provide general information about futures studies as an interdisciplinary domain.

Thinking about the future is not a novelty. Futures thinking is a universal activity that can be traced back to the dawn of human prehistory; every known society has conceptions of past, time and future. (Bell 2004, 2.) Futures thinking has evolved

along with the evolution of human consciousness. Taking a closer look at papers of prominent philosophers over different centuries such as Plato, Thomas More, Louis de Molina, Augustine, Kant, Rousseau, we can notice attempts to predict or anticipate the future and develop either utopian or apocalyptic scenarios. Bell (1997) and Gidley (2017) give detailed overview of the history of mainly western philosophical idea focused on the future and the "past of the future" (Gidley 2017, 20).

However, it is commonly believed that futures studies, futurology or foresight as a separate discipline emerged in the middle of the past century. According to Gidley (2017), the academic study of the future was born in January 24, 1902 thanks to H. G. Wells who constantly emphasized the need in establishing a more formalized and systematic study of the future consequences of new technological inventions. However, Gidley states that his appeals were seriously taken into consideration only fifty years later.

Kuosa (2011) has presented a critical analysis of the evolution of modern futures studies. Three stages were identified, i.e. 1940s–1950s, 1960s–1970s, and 1980s to modern times. The author labeled the first period, which was shaped under the conditions of emerging advanced technologies, economic growth, urbanization, industrialization and exceeding globalization, as the era of positivism, empiricism, statistical analysis, quantitative methods, planning, and financing. The key actor in futures studies of that time was RAND (Research and Development) Corporation, U.S. military think tank. At the next stage, futures studies were internationalized which means that this domain started being accepted in more countries, especially in Europe. This was the time of Cold War and pacifist movement, when the threat of nuclear war and the energy crisis, when researchers and decision-makers started thinking about longer-term consequences especially for younger generations. The key characteristics of the last and modern stage of futures studies, according to Kuosa, are quite controversial. On the one hand, we may notice many debates regarding the identity of the field, which is a good sign that shows the relevance of this discipline. Further, there is a certain degree of stabilization of the field, which means that it became more popular to teach futures studies and foresight at universities and other educational institutions. On the other hand, in this period the number of the new methods developed inside the field has dropped compared to the previous decades; only one fifth of

the total number of futures studies methods has been developed during this time. (Kuosa 2011, 331.)

The term “futurology” was first coined in 1943 by German professor of history and government Ossip Flechtheim in his book History and Futurology as the science of future systematically and critically examining future questions (Sardar 2009, 178). Flechtheim was the first who attempted to create an academic approach to studying the future (Gidley 2017, 6). Further, futures studies were philosophized through the theory of prediction in the beginning of the Cold War by the RAND Corporation. RAND was trying to perfect the science of prediction through developing a range of predictive techniques mainly deriving from mathematical methods and relying on the newly acquired computer power. (Ibid., 44.) At the same time, RAND initiated mixed qualitative and quantitative approaches based on experts’ judgements such as Delphi technique and scenario building that will be discussed further in this chapter.

Conventionally, futures studies distinguish probable, possible and preferred futures. This division was first raised in 1981 by Amara, who characterized studying of probable future as extrapolation of past trends, which therefore has a pessimistic nature. By possible futures he meant creation of alternative visions. The last one, preferred futures related to normative values. (Gidley 2017, 63.) According to Amara (1981), the defining objectives of futures studies are “to help inform perceptions, alternatives and choices about the future by: laying out paths of possibilities (the art of the “possible”); examining in detail particular paths and the likelihood of their occurring (the science of the “probable”); expressing preferences for, and implementing, particular paths (the politics of the “preferable”)”. (Amara 1981, 646.)

Thus, futures studies do not intend to predict the future, but to explore many possible futures (Masini 1993, 8). The future bears unpredictable nature, because it is fundamentally plural and open and can be seen as the arena of possibilities but not of discernible inevitabilities (Dator 2002, 6).

Methodology of futures studies contains many different methods, approaches and techniques that were developed during the last decades. Many of these methods take their roots from other disciplines such as economics, social and political sciences, environmental sciences and so forth. This hybridization explains why we refer futures studies to interdisciplinary field. Some of the methods, however, were formed

inside futures research field, for example, scenario planning method, futures workshop or Delphi method with its numerous variations.

The validity of futures research is a controversial question that has also been the subject of criticism. The key dispute of futures studies lies in distinguishing the substantial changes in the information flux. The risk that slower and therefore less visible, but more fundamental changes can be left unnoticed always remains. (Hietanen et al. 2003, 412). Another important challenge is related to biased judgement of experts regarding what is essential and valuable since all decision-making processes and envisioning are based on values of individuals in charge. The question of who can be considered an expert is the most fundamental one that affects the validity and credibility of any futures research. The difficulty however is that there is no universal criterion for identifying experts and for measuring the values of different actors. Therefore, futures studies as a discipline occurs in risk to be strongly biased. (Kamppinen et al. 2003, 39). At the same time, one of the guiding principles of futures studies is its diversity or multidisciplinarity (Bell 1997), which means that opinions from various domains should be included in the envisioning process.

Another challenge of futures studies raised by Kuosa (2011, 333) lies in fragmentation of the discipline. Metaphorically speaking, futures studies serves as a platform where many branches of art, science and policy making meet each other. This can be considered as advantage but also as a disadvantage, that creates a barrier for final recognition of futures studies as a separate and solid domain. Undoubtedly, futures thinking, planning and strategy building activities are typical for all the private and public entities. Many of them tend to establish their own expertise of anticipating future; therefore, there is a huge stream of new practices that results in disorientation and lack of organization and the question regarding who should be in charge and who holds the expertise in envisioning upcoming tendencies still remains unanswered.

Finally, in the literature it has also been a disputable question whether futures studies can be referred to art or science. For instance, Niiniluoto (2001, 376) regards futures studies as a design science, which attempts to help the rational planning of our future. When it combines the tasks of exploring probable and preferred futures, it is a synergy between “theoretical and empirical research, methodology, philosophy, and political action” (Niiniluoto 2001, 376).

3.2 Concept of Megatrends

Megatrend analysis is an important part of futures research. Concepts of megatrends and trends are close to each other in their core, however central characteristics of megatrends is that they last during a longer time span and they entail deeper change than regular trends (Krigsholm et al. 2017, 134.) Hiltunen call them "large-scale changes" (Hiltunen 2012, 44).The first to introduce the term "megatrend" was John Naisbitt in his book "Megatrends" in 1982. Naisbitt (1982, xxiii) elaborated that the society seems to be about events, "just moving from one incident -- to the next", and the individual events can only make sense by understanding the processes and large patterns underneath. Together with his colleagues, he scanned more than two million articles of local newspapers and based their megatrends on these findings. (Naisbitt 1984, xxiv- xxv.) Later the study has been broadly criticized, and it has been stated that all the megatrends were not "mega" or not always even "trends". (Bell 2003, 293.) Even if Naisbitt established the existence of macro changes or megatrends, he did not propose any definition to label them. As a result, megatrend terminology varies as well as futures studies one and there is no generally accepted set of phenomena defined as megatrends, nor is there a set of qualities that should characterize that concept. (Hiltunen, 2012, 43.)

According to Mittelstaedt (2014, 2), "megatrends are complex combinations of economic, political, cultural, philosophic, and technological factors, in their origin". Even if they originate from one sphere, they are able to influence on all constituents of society. For instance, as it was previously explained in Chapter 2, industrial revolution of the 18th century shaped new socio-economic conditions and entailed the emergence of land market that in its turn required cadastral system to carry out new functions, i.e. to support legal land transfer.

Thus, megatrends have capacity to affect many spheres in life without being tied to a particular geographical area. They are long lasting therefore according to Hiltunen we may presume that they can tell us something about the future. Different futures oriented institutes and think tanks publish their own megatrend lists that often resemble each other to a great extent. Which is not surprisingly, considering that nowadays huge stream of information are available with the help of Internet, but getting access to a more particular source is another challenge. Often we may find there such changes as globalization, aging demography, and development of advanced

technologies, climate change, digitalization, and scarcity of natural resources. (Hiltunen 2012, 44.)

An important feature of megatrends is that their directions can often be recognized but there are not many chances to affect them. Naisbitt (1984, xxxii) describes megatrends "like horses, -- easier to ride in the direction they are already going". Groddeck suggests perceiving megatrends as empty signifiers. This refers to that fact that megatrends are so overcharged with meaning that they often become meaningless, like a fad. This also means that megatrends or empty signifiers are able to blur strategic guide and to block further development. (Groddeck 2013, 28.)

3.3 Delphi technique

Prior to starting analyzing Delphi as a forecasting tool and an aid in decision-making processes, it is fundamental to give a definition of the method. Originally, this technique was seen as a tool "to obtain the most reliable consensus of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey & Helmer 1963, 458). The most widespread definition of the Delphi takes its roots from the first methodological book that was written by its key developers, Linstone and Turoff in the book *The Delphi Method. Techniques and Applications*, published in 1975. They defined Delphi "as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (Linstone & Turoff 1975, 4). Winkler and Moser (2016) gave one of the most recent and more detailed definitions of Delphi:

"The Delphi methodology is a structured, interactive group communication and judgmental forecasting process aiming at systematically exchanging informed opinion concerning an uncertainty-bearing field of interest among a panel of selected experts and developing consensual understanding that reduces uncertainty and finally enhances decision quality" (Ibid., 64).

Delphi is a mixed, both qualitative and quantitative, long-range forecasting technique and decision-making tool to be applied in the uncertain environment. The logic behind Delphi assumes that structured group thinking provide more accurate judgments than a single expert (Winkler & Moser, 2016). The method is widely applied in futures research, technological forecasting and decision-making processes.

For instance, in Japan, a local institute focused on technology and science, National Institute for Science and Technology Policy, NISTEP, conducts every fifth year thorough Delphi study on the development of technology in the future. In Finland, the Delphi method has been applied, for example, by the Finland Futures Research Centre and the Committee for the Future of the Finnish Parliament. (Hiltunen, 2013).

Gidley (2017) identifies three items of futures studies: the extrapolation of historical experience, the utilization of analytical models, and the systematic use of experts as forecasters (Gidley 2017, 49). Delphi can be referred to the last one, which is typically useful in the technological, social and scientific domains. Delphi is not a unified method; it has many variations and is quite flexible by nature. Some researchers consider that Delphi is a set of techniques that have common features such as partial or complete anonymity of the participants, structured feedback usually statistically summarized and iterative rounds. (Murray et al., 1979.) The first experiment using Delphi was conducted in 1948 to improve betting scores at horse races. Later, the name "Delphi" was coined by Kaplan, a researcher working for the RAND Corporation who headed a study in improving the use of expert predictions in policy-making. (Woudenberg, 1991.) There, it was decided to name the method after the ancient Greek oracle at Delphi, "who offered visions of the future to those who sought advice" (Gupta & Clarke, 1996, 185). Ancient Greek Oracle and modern Delphi method bare at least two common attributes: the search for knowledge that cannot be obtained by rational means as the key activity and policy-making as the main field of application. (Marchais-Roubelat & Fabrice Roubelat, 2011.) In early 1950s, RAND initiated *Project Delphi* in order to apply "expert opinion to the selection – from the point of view of a Soviet strategic planner – of an optimal U.S. industrial target system, with a corresponding estimation of the number of atomic bombs required to reduce munitions output by a prescribed amount" (Dalkey, 1963, 1). Gordon, Helmer and Dalkey (according to some sources, Nicholas Rescher was also a member of the group), stayed at the roots of Delphi's elaboration and were considered to be its original developers.

The main assumption behind Delphi according to which the collective opinion of experts is more accurate than individual judgements is based on the so-called "theory of errors". "The basic assumption follows from the old adage; two heads are better than one. Extending this wisdom; N heads are better than two. In other words,

forecasts (or decisions) that derive from the consensus of a structured group of individuals will be more accurate than those obtained from at least half of the group". (Parente & Anderson-Parente, 2011, 1705). Its states that, "an aggregate of a group will provide a judgement/forecast that is generally superior to that of most of the individuals within the group" (Rowe et al. 1991, 238).

Delphi serves as a useful tool in the conditions of severe uncertainty, when expert judgements regarding a complex issue and when objective factual data is scarce. Due to its fundamental feature, flexibility, Delphi "can be used in diverse domains for a wide range of complex problems and every time different applications are specifically tailored according to the nature of the problem and the panel of experts" (Winkler & Moser, 2016, 64).

Nowack et.al. (2011) made an analysis of previous studies on the methodology of the technique and defined its three main purposes:

- Idea generation (e.g. brainstorming, ranking);
- Judgement function;
- Consolidation function (narrowing down, consolidate the range of ideas by asking the experts to evaluate the importance of the identified items).

Delphi's key principles include anonymity, iteration and feedback. The purpose of iteration of the questionnaire and group feedback lies in reconsideration of initial opinions by a sample. Thus, being familiarized with anonymous group response and in some cases with qualitative arguments of their colleagues, participants of the survey get a chance to listen to new insights, to revise their own views and to change their opinions if necessary. Observing the problem from a different angle can result in a more accurate judgement making and thus can improve the quality and reliability of the final decisions. Anonymity provides experts an opportunity to express their judgements privately. As a result, it allows to avoid or mitigate negative social and psychological impacts of group communication processes such as "Bandwagon effect" and group pressure. Group pressure can be emitted by individuals with dominant personalities, from panelists with higher social status or with stronger oratorical abilities. (Rowe et al. 1991, 237.) The purpose of giving group feedback is to inform participants about the opinions of their anonymous colleagues. Feedback can be organized in various forms but anonymous element should be maintained. Giving feedback is especially fundamental when the purpose of the study is to foster the cre-

ative thinking and explore new views that goes along with idea-generation function of Delphi.

In science or experimental studies, it is typical to modify the theory unless it starts working appropriately and giving accurate and valid results. Delphi is not an exception at that point. The method has entangled history and has survived through two waves of since it was first applied. Many researchers have thereafter tried to alter the method in order to enhance the desired accuracy. Moreover, other alternatives such as Shang inquiry, POSTURE, SPRITE were developed. However Delphi survived the criticism (Tapio, 2003), and today it is still widely used in practice. New modifications, such as combination with other techniques, are still being developed and can serve as an evidence that the method has a potential.

In the relevant literature, there is no unified and commonly used classification of Delphi techniques and sometimes different names can refer to the same variation (e.g., the Policy Delphi = Dissensus Delphi). Hasson and Keeney (2011) identified ten categories of Delphi: classical, modified, decision, policy, real-time, e-Delphi, technological, online, argument and disaggregative. They state that Delphi design is situational and is constrained by the research problem. Key attributed of each version is not easy to specify due to a wide source of wide diversity and application, which goes along with the common problem of fragmentation in futures studies that was previously discussed.

Disaggregative Policy Delphi, developed by Tapio, similarly to the Policy Delphi aims at defining dissensus, but its final goal is to build scenarios based on different groups (clusters) of responses. After analyzing quantitative data, clusters are complemented with the qualitative data (answers of the experts to open questions) and then holistic scenarios are built. In order to group answers in different categories, cluster analysis is applied. This version of Delphi is valuable in gathering qualitative and quantitative data and in analyzing interconnections between them, which in the end is helpful in building several alternatives of the future, scenarios. According to the author, Disaggregative Delphi can lead to innovative grouping of responses that are challenging to imagine without special technique. (Tapio 2003, 84.)

Similarly to the concept of megatrends and the whole idea of futures studies, negative evaluations of Delphi techniques have been appearing since the method was just introduced at RAND Corporation. Already Dalkey, one of its first developers,

was postulating negative aspects of Delphi, including Bandwagon effect and conformity caused by statistical feedback of the group response. Nevertheless, he believed that with further experimentation of Delphi the weaknesses can be reformed. (Dalkey, 1963). One the strongest critiques were written by Sackman (1975) and Woudenberg (1991). However, even today many modern Delphi advocates and practitioners still persistently point out its possible pitfalls and try to find the ways to overcome them.

The most often debated limitations or weaknesses of Delphi in the literature are anonymity, false consensus, poor experts' selection, judgement change, poorly designed questionnaires, accuracy and poor facilitation. (Murray, 1979.) Some researchers such as Linstone, Bell, Sackman also define general ambiguity of the method and lack of theory as a weakness. Gupta et al. (1996) in their bibliography report added in this list some new limitations of Delphi such as its conceptual and methodological inadequacies, limited value of controlled feedback, and instability of responses among consecutive Delphi rounds. They also defined a scope of problems connected with individual scoring system, e.g. how to combine individual scores into a group score.

Rowe et al. (1999) published a review and critique on empirical studies that aimed at evaluating accuracy of Delphi, coming to conclusion that process of judgment change should be in focus while analyzing effectiveness of the method otherwise the knowledge about its potential would be poor and not full. The most recent summary of Delphi's drawbacks was conducted by Winkler and Moser (2016) where authors list sloppy execution and poorly designed questionnaire, problematic selection of experts, the potential of anonymity and iteration to lead to forced compromise rather than truly consensus, and difficulties in assessing result accuracy and reliability.

Based on Google Ngram Viewer analysis (Fig. 3), we can see how often Delphi was mentioned in the publications available in Google since 1963 up to 2008. Figure 4 shows that after considerable drop in 1990s, method started gaining its popularity again in 2000s. Many studies still prove Delphi's value therefore it was decided to apply this technique in the present research. To conclude, Delphi has a flexible nature and many variations of it are possible depending on purposes of a study and preferences of a facilitation team. Regardless previously mentioned critical pitfalls,

Delphi keeps being practiced by many public and private entities around the globe nowadays and in many cases, its application brings fruitful results.

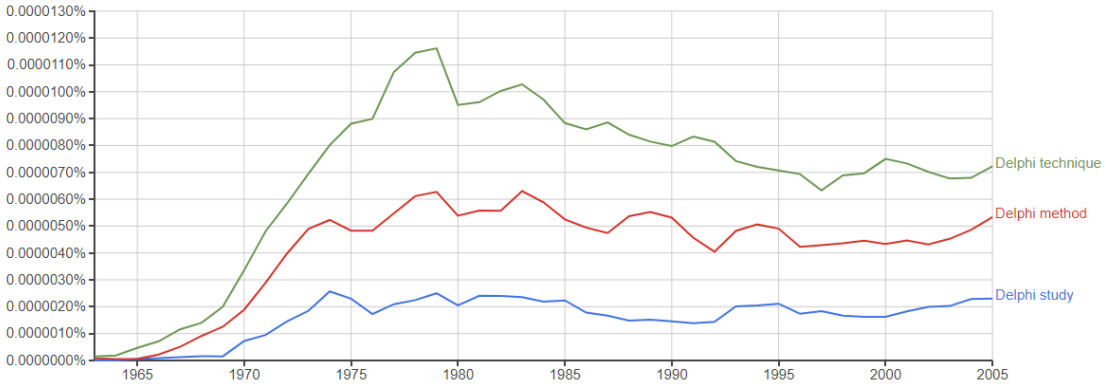


Figure 4 The key words “Delphi study”, “Delphi method” and “Delphi technique” displayed by Google Ngram viewer searching Google Books between 1963 and 2008 (please note that the validity of the absolute values of the graph is modest)

3.4 Scenario building

The word “scenario” comes from the theatrical term “scenario”- the script for a film or play. In a more academic manner, Godet (2000, 11) defines scenarios as “the set formed by the description of a future situation and the course of events that enables one to progress from the original situation to the future situation”. Putting it in another way, scenarios are stories developed by people about the way the world might or should be in the next decades. In scientific or corporate context, scenarios can be defined as a tool for detecting one’s perceptions about alternative futures. (Schwartz 1996, 3-4.)

Scenarios building is a broad methodology that can be utilized within any of the various approached to futures studies (Gidley 2017, 6). As a strategic planning tool, scenario-planning dates back to the Second World War and takes its roots from the military, where it was employed in the form of war game simulations. The first private entity that utilized scenario building process in its strategy development is considered to be Royal Dutch/Shell, an international oil enterprise, in which French oil executive Pierre Wack, who at that time worked there as a planner, formed a department called Group Planning. This department was looking for events that might af-

fect the price of oil, which was stable in the post second world war period. Looking at that situation when USA began to run out of its oil resources and Organization of Petroleum Exporting Countries started expanding its influence, Group Planning department of Dutch Shell realized that Arabic countries could raise prices for their oil. Two sets of scenarios were built which helped the company to better adapt to oil price shock or so called “energy crisis” in 1973-1974. Only Shell was prepared emotionally for this changes, which enabled it to respond quickly and efficiently and had a positive impact on company’s growth and profit.

The purpose of scenarios therefore is to help change one’s picture of reality, to connect present reality with future reality in a more preferred manner. The final output of the scenario building process is not an accurate picture of tomorrow, but a set of alternative futures that supports better decisions about the future. (Schwartz 1996, 8-9). Two decades later, popularity of scenario planning continued growing when Peter Schwartz founded the Global Business Network, and the French "strategic prospective" has been established by Jacques Lesourne and Hugues de Jouvenel. (Godet & Roubelat 1996, 1).

Scenarios building rests on the logic of a multiple futures, which means that several potential futures are possible. Nowack et al. (2011, 55) compares scenario building process with preparation for a hiking tour in the mountains, when one cannot know what the weather conditions will be and therefore should pack sunglasses, a raincoat, and a full set of winter equipment. The number of scenarios in one set typically varies from one three to four, however the final number should be chosen in accordance with the underlying scenario logic. Typical scenario development process consists of framing, scanning, forecasting, scenario transfer, implementing and controlling. (Ibid., 56-59.)

Normally, this technique can be categorized into two groups, i.e. exploratory or descriptive, when past and present trends are extrapolated into the future and construct probable or possible futures and anticipatory or normative that envision desired or feared futures (Godet 2000, 11). The purpose of exploratory scenarios lies in learning- and showing the direction; they try to answer what will and what might happen. Anticipatory scenarios established preferred future, focusing on the alternative paths leading to it (Nygrén et al. 2017, 2-3). Scenarios stimulate the imagination,

structure group thinking, and enable "appropriation by decision makers" (Godet 2000, 8). Wright et al. (2013, 632) defines four purposes of scenario work, i.e.:

- Sense-making: a one-off "exploratory question-raising scenario project";
- Developing strategy: a one-off "decision-making scenario project";
- Anticipation: an "on-going exploratory scenario activity";
- Action-based organizational learning: an "on-going decision-making activity".

Based on the extensive literature review made by Cairns et al. (2013), scenario building is typically applied in addressing complex, uncertain and ambiguous challenges in public policy domain. (Cairns 2013, 4). Scenario planning is a method that facilitates creative group thinking about alternative futures. Scenarios as future narratives consider a set of plausible and preferred futures that based on the uncertainty matrix. The uncertainty matrix typically is represented in the form of two intersecting axes. These axes usually identify relevant megatrends or trends with a significant degree of uncertainty when two opposed polarities are possible to distinguish. (Peterson et al. 2003, 339). For instance, in the product development processes sustainability trend can be considered as an uncertainty with two extreme polarities, i.e. as a main driver that pushes higher volumes of production and development of new products and as a stagnating driver that entails legal restrictions. In fact, many strategic consultancies nowadays even publish uncertainty catalogues. However, not all the scenario techniques consider development of uncertainty axes.

The biggest asset of utilizing scenario-building process is that scenarios are easy to grasp since they are usually presented in the form of narratives, pictures, visual graphs or even theatrical performances. Hence, they tend to stay in memory longer than long reports. Scenarios encourage us to think differently, from different perspective. They help to reduce uncertainty. Additionally, they function as tools for communication and encourage discussion. (Hiltunen 2012, 124.)

Nevertheless, scenarios building method did not avoid criticism as well as previously discussed approaches. Typical pitfalls in conducting a scenario study is to designate scenarios as "business as usual", "worst case" or "best case". Some scenarios turn out to be considered as "most probable" or "most unlikely". This categorization often reflects only subjective perspective and psychological bias that imposes a risk of ignoring scenarios that seem less obvious or realistic. (Nowack et al. 2011,

56.) Another controversial concern related to scenarios refers to their worth and usefulness for their end-user. As Godet claims (2000, 20) that scenarios become meaningful only when its results and implications are embodied in real action. Furthermore, the quality of scenario building procedure is one more issue to question. Even if this method structures group thinking and stimulates creativity, the quality of the group's idea cannot be guaranteed and is conditioned by many factors. (Ibid., 20.) In order to enhance the quality of scenarios building, it can be fruitfully combined with other methods such as Delphi, workshop, modelling, backcasting, cross-impact-analysis and others (Tapio et al. 2017, 41). Nowack et al. (2011, 63) write that such a union has a potential to increase credibility, creativity, and objectivity by distributing responsibility of a researcher among the experts. Referring to Schwarz et al. 1982, Tapio et al. (2017, 41) label scenario building together with Delphi technique as umbrella method that encompass other more specific techniques. They are so called hybrid futures studies methods that combine several techniques.

4 DELPHI STUDY: DESIGN AND IMPLEMENTATION

The current chapter gives an overview of the design process of the present study and its implementation. Methodological design of this thesis is based on the key objectives of the whole study. The key steps of the research are presented in Figure 5. Since this is a future oriented research, techniques and approaches were taken from the field of futures studies. The following methodological section provides details on the research strategy, questionnaire design, selection of respondents, data collection and analysis.

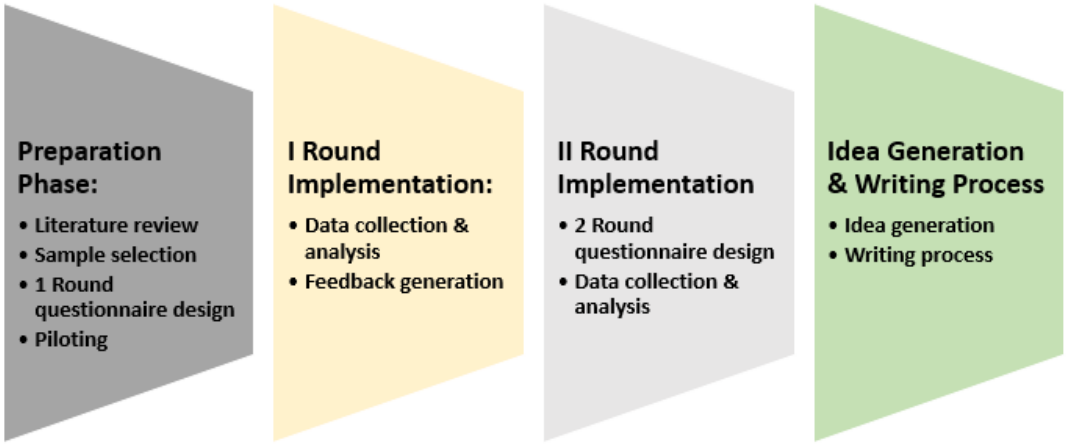


Figure 5 Research steps

4.1 Design of the Delphi

4.1.1 Research Strategy

The research strategy of this thesis was designed according to the Disaggregative Delphi technique. The anonymous two round questionnaire composed from numeric and open-ended questions was carried out among the experts who represented various social and cognitive competence. The core principles of the Delphi questionnaire constituted anonymity, iterative process, and provision of the feedback regarding the answers among the anonymous participants. Such an approach was considered to be

as the most appropriate one since the aim lies in identification of possible and preferable scenarios of development of cadastral; system including the opinions of experts from different background and sectors. Both rounds were held in Finnish language.

With an intention to avoid typical pitfalls commonly met in other Delphi cases, a literature review on Delphi methodology was conducted. Many sources talked about such critical elements of a typical Delphi study as sloppy execution, selection of the panelists, and poorly designed questionnaire.

The choice of technological implementation of the questionnaire imposed some difficulties. Initially, several options were considered. Nowadays, various web-based platforms (e.g. http://www.delfoi.com or http://webporol.fi) represent one of the most popular ways of conducting survey due to conveniences related to time saving and efficient data retrieving process. However, in the platform positioning of the graphs and question boxes would not be so flexible therefore, in order to keep more options for the design of the layout it was decided to conduct questionnaire by email using interactive PDF form. The option of a paper-and-pencil questionnaire was also evaluated and its potential to have positive influence on response rates was taken into consideration, however due to possible technological problems and financial reasons, interactive PDF form was determined as the most suitable one, which was created with the help of PDF-Xchange software.

4.1.2 Selection of participants

Following the literature review, the next step was to select a sample. Appropriate selection of the sample is fundamental for the success of any similar study. However, there are no universally agreed algorithm and criteria for the selection of experts or magic formula to decide who is an expert. As stated in many articles related to Delphi technique, sample must be as representative as possible. First, it is vital to set the criteria for selecting experts in advance; secondly, it must be stated explicitly in the research report (Nowack et al. 2011).

In order to achieve a comprehensive sample, an expertise matrix was utilized. The expertise matrix, first introduced by Kuusi (2006, 114; 2013, 257), serves as an aid to assure diversity and quality of Delphi-panel. As emphasized by Varho & Tapio (2013, 615), it is a convenient tool to control that all relevant groups of potential re-

spondents are included in the panel. It helps in recognizing experts with different cognitive and social status and ensures transparency of the sample selection process.

The expertise matrix in this study was modified to match the operational environment of the Finnish cadastral system. Based on the argument that any land information system requires a wide variety of users, including government, landowners, surveyors, lawyers, real estate managers, and retailers (Dale & McLaughlin 1999, 96) and on the typology of people impacted by property objects (Bennett et al. 2008, 134) described in Chapter 2, we tried to invite representatives of different benefiting parties. Since this study focuses on future issues from a national perspective and concentrates on the megatrends driving the future development of the Finnish cadastral system, our expert panel was composed of Finnish experts. Above all, it was also decided to include background questions in the questionnaire in order to see to which sector or organization respondents may represent, years of experience and specific domains of expertise. (Krigsholm et al. 2017, 136.)

Respondents were grouped according to the principle of balance with the help of stakeholders' matrix consisted of cognitive and social expertise as key categories. The range of expertise that respondents represent included such cognitive field as technology, legislation, cadastral surveys and land use, and consumer preferences. Social expertise category was grouped into research, business, administration, non-governmental organizations and policy-making fields. In total, four categories of cognitive and five categories of social expertise relevant to our study are recognized. We consider technology, legislation, cadastral surveys and land use, and consumer preferences as the fields of cognitive expertise. The fields of social expertise include research, business, administration, non-governmental organizations (NGO's), and policy-makers. In identifying potential panelists, we aimed to cover all grids, i.e. all categories of expertise. Some examples of recognized actors are listed in Table 2 (Krigsholm et al. 2017, 136).

Table 2 Categories of the sample in expertise matrix for the Finnish cadastral system and the field of land surveying (taken from Krigsholm et al. 2017, 136)

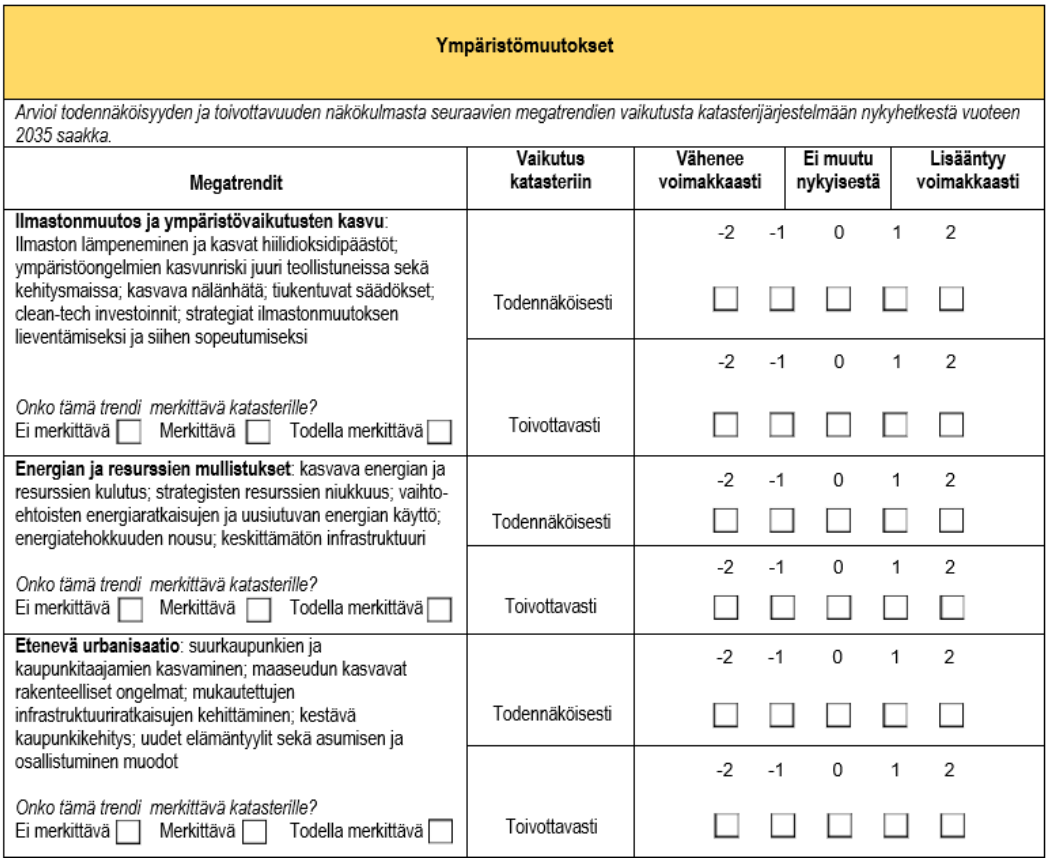
Social / cognitive	Technology	Legislation	Cadastral surveys and land use	Consumer preferences
Research	Universities, research institutes	…		
Business	Construction and mapping industry			
Administration	NLS, municipalities			
NGO	Citizens, construction and mapping industry			
Policy-makers	…			

4.2 First round data collection and analysis

Prior to sending out the questionnaire, in order to ensure the clarity and relevance of the questions, the piloting version was sent out among the ten panelists from different fields. Comments and critiques acquired at that stage resulted in the edition of the first version and modification of several questions. It is also important to mention that the design of the questionnaire was first carried out in English and further translated into Finnish. The first round was conducted by email with interactive PDF forms. The emails were complemented with a cover letter. The purpose of this letter was twofold, i.e. to motivate respondents to fill the questionnaire form and to explain the objective of the study. Round 1 email was sent to 150 individuals. The initial response period was two weeks, and a reminder email was sent after one week. The response period was extended by four days due to the low response rate during the initial period.

The questionnaire included both closed- and open-ended questions. The open-ended questions partly supported the numerical answers given in closed-ended questions. The collected data were analyzed both descriptively (means and standard deviations for close-ended questions) and qualitatively (content analysis for open-ended

questions). Extract from the questionnaire is shown in Figure 6. For more details see Appendix 1.



Ympäristömuutokset

Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.

Megatrendit	Vaikutus katasteriin	Vähenee voimakkaasti		Ei muutu nykyisestä		Lisääntyy voimakkaasti
Ilmastonmuutos ja ympäristövaikutusten kasvu: Ilmaston lämpeneminen ja kasvat hiilidioksidipäästöt; ympäristöongelmien kasvunriski juuri teollistuneissa sekä kehitysmaissa; kasvava nälänhätä; tiukentuvat säädökset; clean-tech investoinnit; strategiat ilmastonmuutoksen lieventämiseksi ja siihen sopeutumiseksi	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Onko tämä trendi merkittävä katasterille? Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Energian ja resurssien mullistukset: kasvava energian ja resurssien kulutus; strategisten resurssien niukkuus; vaihtoehtoisten energiaratkaisujen ja uusiutuvan energian käyttö; energiatehokkuuden nousu; keskittämätön infrastruktuuri	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Onko tämä trendi merkittävä katasterille? Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Etenevä urbanisaatio: suurkaupunkien ja kaupunkitaajamien kasvaminen; maaseudun kasvavat rakenteelliset ongelmat; mukautettujen infrastruktuuriratkaisujen kehittäminen; kestävä kaupunkikehitys; uudet elämäntyylit sekä asumisen ja osallistuminen muodot	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Onko tämä trendi merkittävä katasterille? Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐

Figure 6 Extract from the questionnaire form Round 1.

In this study, we used the list of megatrends that was published by German Foresight company Z punkt, a respected consulting entity in the field of futures research working with private and public sector clients (Z punkt 2016). (Krigsholm et al. 2017, 134). The list however was slightly modified. For example, the direction of the megatrend was clarified, since originally the drivers were published in the static condition and did not reflect whether the process was increasing or decreasing. Besides, one additional megatrend, increasing trend in transparency, accessibility and open data, was added in the political group.

It is worth mentioning that there are many trendspotting companies nowadays whose business is built around trend analysis. These companies, institutes and think tanks on a regular base produce reports, in which they try to document the identified tendencies. Not all of these reports are publicly available though. Some of them are

regularly updated by such think tanks as Sitra, Trendsetters, Trendwatching etc. Although they are not peer-reviewed, these sources can potentially provide valuable insights in the search for trends that drive current practices in businesses and other organizations. The choice to include a relatively large number of megatrends (21) including social ones that are typically ignored in cadastral research is motivated by our intention to look at new emerging developments holistically, which as we assumed would provoke tunnel vision and contribute to broaden our understanding of the future of the Finnish cadastral system. (Krigsholm et al. 2017, 134-135). Alternatively, as an initial stage of this research, it could have been possible to conduct environmental scanning activity in order to identify macro phenomena relevant only for cadastral system. However, this procedure would require sufficient time resources and could have resulted in a separate paper. The complete list of megatrends and their phenomena is presented below (Table 3).

Table 3 List of megatrends (taken from Z punkt 2016)

INCREASING TREND IN TRANSPARENCY, ACCESSIBILITY AND OPEN DATA	Citizen engagement, lack of popular trust in the authorities, and consumer-oriented policies
DEMOGRAPHIC CHANGE	Growing global population; Ageing populations; Declining populations in the West; Increasing migration streams; Demographic shifts
INDIVIDUALISATION REACHES A NEW STAGE	Individualism, a global phenomenon; Changing relationship patterns: Few strong, many loose relationships; Complex biographies and identities; From mass markets to micro markets; Self-sufficiency and DIY-economics
SOCIAL AND CULTURAL DISPARITIES	Growing polarisation of the rich and poor; Precarious lifestyles becoming the norm; Social fragmentation across different life situations; Competing and merging value systems
REORGANISATION OF HEALTHCARESYSTEMS	Increasing health awareness and higher personal responsibility; Changing disease patterns; Sharp increase in health expenditure - greater privatisation of costs; Reorganisation of the healthcare sector; New approaches to diagnosis and treatment; New converging markets
CHANGES TO GENDER ROLES	Breakdown of traditional gender roles; Increasingly important role played by women in the workplace; Appreciation of social and communicative skills; Growing importance of a healthy work-life balance; New family structures and lifestyles
NEW PATTERNS OF MOBILITY	Mobility increases worldwide; Barriers to mobility increase; Intermodal mobility patterns; Digital networking of traffic; New vehicle concepts and drive technologies; Intelligent logistics solutions
DIGITAL CULTURE	Digital technologies pervading and connecting all

	aspects of daily life; Greater differentiation between digital lifestyles; Digital natives: New forms of social communication, participation and organisation; Web 3.0 is on its way
LEARNING FROM NATURE	Natural structures and processes becoming a key characteristic of innovation; Bionics incorporated into design and technology; Swarm intelligence; Influence of biology on production systems— decentralisation and the closed-loop economy
UBIQUITOUS INTELLIGENCE	Transition towards cloud-based IT; New interfaces and intelligent environments; Emergence of the Internet of Things; Creation of intelligent infrastructures; Breakthroughs in artificial intelligence and robotics
TECHNOLOGY CONVERGENCE	Miniaturisation and nanotechnology becoming key drivers of technology convergence; Dynamic innovation for new materials and construction methods; Expansion of biotechnology; Greater NBIC-convergence to achieve the vision of a "second nature"
GLOBALISATION	2.0 Shift in the location of economic power centres; Volatile economy; Emergence of a global middle class; Globally fragmented and distributed value chains; Globalised flow of capital – unrestrained financial sector
KNOWLEDGE- BASED ECONOMY	Rising levels of education around the world; Innovation as a key driver and competition factor; Data and knowledge-based value creation; New global knowledge elite—the creative class; Lifelong learning
BUSINESSECOSYSTEMS	New value-chain partnerships; System innovations; Business mash-ups—interfaces give rise to new markets; Creation of the fourth sector; Complexity management
CHANGES IN THE WORK WORLD	Highly dynamic and flexible working practices; New managerial and organisational patterns; Collaborative methods of working; Advances in automation
NEW CONSUMPTION PATTERNS	Shifts in consumer spending and consumer preferences; Third World enjoying greater prosperity; Catch-up consumption in newly-industrialised countries; Sustainable consumption in the West; Change in buying habits—hybrid and virtual models; Growing importance of collaborative consumption
ENERGY AND RESOURCES REVERSAL	Growing energy and resource consumption; Strategic resource scarcities; Use of alternative sources of energy and renewable resources; Revolution in resource efficiency; Decentralised infrastructures
CLIMATE CHANGE AND ENVIRONMENTAL IMPACTS	Rising temperatures and CO2 emissions; Growing risks posed by environmental problems in newly-industrialised and developing countries; Increased food shortages; Stricter regulations; Cleantech investments; Strategies for mitigating and adapting to climate change
URBANISATION	Strong growth of megacities and urban conglomerations; Greater structural problems in rural areas; Development of adapted infrastructure solutions; Sustainable urban development; New forms of residence, living and participation
NEW POLITICAL WORLD ORDER	China and India join the ranks of world powers; Crisis of Western democracies; New strategic alliances in a multipolar world; Transformation of systems; Africa awakes
GLOBAL RISK SOCIETY	Growing vulnerability of technical and social infrastructures; Greater number of natural disasters; Asymmetric conflicts; Global organised crime and cybercrime;

All the 21 megatrends were further categorized according to PESTE framework (Table 4), where “P” stands for political, “E” for economic, “S” for social, “T” for technological, “En” ecological/environmental themes. These five categories are used to structure thinking and to identify of hidden potential political, economic, social, technological and environmental phenomena (Schwartz 1991, 227; Heinonen et al. 2013, 329). In addition, PESTE-categories correspond with the four elements of the operational environment of the cadastre identified by Riekkinen et al. (2016) to a considerable extent. As stated by Riekkinen et al. (2016), operational environment is the socio-cultural, political, ecological and economic environment in which the cadastre operates. Operational environment of the cadastre is illustrated on Figure 7 (Riekkinen et al. 2016, 705). The only missing category is technological shifts.

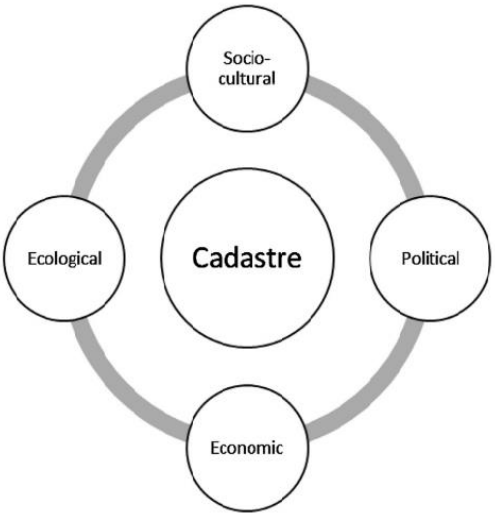


Figure 7 The operational environment of the cadastre. (taken from Riekkinen et al. 2016, 705)

Each group included several megatrends with their description. The respondents were asked to estimate the probable and preferable impact of each megatrend on the cadastral system in Finland by 2035. In addition, the relevance criterion under each megatrend was also incorporated, since some megatrends could be completely irrelevant to the topic of land information system. In the end of each category, respondent has two answer two open questions: What are the ways to make positive impacts come true? What other political changes will have impact on cadastral system in Finland in the future?

Table 4 Megatrends by PESTE category (taken from Krigsholm et al. 2017, 135)

Category	Megatrends
Political	Transformation of political world order; Global risk society; Increasing transparency, accessibility, and open data
Economic	Knowledge-based economy; Business ecosystems; Changes in the work environment; Globalization; New consumption patterns
Social	Demographic change; Individualization; Social and cultural disparities; Reorganization of healthcare systems; Changes to gender roles; New patterns of mobility
Technological	Digital culture; Learning from nature; Ubiquitous intelligence; Technology convergence
Environmental	Climate change and environmental impacts; Upheaval in energy and resources; Urbanization

The potential connection between listed megatrends and the cadastral system should be clarified. As stated by Krigsholm et al. (2017, 135) there is only scarce previous research on cadastre foresight (e.g. Williamson & Ting 2001), therefore studies from related disciplines, for example on sustainability, can be used as a reference point. Research on sustainability can be one of such examples. Pätäri et al. (2016) conducted a study on global sustainability megatrends transforming pulp and paper industry, and Retief et al (2016) identified the same forces in the environmental assessment practice (Ibid.).

After the results were collected following the principle of the Delphi, all the answers were analysed and integrated in the form of feedback for the next round to give a chance for participants to get familiarized with the opinions of their anonymous colleagues. The feedback for the quantitative data was given in the form of average values and histograms. Numeric data were analysed descriptively, i.e. means and standard deviations were calculated. Further, quotations from the open-ended answers were also included in the feedback in order to increase the argumentation between panelists on the second round. Qualitative data were analysed using content analysis. (Krigsholm et al. 2017, 136).

Results of the first round partially provided answers for the first research question: what are the global driving forces shaping the Finnish cadastral system by 2035? The mean relevance of each megatrend was calculated. Next, the means were

compared and those megatrends which relevance was not lower than 1,000 were chosen for the further analysis. Means and ranks of all the megatrends according to the average value of respondents' opinion are represented in the Table 5. The following megatrends were included in the more in-depth analysis: digital culture, ubiquitous intelligence, increasing trend in transparency, accessibility, and open data, urbanization, business ecosystems, new patterns of mobility, global risk society, knowledge-based economy and changes in the work world.

Table 5 List of megatrends and mean and ranking order of the answers. Number of respondents, N = 21 (taken from Krigsholm et al. 2017, 137)

Megatrend	Mean	Rank
Transformation of political world order	0.429	18
Global risk society	1.048	7
Increasing trend on transparency, accessibility, and open data	1.476	3
Knowledge-based economy	1.048	8
Business ecosystems	1.190	5
Changes in the work world	1.000	9
Globalization	0.905	10
New consumption patterns	0.762	13
Demographic change	0.789	11
New stage of individualism	0.474	17
Social and cultural disparities	0.579	14
Reorganization of healthcare systems	0.211	21
Changes to gender roles	0.333	20
New patterns of mobility	1.105	6
Digital culture	1.632	1
Learning from nature	0.421	19
Ubiquitous intelligence	1.632	2
Technology convergence	0.500	16
Climate change and environmental impacts	0.789	12
Upheaval in energy and resources	0.526	15
Urbanization	1.368	4

4.3 Second round data collection and analysis

The second round was implemented after the first round answers were analyzed and summarized for the feedback. The response period for the second round was four weeks in total. With an intention to create the iterative process characteristic of Del-

phi studies, the second round questionnaire was sent out to only 21 experts, who answered in the first round. In the second round, we received 12 responses (Krigsholm et al. 2017, 136).

During the second round, in addition to the same list of megatrends integrated feedback was added in the form of graphs and regrouped open-ended answers. The purpose of the feedback was to allow panelists to evaluate the numeric answers and arguments behind them. An extract from the second round questionnaire is demonstrated in Figure 8. For more details see Appendix 2.

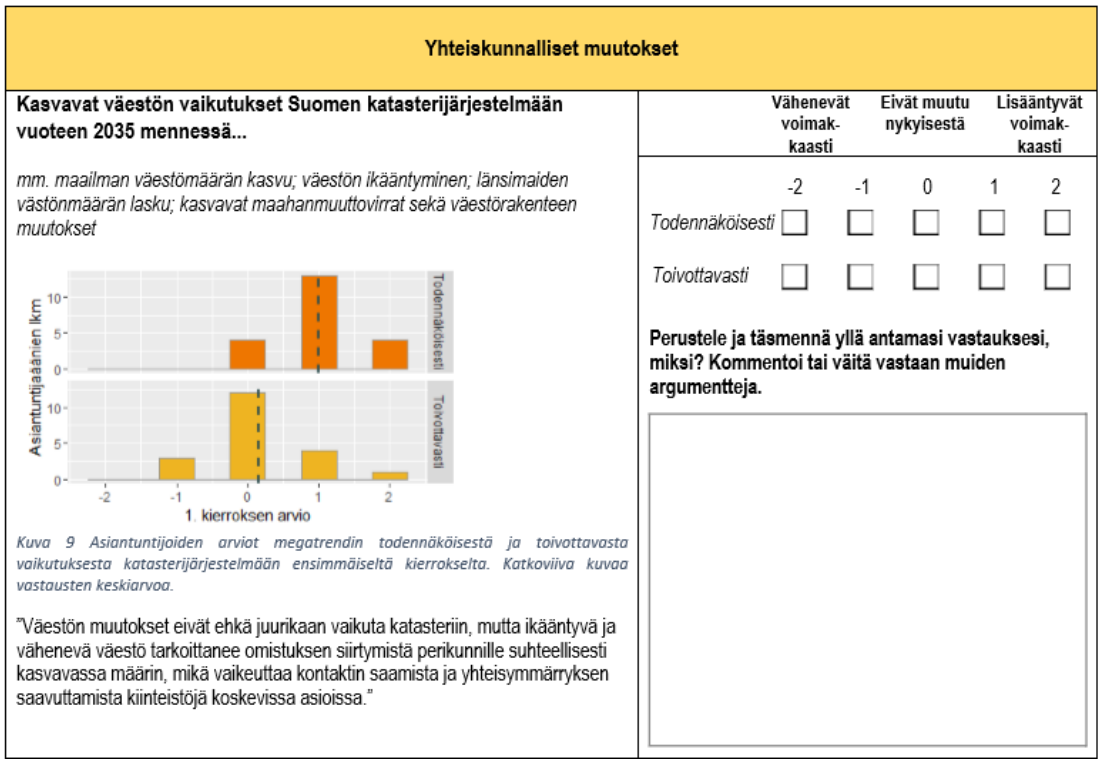


Figure 8 Extract from the questionnaire form Round 2

In this round, the experts were asked to reevaluate probable and preferable effects of the megatrends with the same scale used in the first round. Relevance criterion was not included anymore. Differently from the previous round, respondents were asked to give written arguments for each of the megatrend in order to state their quantitative evaluations. The aim of this iteration was to provoke nonconventional thinking after familiarizing themselves with the quantitative answers and arguments of the other participants (Krigsholm et al. 2017, 136).

The second round results were mainly used to answer the second research question, i.e. what are the alternative scenarios of the operational environment of the cadastral system in Finland? The acquired data were analysed using Statistical Package for the Social Sciences version 23 for Windows (SPSS 23; IBM) and Microsoft Excel (Microsoft Office Professional Plus 2013, Microsoft). Hierarchical cluster analysis combined with Ward's minimum variance method was conducted. A more detailed description of the analysis will be presented in Chapter 5.

The quantitative data were analysed by calculating the mean values and the standard deviations of the quantitative variables. Both the probable and preferred future up to 2035 was asked for as in the previous round. This means that each respondent had the possibility to create two images of the future. As there were 12 respondents in the second round, there were 2*12=24 initial future images. Two of them included blank answers to some variables and were therefore excluded from the cluster analysis. Altogether 20 complete answers were grouped to form the scenarios. Qualitative arguments were collected from the questionnaires and connected to quantitative variables and content analyzed.

Subsequently, the qualitative data were translated from Finnish to English and the figures to illustrate the final quantitative results were created. The outcome in the form of scenarios is presented in the next chapter.

5 RESULTS

This chapter introduces the outcome of the Delphi study. Following the order of the two research questions, first, the relevance criterion was analysed in order to identify the most impactful drivers in the operational environment of the cadastral system and further, a set of four normative scenarios was constructed based on hierarchical cluster analysis.

5.1 Driving forces shaping the cadastral system in Finland

This section provides an answer to the first research question. In the first Delphi round 150 respondents were asked to rank the relevance of 21 political, economic, social, technological and environmental megatrends affecting the cadastral system towards the year 2035 using a three-step Likert scale: “not relevant”, “relevant”, and “highly relevant”, scored as 0, 1, and 2 for the analysis (Krigsholm et al. 2017, 136). Round 1 questionnaire was sent to 150 experts. The response rate of the first Delphi round was 14 %.

Table 6 presents the results for the perceived importance of megatrends and their ranking. Higher mean value indicated higher relevance rank of a megatrend for the cadastral system by 2035. Standard deviations are also included in this analysis since these indications help interpret the responses: the lower the standard deviation, the higher the consensus among the respondents. In ranking megatrends, if two megatrends receive the equal mean value, the one with a lower standard deviation is ranked lower. Table 6 demonstrates that technological, economic, and political megatrends have higher ranks and thus are considered more relevant, whereas social megatrends, on the contrary, are mostly perceived as irrelevant. (Krigsholm et al. 2017, 136.)

Based on the ranking, we can distinguish nine the most impactful drivers. The relevant megatrends include digital culture, ubiquitous intelligence, increasing trend in transparency, accessibility, and open data, urbanization, business ecosystems, new patterns of mobility, global risk society, knowledge-based economy and changes in the work world. Further, these nine megatrends will be analysed more deeply.

Table 6 List of megatrends with assigned variables and mean value of their relevance on the 3 steps Likert scale from 0 to 1, standard deviation, and ranking order of the answers. Number of respondents, N = 21 (taken from Krigsholm et al. 2017, 137)

Variable	Megatrend	Mean	Standard deviation	Rank
P1	Transformation of political world order	0.429	0.598	18
P2	Global risk society	1.048	0.384	7
P3	Increasing trend on transparency, accessibility, and open data	1.476	0.602	3
E1	Knowledge-based economy	1.048	0.669	8
E2	Business ecosystems	1.190	0.680	5
E3	Changes in the work world	1.000	0.707	9
E4	Globalization	0.905	0.700	10
E5	New consumption patterns	0.762	0.700	13
S1	Demographic change	0.789	0.768	11
S2	New stage of individualism	0.474	0.507	17
S3	Social and cultural disparities	0.579	0.750	14
S4	Reorganization of healthcare systems	0.211	0.402	21
S5	Changes to gender roles	0.333	0.571	20
S6	New patterns of mobility	1.105	0.793	6
T1	Digital culture	1.632	0.498	1
T2	Learning from nature	0.421	0.590	19
T3	Ubiquitous intelligence	1.632	0.590	2
T4	Technology convergence	0.500	0.510	16
En1	Climate change and environmental impacts	0.789	0.680	12
En2	Upheaval in energy and resources	0.526	0.746	15
En3	Urbanization	1.368	0.498	4

Ranking in the Table 6 demonstrates that the most relevant megatrend for the future of the Finnish cadastral system is digital culture. This phenomenon consists of such factors as social communication, participation and organization, and digitalization of everyday life. According to the overall opinion of the respondents, the advanced technologies should improve the capacity of the cadastral system, make it easier to use and more user-friendly. As one of the respondents noticed:

"Cadastral system should be integrated with other web interfaces and virtual realities."

The second most relevant megatrend is ubiquitous intelligence, with the same mean value as digital culture but with a higher standard deviation. This phenomenon can be described as a transition towards cloud-based IT, new interfaces and intelligent environments, emergence of the Internet of things, creation of intelligent infrastructures and breakthroughs in artificial intelligence and robotics (Z punkt 2016, Krigsholm et al. 2017, 137).

"Getting access to the digital cadastral system information will open great opportunities and will create completely new information connected to other services…"

The increasing megatrend towards transparency, accessibility, and open data were ranked as the third most relevant megatrend. This tendency can be characterized as citizen engagement, lack of popular trust in the authorities, and consumer-oriented policies (Krigsholm et al. 2017, 137). Some elaborations of the respondents on how increasing degree of transparency and access to the data may affect cadastral system are presented below:

"Increasing transparency, for example, requires restricted data protection, but also the clarification of the roles of different actors in the society and common operating models."

"Open data and change in consumer behaviour, together with the widespread utilization of digitalisation, change the significance of the cadastral system. In the future, cadastre will be a self-service tool maintained by society through mobile applications. The authority level will become almost invisible and soon the users of the system will not even know where the information comes from."

Urbanization and business ecosystems were ranked as the fourth and fifth most relevant megatrends (Krigsholm et al. 2017, 137). Urbanization comprised such factors as sustainable urban development, the strong growth of megacities and urban conglomerations, and new forms of residence. Increasing urbanization increases the need for planning, building urban environments that in response bring the need for 3D cadastre. It expands the amount of data in the system imposing at the same time stricter requirements for the accuracy of information. Urbanization also brings new challenges and problems such as overpopulation and high density leads to vertical planning of the city that makes it difficult to define borders underground. At the same time, together with other megatrends urbanization brings new forms of housing and ownership that will change the cadastral system as well.

Business ecosystems consisted of new value-chain partnerships, system innovations, interfaces that give rise to new markets, and complexity management. Four final megatrends included in the further analysis were new patterns of mobility, global risk society, knowledge-based economy and changes in the work world.

Selected qualitative comments regarding business ecosystems from the first round responses:

“Deepening globalization can also lead to the narrowing of production and, possibly, the depreciation of the Nordic welfare model. The prerequisites for maintaining a well-functioning Nordic welfare state may fail.”

"Changing working life together with technological development will revolutionize catastrophe maintenance methods and related data collection. Multi-channel and automated data collection replaces almost entirely human work. The concepts of "legal cadastral survey", "application for mortgage document" or "register’s controller’s decision" currently known in the catastrophe are lost and replaced by concepts related to data stream management.”

Figure 9 demonstrates that relevance criterion and perceived significance have similar results. According to ranking, technological megatrends were considered the most relevant as well as they are expected to have the strongest impact on the development of the Finnish cadastral system. The average for the probable impact for both

the digital culture (first round mean 1.62 and second round mean 1.67) and ubiquitous intelligence (1.57 and 1.58) is over 1.5, which indicates that they are expected to shape the cadastral system significantly by year 2035. Urbanization (1.48 and 1.42), increasing trend in transparency, accessibility, and open data (1.43 and 1.42), and global risk society (1.05 and 1.17) are foreseen as the third, fourth and fifth most probable influential factors for the Finnish cadastral system. Changing work world (1.14 and 1.08), new patterns of mobility (1.14 and 1.08), business ecosystems (1.19 and 1.0), and knowledge-based economy (1.10 and 1.0) come after with arithmetic averages slightly around 1. (Krigsholm et al. 2017, 137.)

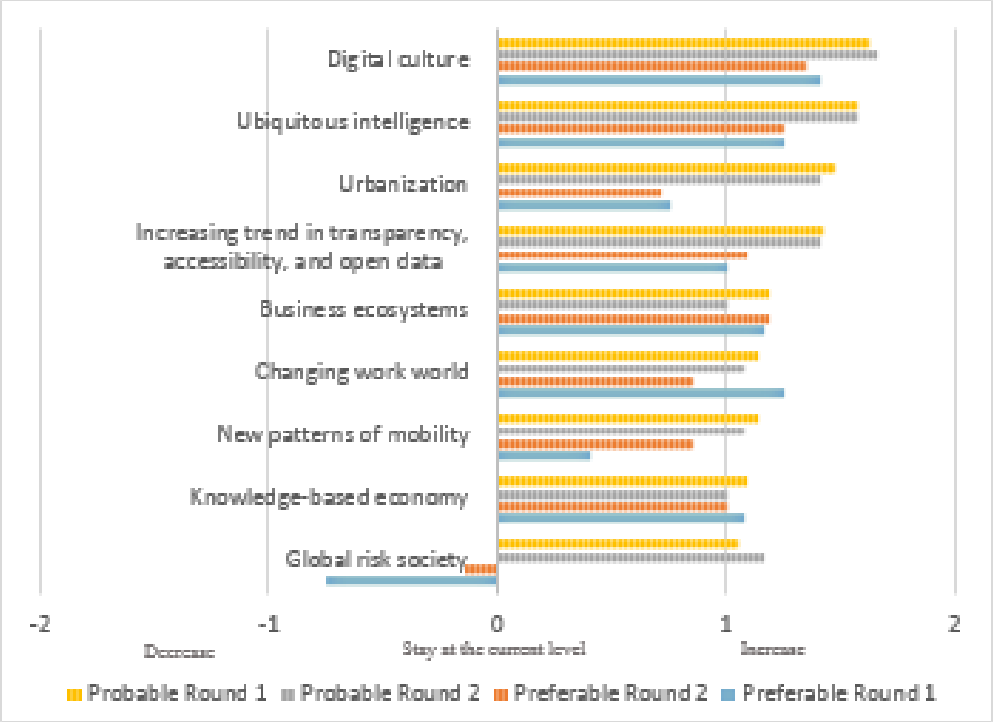


Figure 9 Mean values of probable and preferred impacts of relevant megatrends under Round 1 and Round 2 (adapted from Krigsholm et al. 2017, 137)

The diagram in Figure 9 illustrates that the impacts of all of the nine examined megatrends are considered more probable than preferred. The potential explanation to this pattern could be that fact that the respondents more negative effects coming from these megatrends causing unwanted consequences even considering the established opinion that the current form of the cadastral system in Finland should be redesigned. Our study also includes a clear example of a megatrend that most likely is

viewed as a threat in this particular context: the global risk society. The preferable impacts of global risk society on cadastral system were the only negative values among the 32 (8x4) estimations (Krigsholm et al. 2017, 137-138). One of the suggestions for further studies could be to conduct an environmental scanning of desirable driving forces of the Finnish cadastral system that would impose more positive transformation processes.

5.2 Scenarios

5.2.1 Clustering in numbers

This section provides the answer to the second research question, i.e. what are the alternative future developments of the operational environment of the cadastral system in Finland by 2035. Results of the hierarchical cluster analysis are described in figures and, further, a set of four normative scenarios is presented. The combination of a quantitative cluster and qualitative arguments of the cases within the cluster can be considered here as scenarios. Scenarios are built based on numerical data and open-ended arguments from the second round of the questionnaire. This material provided us with arguments, meanings and rationale of the scenarios following the Disaggregative Policy Delphi technique (Tapio et al. 2017, 36). Scenarios are introduced in a form of narratives provided with illustrative material.

The results of the cluster analysis can be illustrated by looking at the dendrogram (Figure 10), which demonstrates how grouping of the cases are processed at each phase. The dendrogram below shows 20 clusters, however according to the methodological instructions, cluster analysis cannot decide the proper number of scenarios and therefore this choice belongs to the researcher (Tapio 2002, 84). In this study, four scenarios were chosen as the most optimal range. The scenarios that were formed include:

1) Digital, Ubiquitous, Accessible
2) Antisocial & User-friendly
3) Relative consonance
4) New Capitalism

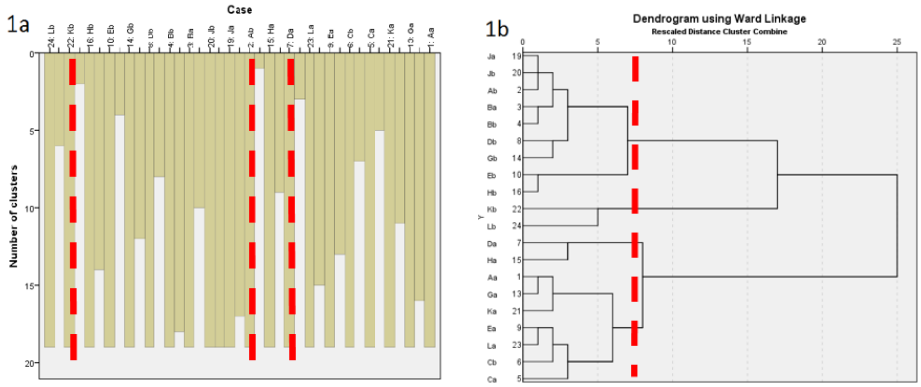


Figure 10 Formation of clusters indicated by icicle graphs (1a) and dendrogram (1b). Red lines indicate cluster cut points

The scenarios differ in how much they envision operational environment of the land register system in Finland by 2035. Based on the second round questionnaire they cover diverse political, economic, social, technological and environmental phenomena. The numeric responses were complemented with the qualitative data gathered during the second round of Delphi, when each expert had a chance to get familiarized with comments of other respondents from the previous round and to revise his or her opinion based on these collective judgments. Next, each scenario is described and illustrated by quotes from the respondents. Names of the respondents are not presented due to the anonymity criterion of this study; therefore, each individual was assigned with a personal code.

During the second round, those 21 experts who filled the first round form were asked to revise and comment their answers again. Response rate for the second round was higher than for the previous one and constituted 57%, however the overall number of participants was almost twice lower than in the first round (Figure 11). The expert panel was represented by respondents from government organization (12 respondents), municipalities (4 respondents), private sector (3 respondents), research institutions (1 respondent) and regional council (1). Panelists from government organization all represented National Land Survey. Other areas of expertise that panelists listed out themselves included real estate appraisal, cadastral surveys, strategy and quality work, credit granting and collaterals, land use planning, GIS, and photogrammetry. The average working experience of the panelists was almost 25 years. (Krigsholm et al. 2017, 136.)

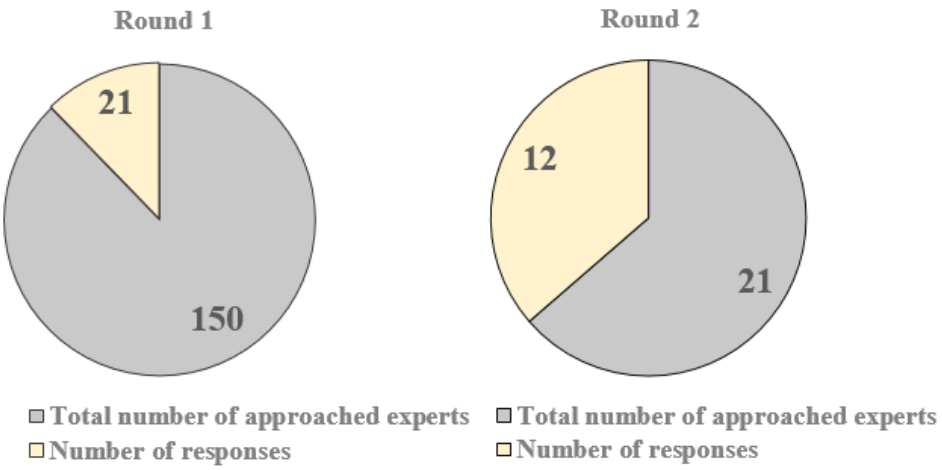


Figure 11 Response rate during Round 1 & 2

Following the principle of Disaggregative Policy Delphi, results of the cluster analysis were used as the template for scenarios. The mean and standard deviations of the answers categorized by clusters are presented in Table 7, and further illustrated in Figure 12. All variables are on five-point Likert scale ranging from -2 to 2, with negative values indicating a decreasing impact by 2035, zero an unchanged impact, and positive values an increasing impact. The qualitative answers were analyzed to provide arguments behind the numeric data. The scenarios were afterwards named based on their core characteristics.

Table 7 Means and standard deviations of each variable in clusters. All data transformed to receive values between -2 and +2

	Cluster 1 Average	Cluster 1 STDEV	Cluster 2 Average	Cluster 2 STDEV	Cluster 3 Average	Cluster 3 STDEV	Cluster 4 Average	Cluster 4 STDEV
P1	0.71	0.48	0.00	0.00	1.00	0.00	-0.50	0.70
P2	1.00	0.00	-0.11	0.92	2.00	0.00	-2.00	0.00
P3	1.42	0.53	1.22	0.66	2.00	0.00	0.00	0.00
E1	0.71	0.48	1.00	0.50	2.00	0.00	1.50	0.70
E2	0.85	0.37	1.11	0.60	2.00	0.00	1.00	0.00
E3	1.42	0.78	0.88	0.60	1.00	0.00	2.00	0.00
E4	0.85	0.37	0.00	0.50	1.50	0.70	0.00	0.00
E5	0.85	0.37	0.00	0.00	0.50	0.70	1.50	0.70
S1	1.00	0.00	0.10	0.33	2.00	0.00	-0.50	0.70
S2	0.00	0.57	-0.11	0.33	0.50	0.70	-0.50	0.70
S3	0.28	0.48	0.11	0.33	0.50	0.70	-1.50	0.70
S4	0.57	0.78	0.00	0.00	0.00	0.00	-0.50	0.70
S5	0.42	0.53	0.00	0.00	0.00	0.00	1.00	1.40
S6	1.28	0.48	0.33	0.50	1.50	0.70	0.00	1.40
T1	1.57	0.53	1.44	0.52	2.00	0.00	1.00	0.00
T2	0.57	0.53	0.55	0.52	0.50	0.70	0.00	0.00
T3	1.57	0.53	1.33	0.50	2.00	0.00	0.00	0.00
T4	0.57	0.53	0.77	0.60	1.50	0.70	1.00	1.40
En1	0.57	0.53	0.66	0.50	1.00	1.41	-1.50	0.70
En2	0.57	0.53	0.33	0.50	0.50	0.70	0.00	0.00
En3	1.00	0.57	0.88	0.33	2.00	0.00	0.50	0.70

Note: Transformation of political order (P1), Global risk society (P2), Increasing trend in transparency, accessibility, and open data (P3), Knowledge-based economy (E1), Business ecosystems (E2), Changes in the work world (E3), Globalization (E4), New consumption patterns (E5), Demographic change (S1), New stage of individualism (S2), Social and cultural disparities (S3), Reorganization of healthcare systems (S4), Changes to gender roles (S5), New patterns of mobility (S6), Digital culture (T1), Learning from nature (T2), Ubiquitous intelligence (T3), Technology convergence (T4), Climate change and environmental impacts (En1), Upheaval in energy and resources (En2), Urbanization (En3).

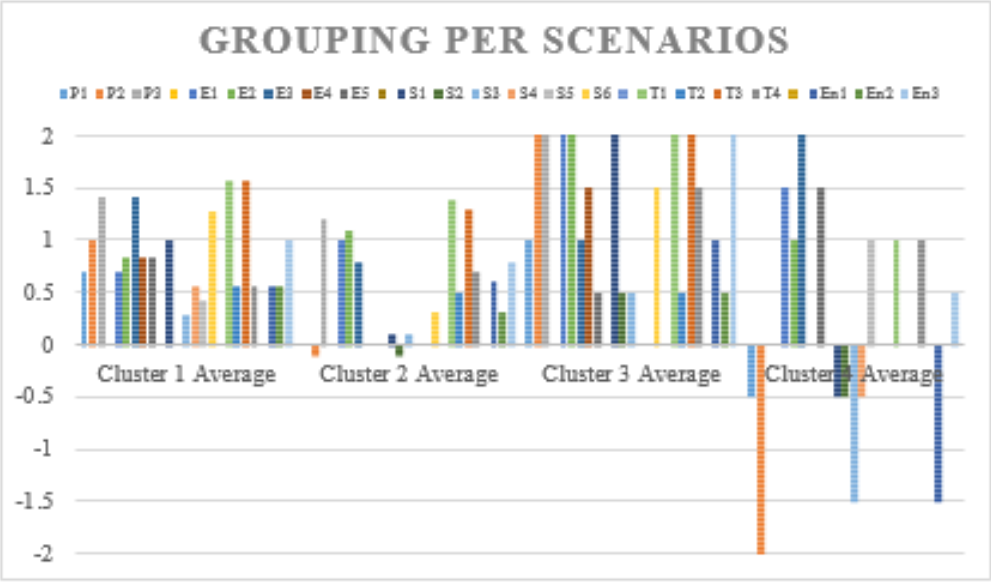


Figure 12 Hierarchical cluster analysis results for four main clusters, indicating the mean and standard deviations for each question

Note: Transformation of political order (P1), Global risk society (P2), Increasing trend in transparency, accessibility, and open data (P3), Knowledge-based economy (E1), Business ecosystems (E2), Changes in the work world (E3), Globalization (E4), New consumption patterns (E5), Demographic change (S1), New stage of individualism (S2), Social and cultural disparities (S3), Reorganization of healthcare systems (S4), Changes to gender roles (S5), New patterns of mobility (S6), Digital culture (T1), Learning from nature (T2), Ubiquitous intelligence (T3), Technology convergence (T4), Climate change and environmental impacts (En1), Upheaval in energy and resources (En2), Urbanization (En3).

The four scenarios have five core components based on PESTE framework and difference between them will be discussed further. Figure 13 represents five bar charts with political, economic, social, technological and environmental megatrends are presented by cluster. Prior to describing the scenarios, it is important to see the difference between these five PESTE categories in each cluster.

As it can be seen in cluster 1 and 3, political megatrends tend to have more impact on the development of cadastral system, whereas in cluster 2 and 4 its impact is less substantial. Interestingly that in all four clusters, economic megatrends have higher importance, which means that according to all the respondents, in any alternative futures development of the cadastral system will be affected by economic tendencies, however in cluster 4 globalisation has zero impact. The most prominent economic trends are knowledge-based economy, business ecosystems, and changing work world. Social driving forces have clearly less importance especially in cluster 4. Technological megatrends together with economic ones have higher impact than social and political phenomena. The most impactful social megatrends are demographic change and new patterns of mobility. Cluster 3 is the one mostly driven by technological change with highest rank in digitalization and ubiquitous intelligence. When it comes to the environmental megatrends, in all the clusters the highest value assigns to urbanization. Cluster 1 and 2 do not differ significantly in this sense, whereas cluster 3 and 4 present more diverse views. Based on these observations, we can suppose that according the respondents' views, environmental changes such as climate change and growing energy resources consumption have lower impact on the development of land register system. Each of the scenarios is described next in the light of findings.

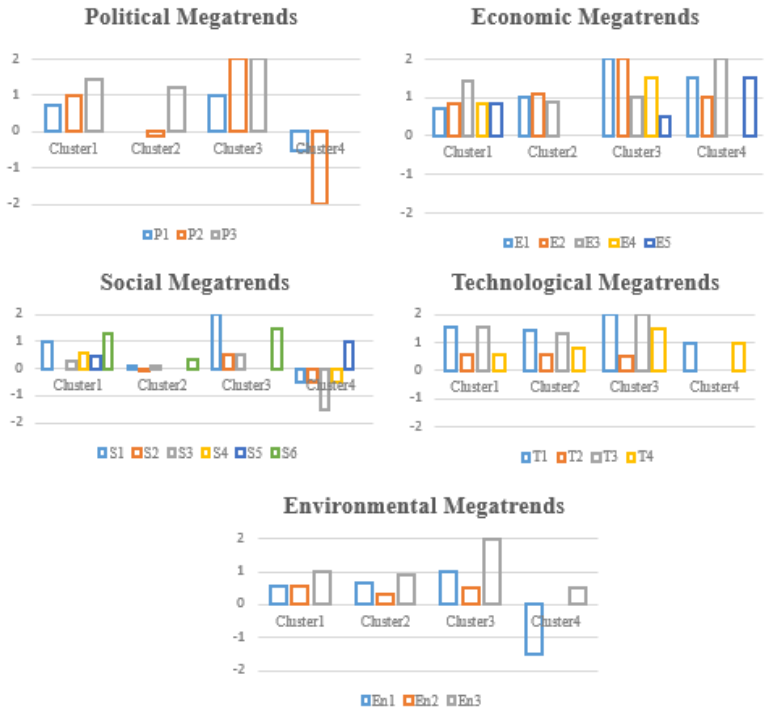


Figure 13 PESTE megatrends per cluster.

Note: Transformation of political order (P1), Global risk society (P2), Increasing trend in transparency, accessibility, and open data (P3), Knowledge-based economy (E1), Business ecosystems (E2), Changes in the work world (E3), Globalization (E4), New consumption patterns (E5), Demographic change (S1), New stage of individualism (S2), Social and cultural disparities (S3), Reorganization of healthcare systems (S4), Changes to gender roles (S5), New patterns of mobility (S6), Digital culture (T1), Learning from nature (T2), Ubiquitous intelligence (T3), Technology convergence (T4), Climate change and environmental impacts (En1), Upheaval in energy and resources (En2), Urbanization (En3).

5.2.2 Future narratives

Scenario 1 "Digital, ubiquitous, accessible"

The first scenario is called "Digital, ubiquitous, accessible" (Figure 14) as it includes higher impact of technological megatrends in respect to other PESTE factors. This is a more probable scenario with 6 probable and 1 preferred images. Representation of all the PESTE factors in this scenario looks balanced enough. The main peculiarity of this vision is that it highlights essentiality of technological advancements. We can observe clear dominance of two technological megatrends, i.e. digitalization and ubiquitous intelligence.

Related to that, respondent G elaborates that owners of the property should have access to cadastral system to fix possible mistakes in marking the boundaries. Visibility and accuracy of registered information should be enhanced with the help of advanced technologies. Since the nature of the information is changing, up-to-date information should be accessed easily. Cadastral system should also be adapted to customer needs and easy to use without external help of a professional.

Social megatrends such as individualism or social and cultural disparities have minor impact on the cadastral system in this scenario. For instance, according to respondent C, "cadastre is a database that is to a large extent independent on social and cultural differences". However, new patterns of mobility is valued as one of the dominant trends in this scenario as well.

Other influential megatrends are political and economic ones. As we can see, tendency on the increasing transparency and open data together with changing world of work and employment reaches a high level. As argued by respondent C:

"Open data and changes in consumer behavior, together with the widespread utilization of digitalisation transform the meaning of cadastral system. In the future, cadastre will function as a self-service tool maintained by society; its data will be utilized in mobile ad hoc where data need arises. The authorities will lose its functions and soon users of the cadastral system will not even know where the information originally comes from. It will be enough to be up to date, reliable and easy to use."

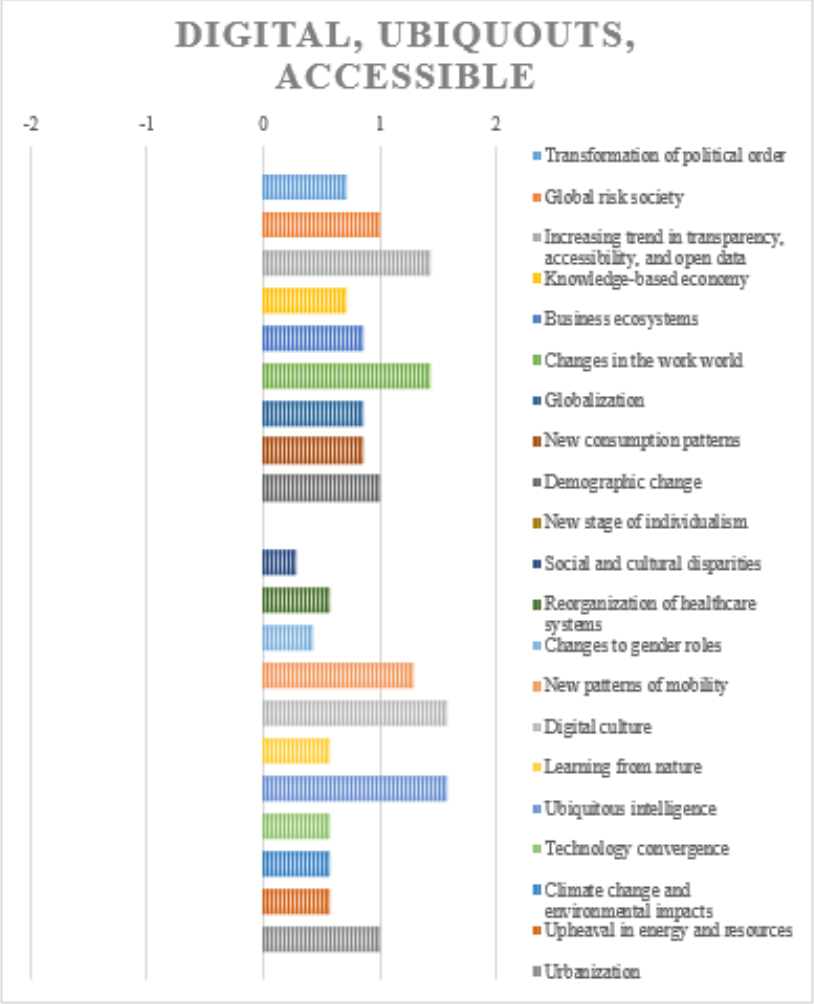


Figure 14 Scenario 1

Scenario 2 "Antisocial & User-friendly"

The second scenario is labeled as "Antisocial & User-friendly" (Figure 15). This scenario reflects more preferred futures since out of 9 respondents, 7 represent preferred and 2 probable future. The difference between first and second scenario is not signif-

icant. The most distinguishing attribute of this scenario is a very low impact of social and political phenomena. For instance, the impact of demographic change, individualism, social and cultural disparities, new healthcare system is around zero. Respondent B states that the influence of these drivers on the cadastral system is missing. Sharing the same opinion, respondent H comments that it is difficult to find criterion regarding how changes in healthcare system could change cadastral system, however in case of a dangerous epidemic (e.g. bird flu) also the cadastre could have been affected.

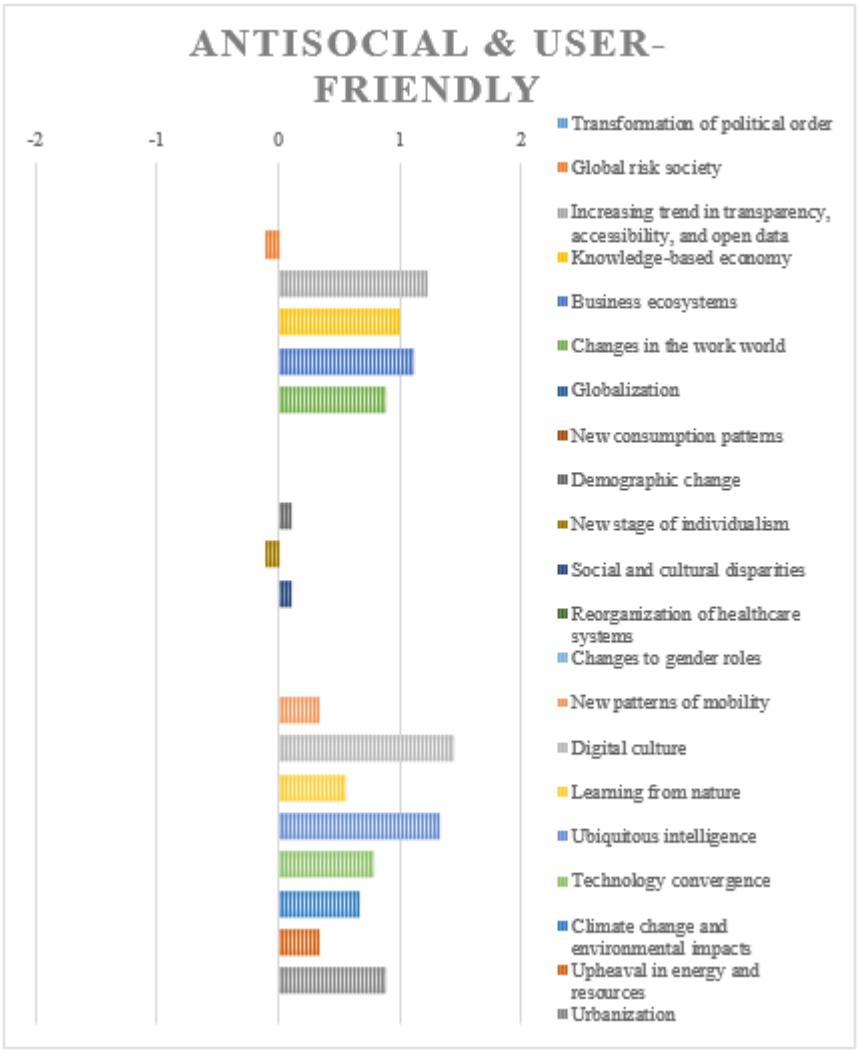


Figure 15 Scenario 2

This vision is mainly driven by technological and economic change. Likewise the first scenario, the highest impact comes from technological megatrends, i.e. digitalization and ubiquitous intelligence. Selected qualitative comments from the second round:

"Thanks to digitalization, new opportunities and ways to utilize information are emerging." (Respondent B)

"Digitalization changes principles of all other service systems as well, but at the same time they all are driven by customer experience." (Respondent H)

"Augmented reality connects virtual reality and real world." (Respondent B)

"Ubiquitous intelligence changes the nature of information, it eases its gathering and the role of the authorities in controlling land register system diminishes (becomes less important) or even disappears." (Respondent H)

Nevertheless, one political factor, increasing transparency and open data has quite a high value (1.22) in this scenario. As respondent G points out:

"Transparency and digitalization go forward. The use of data is changing. The real world and the registers are connected in a user-friendly way to increase their maintenance. The role of authority changes and their functions are supported by citizens. Individuals take care of their properties, including the digital information on their property." (Respondent G)

When it comes to global risk society, respondents in this scenario valued its impact as -0.11. However, according to respondent H and E since the time for the centralized registers is ending, cybercrime is increasing dramatically and should be taken into consideration even in land management domain.

Scenarios 3 "Relative consonance"

Scenario 3 is called "Relative consonance" as all the megatrends from each PESTE category here have considerable or at least positive (higher than 0) affect the development of cadastral system. This scenario reflects solely probable futures since it is composed out of 2 probable images. As Figure 16 demonstrates, two political (global risk society & increasing trend in transparency), two economic (knowledge-based

economy & business-ecosystems), one social (demographic change), two technological (digital culture & ubiquitous intelligence) and one environmental (urbanization) megatrends have highest impact here.

In regard with global risks and migration processes respondent D highlights:

"*Our system is stable, but we do not live in a vacuum. Desirable and undesirable migration will put pressure on a wide range of issues in the future.*"

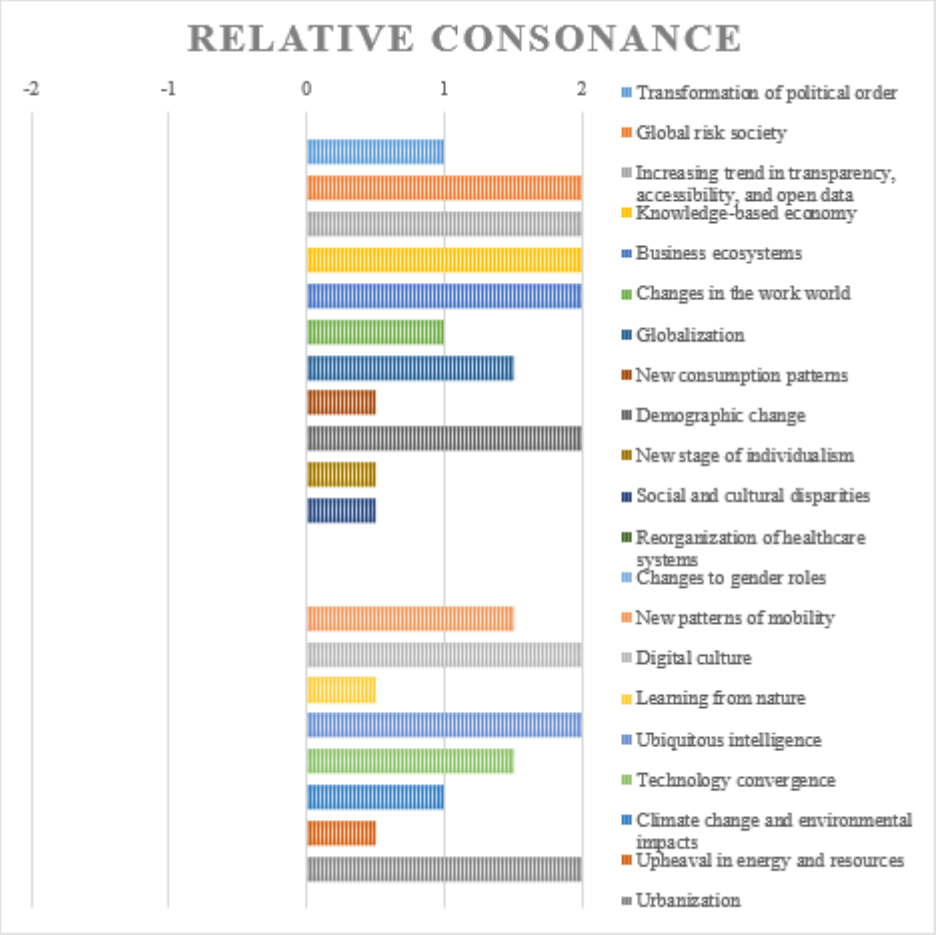


Figure 16 Scenario 3

Respondent H claims that the need for a common European cadastral register is growing because of the globalized real estate market. Transparency and open access instead entail emergence of plenty of new commercial applications and the time of the centralized registers is coming to an end (Respondent H). Due to that, respondent D recommends authorities to focus on securing a good infrastructure and allow commercial operators to evaluate the potential for success and product development of different "handy" user interfaces.

Knowledge-based economy and business ecosystems will have considerable impact as well:

"Development of the cadastral system should be driven by the improvement of the customer service experience more than by the need to manage the entire historical data and its different layers." (Respondent H)

When it comes to demographic change, aging of the population will have a huge impact on cadastral system since real estate ownership increases considerably because people inherit property more and more, which instead will entail difficulties in dividing the parcels (Respondent H). Digitalization, ubiquitous intelligence, and urbanization have the highest value. Selected qualitative comments from the second round responses:

"Block chains overwhelm traditional centralized repositories. The controlling role of authorities in the change of property will be significantly reduced or completely eliminated." (Respondent H)

"Excessive digitalization can be dangerous as well." (Respondent D)

As in previous scenarios, the 0 impact assigns to changing gender roles and new patterns of mobility.

Scenario 4 "New Capitalism"

The fourth scenario is called "New capitalism" (Figure 17). This vision deviates from the others in a more considerable manner. The cluster that forms this scenario is based on the responses of the two preferred futures. From the rather scarce set of open-ended arguments the rationale of the scenario is not entirely clear. Several interpretations can be made here. The core driving force in this future vision comes from economic transformations, i.e. changing work world, knowledge based economy and new consumption patterns, which drive the future of the cadastre. Respondent L notices that development of the new cadastral system should be modelled together with younger generation.

Two technological factors, learning from nature and ubiquitous intelligence, have 0 impact. Political factor such as global risk society has the lowest impact, -2. Respondent K emphasizes the importance of taking into consideration local condi-

tions and needs. Social and cultural disparities and climate change have low impact as well. Compared to other scenarios, this vision is less driven by environmental change and has relatively low technological impact.

Figure 17 Scenario 4

6 DISCUSSION

6.1 Validity and reliability of the study

The validity and reliability are considered to be important attributes of any scientific study. They are the fundamental principles for the evaluation of the research. Reliability stays for repeatability of the findings of a study. Reliability of a Delphi study is difficult to verify since as in the case with this thesis, it is typically based on mixed qualitative and quantitative analysis. Subjective judgements of the participants of a study can be assessed in this manner. When it comes to validity, this criterion can be traditionally divided into internal and external one. Internal validity refers to design structure and steps of a scientific process, whereas external one goes to the applicability of the results of a study in different contexts. (Thietart 2001, 196.) The findings of this study can be applied to other geographical regions since phenomena considered in this research are global and massive, however it would be more preferred to conduct a similar study among the international group of experts, as was suggested by, for instance, Krigsholm et al. (2017) and Bogaerts & Zevenberg (2001).

As typical for any Delphi study, the validity of this research may be affected by the number of experts in a sample (Rowe et al. 1991, 242). 21 experts participated in the first Delphi round and 12 in the second one. This particular group is only one sample in the huge pool of experts that are working in different land administration units. The response rates during the first round was 14 % out of total 150, and 57 % during the second out of total 21. The low response rate could have been improved by calling all the experts by phone and discussing the questionnaire with them, so conducting a Real-time Delphi. Alternatively, a futures workshop or a face-to-face stakeholder seminar (Tapio et al. 2017, 40) could have been organized at the final stage to motivate people to discuss their ideas in groups. One more explanation to the low response rate could be technological aspect of this study. The questionnaire nowadays are typically conducted through various online platforms that helps save respondents' time on downloading the form, naming it and sending it back.

However, as it was justified in Chapter 4 the interactive PDF form allowed us to construct flexible layout in a more creative manner. It could have been also fruitful for future methodological considerations, to ask panelists to comment on the quality

of the questionnaire, formulation of the questions and the difficulties they faced with while filling it. On the other hand, according to a recent review of 63 Policy Delphi studies, most of them typically involve from 10 to 50 experts (Nygrén et al. 2017, 4). Hence, it is an argumentative question whether low response rate in this study can be considered as a limitation or not.

Further, it must be acknowledged that the qualitative data were quite scarce and making scenarios based on that was relatively challenging. This could also be elucidated by the topic of the study, which is first rather technical and is usually not discussed from the social angle. Therefore, thinking of the future of the cadastral system and how it may be affected by, for instance, climate change or changes in the healthcare sector could seem like brainteaser, especially if it has to be imagined in two different realities, probable and preferred, almost two decades from now. Howbeit, the goal was to encourage peripheral thinking among the panelists and this is why such a long, almost 20-year time horizon was set. (Krigsholm et al, 2017, 138.)

Another difficulty of this study was to explain the concept of megatrends and to distinguish it with more simple and common for the audience term "trends". As it was mentioned in methodological background, megatrend itself is a volatile concept and nowadays still, there is lack of strict terminology and explanations regarding this phenomenon (Ibid.). This obviously complicates the task of identifying relevant megatrends and assessing how panelists perceive the importance of different megatrends. Our questionnaire listed under each megatrend some phenomena that can be considered to form part of that megatrend. The idea was to steer the respondents in the right direction, but there is of course the risk that the list draws the respondents' attention to just one or a few phenomena instead of the megatrend itself. Another difficulty arising from the complexity of the concept of megatrend was that the respondents identified similar anticipated impacts stemming from different megatrends. For example, innovations and new forms of partnership were often mentioned in connection with both business ecosystems and increasing transparency, accessibility, and open data. (Ibid.) This, on the other hand, reaffirms the idea that megatrends are massive phenomena that do not determine only one sphere, but have broader diapason (Mittelstaedt et al. 2014).

What is more, the Delphi technique can be questioned for relying too much on the cognitive and social expertise of the panelists. It is an arguable question whether

one can be considered an expert in judging possibility and probability of future events since the future has not unfold yet. In this case, Delphi's apologists usually appeal to the fact that Delphi so as futures studies in general does not intent to forecast the future, but explores multiple futures and provokes discussion that in its turn would impact decision-making process.

Nevertheless, aside from the apparent limitations, this thesis also comprises positive aspects and one of them is its novelty, i.e. synergy of two disciplines, cadastral research and futures studies or foresight represented by Disaggregative Policy Delphi. This is one of the first studies in the field of land management that considers the development of the cadastral system from the perspective of futures studies. As it was stated by Krigsholm et al. (2017), future-oriented studies in the field of land management are still scarce. Typically, most publications have been industry-led and heavily focused on the development of cadastral systems (Krigsholm et al. 2017, 133).

6.2 Discussion on the findings

The first research question focused on investigating the most important driving forces shaping the operational environment of the Finnish cadastral system towards the year 2035. All together 21 megatrends were ranked in the first round. The means and standard deviation of each megatrend ranking was calculated. If the mean value was higher than 1.00, the megatrend was considered relevant. After the first round and calculating the means of each megatrend, the most important ones were digital culture, ubiquitous intelligence, increasing trend in transparency, accessibility, and open data, urbanization, business ecosystems, global risk society, knowledge-based economy and changing work world. Surprisingly, some results did not match with the previously conducted research by Riekkinen et al. (2016) and Williamson and Ting (2001). For instance, in both studies globalization was recognized as one of the 14 themes relevant to the future operating environment of the Finnish cadastral system and as an important global driver for land administration. Whereas according to the results of the present research, globalization was considered of relatively little significance. Further, it was expected to see the increasing need for a 3D/4D cadastre and beyond, but no one mentioned this concept. One explanation to that could be the

suggestion that in this development is already taken for granted as being implemented in 2035. (Krigsholm et al. 2017, 138.)

Considering everything, there are some similarities with earlier publications that deserve to be mentioned. Tendency towards accessibility, digitalization and advanced technologies were highlighted as driving forces in other strategic reports on the future of cadastre (LINZ 2014, FIG 2014, ICSM 2014). Urbanization is another driver that has emerged in earlier studies (e.g. Williamson & Ting, 2001) (Ibid.).

As for the second research question, a set of four normative scenarios was constructed based on hierarchical cluster analysis. The core plot of the scenarios was built around 21 megatrends that interconnected with the subject of future themes and phenomena occurring in the operational environment of the Finnish cadastral system, identified by Riekkinen et al. (2016). The connection between the complexity of these future themes, which were discussed in Chapter 2, and the scenarios of the present thesis are illustrated in Figure 18. Driving forces written in a bigger font size reflect their relevance score estimated during the first round of the study.

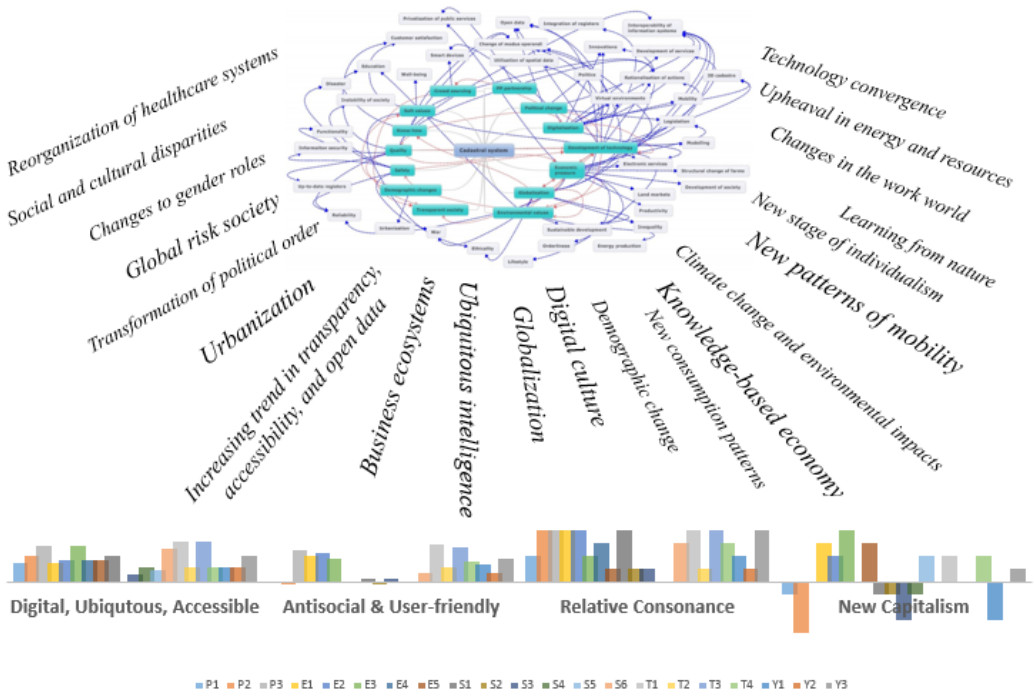


Figure 18 Visualization of the interconnectedness of the four scenarios and the complexity of future themes and phenomena occurring in the operational environment of the Finnish cadastral system identified by Riekkinen et al. (2016, 706)

Note: Transformation of political order (P1), Global risk society (P2), Increasing trend in transparency, accessibility, and open data (P3), Knowledge-based economy (E1), Business ecosystems (E2), Changes in the work world (E3), Globalization (E4), New consumption patterns (E5), Demographic change (S1), New stage of individualism (S2), Social and cultural disparities (S3), Reorganization of healthcare systems (S4), Changes to gender roles (S5), New patterns of mobility (S6), Digital culture (T1), Learning from nature (T2), Ubiquitous intelligence (T3), Technology convergence (T4), Climate change and environmental impacts (En1), Upheaval in energy and resources (En2), Urbanization (En3).

Results of the scenario analysis cannot be left without conclusions as well. First, as it was expected based on the relevance ranking under the first round, impacts of technological and economic megatrends prevail in three out of four scenarios. Hence, we may conclude that the future of the cadastral system will be most probably driven by such macro phenomena as digital culture and ubiquitous intelligence. Although these scenarios underline four different future alternatives, the degree of resemblance is still high.

First two scenarios represent mixed preferred and probable visions. The third scenario is based on merely probable estimations; fourth scenario represents solely preferred future. In all the scenarios, the most impactful megatrends were considered to be technological and economic ones. Second group of megatrends was composed of political and environmental tendencies, and social factors gained equally low value. Scenario 1 and 3 stay very close to each other. They mainly correspond to what was previously said in other strategies developed by FIG, LINZ, and ICSM.

Scenario 2 has surprisingly low importance of social megatrends, which seems barely probable since the purpose of the cadastre is to regulate land use in the society. Scenario 4 can be considered as the most peculiar one as it does not follow common mainstream, i.e. technological megatrends in this vision have relatively low impact compared to other scenarios. This scenario is driven by changes in the work world, which is a social driver. Since this scenario reflects solely preferred future, this observation provokes further thinking whether panelists believe that the speed of technological development is too rapid and hence is less preferred.

In regard with more technical aspects of this analysis, the numeric data set of the second round was modified, since two respondents left unanswered questions. The data could have been manipulated with assigning 5 different values (i.e. -2, -1, 0, +1, +2) to the blank questions, however it was decided not to do that in the frame of this research.

When it comes to qualitative data, while composing narratives and filling numeric clusters with open-ended answers, we faced with the problem of lack of arguments and explanations behind the numbers. One way to avoid such a white spot would be to organize a futures workshop or stakeholder face-to-face seminar as proposed by Tapio et al. (2017, 40) at the final stage of the study where already defined scenarios would have been discussed in four groups of experts or parties of interest. Albeit, taking into consideration the technical theme of this study, it is not surprising that our scenarios did not result in long manuscripts but rather short characteristics of alternative futures.

Lastly, since this study consists of two anonymous rounds, it would be interesting to explore whether there is any substantial difference between the two sets of clusters in both rounds. Figure 19 clearly demonstrates that both rounds do not differ from each other significantly. While the importance of the megatrends in cluster 1 under the first round is similar to values given in the cluster 2 under the second round, cluster 2 under the first round recalls cluster 1 under the second round. The same tendency can be observed between cluster 3 and 4 under both rounds. Cluster 3 under the first round is close to cluster 4 under the second and cluster 3 under the second round recalls cluster 4 under the first one. This similarity may uncover that the second round of the study was not necessary. However, the intention of the study was to facilitate exchange of experts' opinions and provoke nonconventional thinking and this could have been implemented only through providing aggregated feedback in the second round.

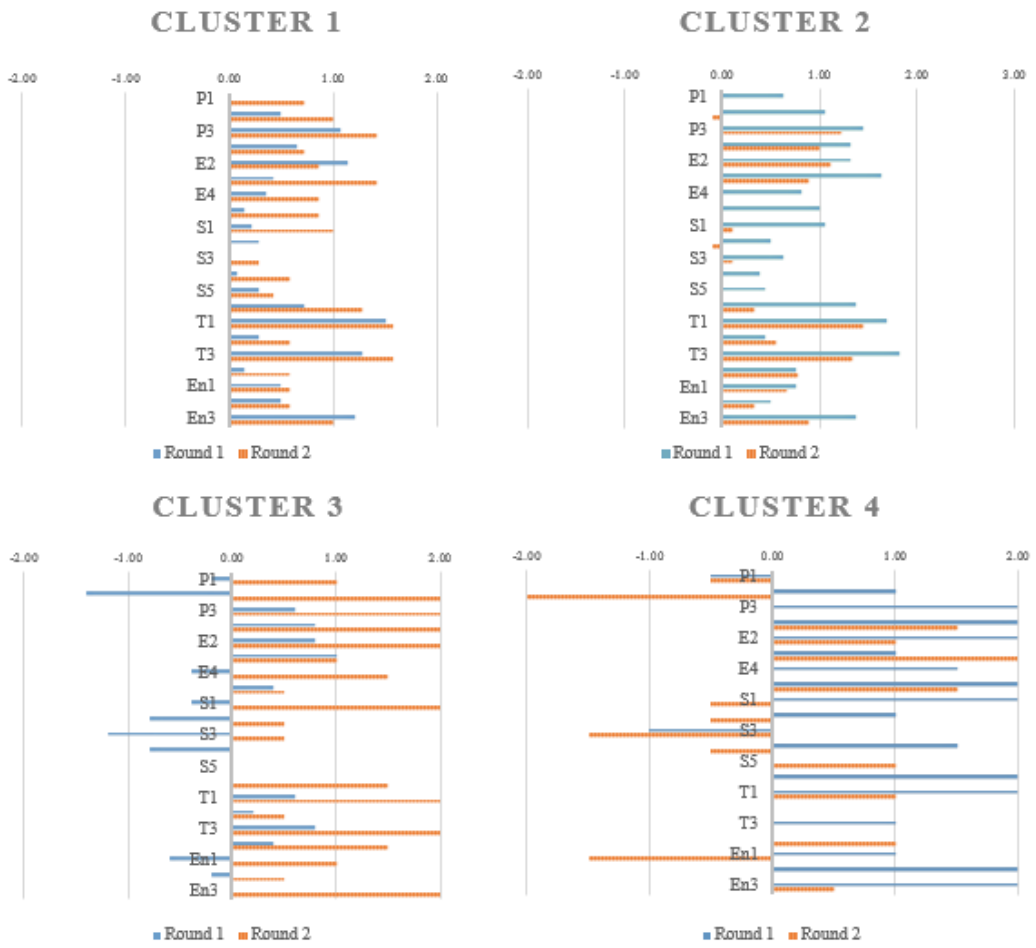


Figure 19 Comparison of clusters in Round 1 and Round 2

Note: Transformation of political order (P1), Global risk society (P2), Increasing trend in transparency, accessibility, and open data (P3), Knowledge-based economy (E1), Business ecosystems (E2), Changes in the work world (E3), Globalization (E4), New consumption patterns (E5), Demographic change (S1), New stage of individualism (S2), Social and cultural disparities (S3), Reorganization of healthcare systems (S4), Changes to gender roles (S5), New patterns of mobility (S6), Digital culture (T1), Learning from nature (T2), Ubiquitous intelligence (T3), Technology convergence (T4), Climate change and environmental impacts (En1), Upheaval in energy and resources (En2), Urbanization (En3).

7 CONCLUSIONS

As we can see from the literature review, the need to redesign cadastral system has been recognized in many countries across the globe. Various research units and governmental bodies attempted to address this issue. However, the future of the cadastre from the perspective of futures studies has been barely considered so far. This thesis intended to reach two goals, i.e. to identify the most relevant global driving forces shaping operational environment of the Finnish cadastral system towards the year 2035 and to explore alternative futures of this environment. This thesis lies between two scientific domains, i.e. cadastral research and futures studies that together can be labeled as cadastral foresight. The study was implemented in accordance with Disaggregative Policy Delphi, a well-known method in futures research. In both rounds of this Delphi study, 21 experts presented their views on the probable and preferred impact of political, economic, social, technological and environmental megatrends.

The most relevant megatrends were identified in the first round and repetitive second round resulted in a set of four normative or descriptive scenarios. The results of the first round were further used to recognize global driving forces shaping the operational environment of the Finnish cadastral system. The second round data were used to answer the second research question and to construct four alternative future developments of the operational environment of the cadastral system in Finland.

Tracing the macro trends in relationships between land and society we can summarize that in the past, development of the cadastre as a subsystem of the land information system was driven by economic, social and environmental changes such as agricultural and industrial revolution, growing world population, urbanization, land scarcity and orientation on sustainable development. In the future up to 2035, according to anticipation of the Delphi panelists, it is expected that the operational environment of the Finnish cadastral system will be mostly driven by technological transformations such as digital culture and ubiquitous intelligence and political change, i.e. increasing towards transparency, accessibility and open data. Estimations regarding the impact of social and environmental tendencies received relatively low value in three out of four scenarios.

Finally, it is important to repeat that the goal of any futures research is not to give an accurate forecast about the future but to generate discussion, to collect experts' opinions, to assist political decision-making and present alternative preferred

and probable prospects. Therefore, constructed scenarios cannot be seen as strict future developments and most probably, reality will see a hybrid mix of them.

With an eye to enhancing managerial and practical potential of this analysis, it would be fruitful to organize a stakeholder seminar and revise implication of these scenarios with the experts in the field. As a final note, it may be commented that this thesis uncovers the demand for a more thorough understanding of the needs and expectations of different user groups of cadastral systems. Moreover, a comparison on the international level would give a clearer insight on whether the development of the Finnish cadastral system should adopt more standardized or localized strategy. (Krigsholm et al. 2017, 139.)

8 SUMMARY

Sustainable and efficient land management system is a crucial factor for the well-being of every society. Cadastral system as a constituent of land management system plays an important role in ensuring legality of relationships between owners, land, government and citizens. Simply saying, cadastre is a storage of information regarding who owns the land, its boundaries and rights of its owner. However, this system has evolved along with the macro transformations in human society. For instance, such macro phenomena as industrialization, urbanization, emergence of real estate market, and technological advancements influenced on the operational environment of the cadastral system considerably. If the external environment changes, all the subsystems inside it have to transform as well in order to remain relevant and be convenient for its users. The aim of this thesis was to understand future operational environment of the cadastral system in Finland towards 2035. The study intended to answer two research questions: (1) What are the global drivers shaping the operational environment of the cadastral system in Finland by 2035? (2) What are the alternative scenarios of the operational environment of the cadastral system in Finland?

Initially, it was assumed that global political, economic, social, technological and environmental megatrends are changing the way people relate to land and consequently change the core of the cadastral system. Contextually and conceptually, this study lies between two scientific domains, cadastral research and futures studies. The research strategy and steps were designed following the principle of a well-established futures studies method, Disaggregative Policy Delphi. The study was conducted from October 2016 until January 2017. Experts from various fields related to land management and land use were invited to estimate probable and preferred impacts of the listed megatrends on the development of the cadastral system in Finland. The core part of the questionnaire in both rounds consisted of five step Likert scale questions, however respondents were also asked to support their choice with qualitative arguments. Besides, respondents were invited to estimate relevance of these megatrends to the development of cadastral system. Finally, the most relevant driving forces shaping the operational environment of the cadastral system were identified and four normative scenarios were constructed based on the hierarchical cluster analysis. Findings of the study revealed the relevance of technological phenomena such as digital culture and ubiquitous intelligence and political tendency to-

wards transparency, accessibility and open data to the operational environmental of the Finnish cadastral system. Scenarios analysis reaffirmed these elaborations, i.e. three out of four future visions were driven by mainly technological and economic megatrends, whereas social and environmental ones received lower value.

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APPENDICIES

Appendix 1 First round Delphi questionnaire

Katasteri 2035

mmm.fi MML MAAN-MITTAUS-LAITOS Aalto University

Hyvä asiantuntija,

Tämä kysely on osa *Katasteri 2035* - tutkimusprojektia, jossa tutkitaan Suomen katasterijärjestelmän (engl. cadastral system) tulevaisuuden näkymiä ja toimintaympäristöä.

Maailman muuttuessa myös paikkaan sidottua tietoa sisältävien rekisterien rooli on muutoksen alla. Useat teknologiset, taloudelliset, sosiaaliset, poliittiset ja ympäristöön liittyvät muutokset linkittyvät vahvasti näiden rekistereiden tietosisältöön. Esimerkiksi automatisoitu liikenne, älykkäät kaupunkirakenteet ja kolmiulotteinen maankäytön suunnittelu vaativat kaikki toimiakseen korkealaatuisia paikkatietoaineistoja. Lisäksi tarve eri rekisterien ja paikkatietojen yhteentoimivuudelle korostuu entisestään tulevaisuudessa.

Katasterijärjestelmään nykyisessä muodossaan liittyviä rekistereitä ovat kiinteistörekisteri eli katasteri ja lainhuuto- ja kiinnitysrekisteri eli kiinteistökirja. Ne kuvaavat todellista, vallitsevaa kiinteistöjaotusta ja olemassa olevia oikeuksia ja niihin rekisteröidään tietoja maasta, maahan kohdistuvista oikeuksista ja oikeuksia käyttävistä henkilöistä. Katasterijärjestelmä suojelee kiinteää omaisuutta toimimalla vakuus- ja luotonantojärjestelmän perustana, edistää osaltaan kiinteistörakenteeseen liittyvien muutosten toteuttamista, parantaa kaupunkisuunnittelun lähtökohtia sekä infrastruktuurin kehitystä ja ympäristöseurantaa.

Tässä tutkimuksessa tunnistetaan katasterijärjestelmän tulevaisuuteen vaikuttavia muutostekijöitä ja hahmotetaan näiden vaikutusta järjestelmän kehitykseen Suomessa vuoteen 2035 asti. Uudistamisprosessi vaatii aikaa, resursseja ja monipuolisia taitoja. Tästä johtuen projektin aikajänteeksi on valittu 20 vuotta.

Kysely toteutetaan kahdessa kierroksessa nk. Delfoi-tekniikkaa mukaillen. Ensimmäisellä kierroksella kerätään asiantuntijoiden näkemyksiä katasterijärjestelmään tulevaisuudessa vaikuttavista muutosvoimista. Menetelmälle tyypillisesti vastaajat ovat anonyymeja toisilleen. Kyselyn toinen kierros toteutetaan joulukuussa. Toisella kierroksella osallistujat voivat halutessaan uudelleenarvioida omia vastauksiaan ensimmäisen kierroksen tuloksiin peilaten. Tällä vuorovaikutteisella ja anonyymilla prosessilla pyrimme luomaan objektiivisen kuvan katasterijärjestelmään kohdistuvista muutostarpeista. Kun kaikki tieto on kerätty ja analysoitu, raportoimme päälöydöksistä tutkimukseen osallistuneille henkilöille.

Palauta kysely 27. marraskuuta mennessä. Tallenna tiedosto omalle tietokoneellesi, vastaa kysymyksiin ja lähetä vastauslomake takaisin osoitteeseen pauliina.krigsholm@aalto.fi. Mikäli haluat painetun version kyselylomakkeesta, ota yhteyttä ja lähetämme sen postitse.

Vastaamme myös mielellään kaikkiin tutkimukseen liittyviin kysymyksiin.

Arvostamme hyödyllistä panostasi ja Suomen katasterijärjestelmän kehittämiseen osoittamaasi aikaa!

Ystävällisin

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Mitä megatrendit ovat?

Megatrendi on tärkeä käsite muutosvoimien tunnistamisessa. Megatrendeillä tarkoitetaan tässä yhteydessä voimakkaita ja selkeästi tunnistettavia pitkäaikaisia muutoksia, jotka rakentuvat makrotason ilmiöiden ja tapahtumakuvausten kokonaisuudesta. Megatrendille ominaisia piirteitä, jotka erottavat ne muista trendeistä ovat:

Aikahorisontti

Megatrendit huomataan pitkän ajanjakson kuluessa. Nykyään monia megatrendejä voidaan mitata määrällisillä ja yksiselitteisillä indikaattoreilla, ja ennakointi jopa 15 vuotta tulevaisuuteen on mahdollista.

Vaikutusalue

Megatrendit vaikuttavat laajoille alueille ja moniin toimijoihin - hallituksiin, yksityishenkilöihin ja heidän kulutustottumuksiinsa, sekä lisäksi myös yritysten liiketoimintaan ja strategioihin.

Vaikutuksen voimakkuus

Megatrendit aiheuttavat perusteellisia, moniulotteisia muutoksia niin politiikkaan, talouteen kuin yhteiskuntaan kokonaisuudessaan. Piirteet vaihtelevat tarkasteltavan alueen mukaan.

(Lähde Z_punkt 2016 / Megatrend Update)

Vastaa seuraaviin kysymyksiin ennen varsinaista kyselyä:

Organisaatio:

1. Valtio ☐
2. Liikeyritys ☐
4. Tutkimuslaitos ☐
5. Kunta ☐
6. Muu: ☐

Osaamisalat ☐

Työkokemus (vuosina) ☐

Poliittiset muutokset						
Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.						
Megatrendit	**Vaikutus kasteriin**	**Vähenee voimakkaasti**		**Ei muutu nykyisestä**		**Lisääntyy voimakkaasti**
Uuden poliittisen maailmanjärjestyksen vahvistuminen: Kiinan ja Intian kasvavat maailmanvallat, läntisten demokratioiden kriisit, uudet strategiset yhteenliittymät multipolaarisessa maailmassa, Afrikan nousu *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Lisääntyvät globaalit turvallisuusuhat ja riskit: kasvava teknisten ja sosiaalisten infrastruktuurien heikkous, luonnonkatastrofien lisääntyminen, asymmetriset konfliktit, kansainvälinen järjestäytynyt rikollisuus ja nettirikollisuus, valvonta ja seuraaminen yhteiskunnassa *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Lisääntyvä selkeys, avoimuus ja avoin data: yhteiskuntasitoumus, vähentyvä luottamus hallintoon, digitalisaatio, muuttuvat arvot, consumer oriented policy *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
	Toivottavasti	-2 ☐	-1 ☐	0 ☐	1 ☐	2 ☐
Kuvaile tarkemmin tärkeimmiksi kokemiesi megatrendien vaikutusta katasterijärjestelmään*. Kirjoita vastauksesi alla olevaan laatikkoon.						
Mitä muita katasterijärjestelmään tulevaisuudessa vaikuttavia poliittisia muutoksia pystyt nimeämään? Kirjoita vastauksesi alla olevaan laatikkoon.						

*Esimerkiksi: Lisääntyvä selkeys, avoimuus ja avoin data edellyttää katasterin osalta viranomaisten dokumenttien saatavuutta kaikille kansalaisille.

Taloudelliset muutokset				
Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.				
Megatrendit	**Vaikutus katasteriin**	**Vähenee voimakkaasti**	**Ei muutu nykyisestä**	**Lisääntyy voimakkaasti**
Osaamistalouden korostuminen: Kansainvälinen koulutustason kasvu; innovaatioiden korostaminen kilpailutekijänä; data- ja tietopohjainen arvon luominen; uusi globaali tietoeliitti — luova luokka; elinikäinen oppiminen *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Liiketoiminnan ekosysteemien muodostaminen: uusiin arvoketjuihin pohjautuva yhteistyö; systeemi-innovaatiot; uudet verkkopohjaiset yritykset uusien markkinoiden rajapintana; neljännen sektorin syntyminen; monimutkaisuuden hallinta *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Lisääntyvät työelämän muutokset: dynaamiset ja joustavat työtavat; uudet johtamis- ja organisaatiomallit; yhteistyötä korostavat työtavat; automatisaation kehitys *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Globalisaation syveneminen: taloudelliset valtakeskusten muutos; epävarma talous; kansainvälisen keskiluokan nousu; kansainvälisesti hajautetut ja levinneet arvoketjut; kansainväliset rahavirrat – vaikeasti hallittava rahoitussektori *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Uusien kulutustapojen muokkautuminen: muutokset kuluttajien rahankäytössä ja kulutustottumuksissa; kehitysmaiden kasvava varallisuus; hiljattain teollistuneiden valtioiden nopeasti lisääntyvä kulutus; kestävä kuluttaminen länsimaissa; muutokset (hybridi- ja virtuaalimallit); yhteiskulutuksen kasvava merkitys *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Kuvaile tarkemmin tärkeimmiksi kokemiesi megatrendien vaikutusta katasterijärjestelmään. Kirjoita vastauksesi alla olevaan laatikkoon.				

Mitä muita katasterijärjestelmään tulevaisuudessa vaikuttavia taloudellisia muutoksia pystyt nimeämään? Kirjoita vastauksesi alla olevaan laatikkoon.

Yhteiskunnalliset muutokset				
Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.				
Megatrendit	**Vaikutus katasteriin**	**Vähenee voimakkaasti**	**Ei muutu nykyisestä**	**Lisääntyy voimakkaasti**
Kasvavat väestön muutokset: maailman väestömäärän kasvu; väestön ikääntyminen; länsimaiden väestönmäärän lasku; kasvavat maahanmuuttovirrat sekä väestörakenteen muutokset *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Syvenevä yksilöllisyys: individualismi globaalina ilmiönä; muuttuvat ihmissuhdekuviot: muutamat vahvat ja useat kevyemmät ihmissuhteet; massamarkkinoista mikromarkkinoihin; itseriittoisuus ja tee-se-itse –talous *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Sosiaalisten ja kulttuuristen erojen korostuminen: kasvava rikkaiden ja köyhien polarisaatio; epävarmuus osana normaalia elämäntapaa; sosiaalinen hajanaisuus eri elämän tilanteissa; kilpailevat ja yhdistyvät arvojärjestelmät *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Terveydenhuollon uudistuminen: kasvava tietoisuus ja henkilökohtainen vastuu terveysasioissa; muuttuvat tautiesiintymät; kasvavat terveydenhuoltokulut — kulujen painottuminen yksilölle; terveydenhuoltosektorin uudelleen organisointi; uudet lähestymistavat diagnoosiin ja hoitoon; uudet yhtyvät markkinat *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Sukupuoliroolien muuttuminen: perinteisten sukupuoliroolien rikkoutuminen; naisten kasvava rooli työpaikoilla; sosiaalisten ja kommunikaatiotaitojen kasvava arvostus; tasapainoisen ja terveellisen työelämän kasvava merkitys; uudet perhemuodot ja elämäntyylit *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Lisääntyvä liikkuvuus: kansainvälisen liikkuvuuden kasvaminen; liikkumisen esteiden lisääminen; intermodaaliset (eri kuljetustapoja hyödyntävät) kuljetukset;	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		

digitaaliset liikenneverkostot; uudet ajoneuvokonseptit ja -teknologiat; älylogistiikan ratkaisut *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐
Kuvaile tarkemmin tärkeimmiksi kokemiesi megatrendien vaikutusta katasterijärjestelmään. Kirjoita vastauksesi alla olevaan laatikkoon.		
Mitä muita katasterijärjestelmään tulevaisuudessa vaikuttavia yhteiskunnallisia muutoksia pystyt nimeämään? Kirjoita vastauksesi alla olevaan laatikkoon.		

Teknologiset muutokset				
Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.				
Megatrendit	**Vaikutus katasteriin**	**Vähenee voimakkaasti**	**Ei muutu nykyisestä**	**Lisääntyy voimakkaasti**
Digitaalisen kulttuurin leviäminen: digitaalisten teknologioiden leviäminen ja yhdistyminen kaikille elämän osa-alueille; digitaalisten elämäntyylien laajempi eroavaisuus; digitaalisten natiivien uudet sosiaaliset kommunikointitavat; osallistuvuuden ja järjestäytymisenmuodot; Web 3.0 tuleminen *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Luonnon imitoinnin hyödyntäminen: luonnon rakenteet ja prosessit innovaatioiden lähteinä; bioniikka yhdistettynä designiin ja teknologiaan; parviälykkyys; biologian vaikutus tuotantosysteemeihin — hajauttaminen ja kierrätystalous *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Jokapaikan tietotekniikan yleistyminen: siirtyminen pilvipalveluihin; uudet käyttöliittymät ja älykkäät ympäristöt; älykkäiden infrastruktuurien luominen; Esineiden internet = ekosysteemi, jossa esineet ja laitteet kommunikoivat keskenään; keinoälyn ja robotiikan läpimurrot *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Teknologian yhdentyminen: miniatyrisaatio ja nanoteknologia teknologian yhdentymisen ajureina; materiaalien ja rakennustapojen dynaamiset innovaatiot; bioteknologian laajentuminen; laajempi nanoteknologian, bioteknologian, informaatioteknologian sekä kognitiivisten tieteiden yhdentyminen *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
	Toivottavasti	-2 -1 0 1 2 ☐ ☐ ☐ ☐ ☐		
Kuvaile tarkemmin tärkeimmiksi kokemiesi megatrendien vaikutusta katasterijärjestelmään. Kirjoita vastauksesi alla olevaan laatikkoon.				

Mitä muita katasterijärjestelmään tulevaisuudessa vaikuttavia muutoksia pystyt nimeämään? Kirjoita vastauksesi alla olevaan laatikkoon.

Ympäristömuutokset

Arvioi todennäköisyyden ja toivottavuuden näkökulmasta seuraavien megatrendien vaikutusta katasterijärjestelmään nykyhetkestä vuoteen 2035 saakka.

Megatrendit	Vaikutus katasteriin	Vähenee voimakkaasti		Ei muutu nykyisestä		Lisääntyy voimakkaasti
Ilmastonmuutos ja ympäristövaikutusten kasvu: Ilmaston lämpeneminen ja kasvat hiilidioksidipäästöt; ympäristöongelmien kasvunriski juuri teollistuneissa sekä kehitysmaissa; kasvava nälänhätä; tiukentuvat säädökset; clean-tech investoinnit; strategiat ilmastonmuutoksen lieventämiseksi ja siihen sopeutumiseksi *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2	-1	0	1	2
		☐	☐	☐	☐	☐
	Toivottavasti	-2	-1	0	1	2
		☐	☐	☐	☐	☐
Energian ja resurssien mullistukset: kasvava energian ja resurssien kulutus; strategisten resurssien niukkuus; vaihtoehtoisten energiaratkaisujen ja uusiutuvan energian käyttö; energiatehokkuuden nousu; keskittämätön infrastruktuuri *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2	-1	0	1	2
		☐	☐	☐	☐	☐
	Toivottavasti	-2	-1	0	1	2
		☐	☐	☐	☐	☐
Etenevä urbanisaatio: suurkaupunkien ja kaupunkitaajamien kasvaminen; maaseudun kasvavat rakenteelliset ongelmat; mukautettujen infrastruktuuriratkaisujen kehittäminen; kestävä kaupunkikehitys; uudet elämäntyylit sekä asumisen ja osallistuminen muodot *Onko tämä megatrendi merkittävä katasterille?* Ei merkittävä ☐ Merkittävä ☐ Todella merkittävä ☐	Todennäköisesti	-2	-1	0	1	2
		☐	☐	☐	☐	☐
	Toivottavasti	-2	-1	0	1	2
		☐	☐	☐	☐	☐

Kuvaile tarkemmin tärkeimmiksi kokemiesi megatrendien vaikutusta katasterijärjestelmään. Kirjoita vastauksesi alla olevaan laatikkoon.

Mitä muita katasterijärjestelmään tulevaisuudessa vaikuttavia ympäristömuutoksia pystyt nimeämään? Kirjoita vastauksesi alla olevaan laatikkoon.

Lähde: Z_punkt 2016 / Megatrend Update, http://www.z-punkt.de/uploads/files/234/megatrends.pdf

Kiitos vastaamisesta!

Appendix 2 Second round Delphi questionnaire

Katasteri 2035

mmm.fi

MML MAANMITTAUSLAITOS

Aalto University

Hyvä asiantuntija,

Kiitos osallistumisestasi Suomen katasterijärjestelmän tulevaisuuden näkymiä kartoittavaan tutkimukseen. Tutkimus suoritetaan kaksivaiheisesti nk. Delfoi-menetelmää käyttäen. Tämä raportti sisältää tiivistetyssä muodossa tutkimukseen osallistuvien asiantuntijoiden vastauksia ensimmäiseltä kierrokselta. Välitulosten lisäksi raportti sisältää toisen kierroksen kysymykset.

Tutkimukseen osallistuu yhteensä 21 hengen asiantuntijaryhmä. Tämän raportin kautta pääset tutustumaan muiden näkemyksiin katasterijärjestelmään tulevaisuudessa vaikuttavista muutostekijöistä. Raportti on järjestelty siten, että vasemman puoleisessa sarakkeessa esitetään yhteenveto ensimmäisen kierroksen vastauksista. Oikean puoleinen sarake sisältää toisen kierroksen kysymykset, jotka ovat osittain saman sisältöiset kuin ensimmäisellä kierroksella. Tutustuttuasi muiden vastauksiin sinulla on mahdollisuus pohtia ja uudelleenarvioida omaa näkemystäsi.

Palauta kysely 31. joulukuuta mennessä. Tallenna tiedosto omalle tietokoneellesi, vastaa kysymyksiin ja lähetä vastauslomake takaisin osoitteeseen pauliina.krigsholm@aalto.fi.

Vastaamme myös edelleen mielellään kaikkiin tutkimukseen liittyviin kysymyksiin ja arvostamme hyödyllistä panostasi sekä Suomen katasterijärjestelmän kehittämiseen osoittamaasi aikaa!

Ystävällisin terveisin

Pauliina Krigsholm

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sähköposti: pauliina.krigsholm@aalto.fi

Kirsikka Riekkinen

puh: 050 3387111

sähköposti: kirsikka.riekkinen@aalto.fi

Vastaa seuraaviin kysymyksiin ennen varsinaista kyselyä:

Organisaatio:

1. Valtio ☐
2. Liikeyritys ☐
3. Yliopisto tai tutkimuslaitos ☐
4. Kunta ☐
5. Muu ☐

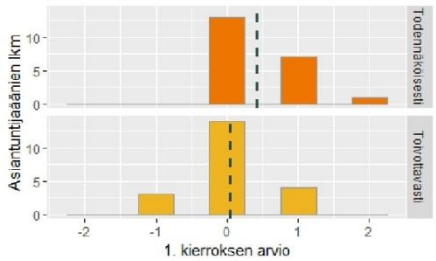
Osaamisalat ☐

Työkokemus (vuosina) ☐

Poliittiset muutokset

Uuden poliittisen maailmanjärjestyksen vahvistumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. Kiinan ja Intian kasvavat mailman vallat, läntisten demokratioiden kriisit, uudet strategiset yhteenliittymät multipolaarisessa maailmassa, Afrikan nousu



Kuva 1 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Muuttuva poliittinen maailmanjärjestys edistää globalisaatiota, mikä taas tuo kasvavan kansainvälisyyden haasteen katasterijärjetelmälle."

"Järjestelmien tulee tuottaa palveluja yli valtakunnan rajojen luotettavasti ja tietoturvallisesti."

"Jos ilmastomuutos etenee uhkakuvien mukaisesti, iso osa eteläistä Eurooppaa ja osia Afrikasta muuttuu viljelykelvottomaksi. Voisi aikaansaada suuret kansainvaellukset - kestääkö pohjoisen euroopan infrarakenteet mukaan lukien maanomistusten kirjaukset tällaisen paineen?"

"Afrikka, Kiina, Intia; tarvetta moderniin katasterijärjestelmään."

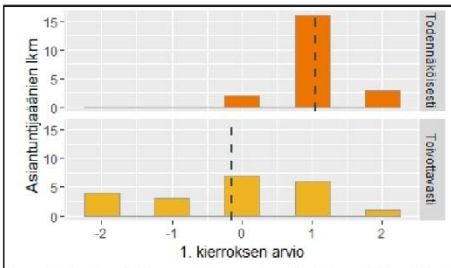
	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Lisääntyvät globaalit turvallisuusuhkien ja riskien vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kasvava teknisten ja sosiaalisten infrastruktuurien heikkous, luonnonkatastrofien lisääntyminen, asymmetriset konflitkit, kansainvälinen järjestäytynyt rikollisuus ja nettirikkollisuus, valvonta ja seuraaminen yhteiskunnassa

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐



Kuva 2 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Globaalit uhat edellyttävät tietoturvallisuuden voimakasta vahvistamista."

"Katasterijärjestelmän on toimittava luotettavasti ajasta ja paikasta riippumatta laajenevien muiden digitaalisten palvelujen "pohjana". Tieto- ja kyberturvallisuusuhkiin varautuminen pitää olla nykyistä korkeammalla tasolla."

"Rekistereiden ja tiedonsiirtoverkkojen haavoittuvuus mahdollisesti uhka katasterijärjestelmälle ja sen toimivuudelle."

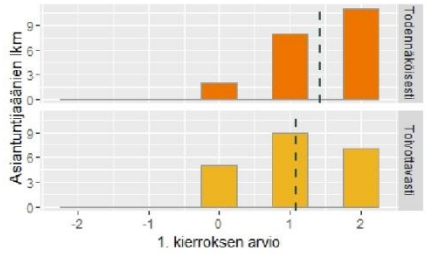
"Tietosuoja- ja tietoturvavaatimukset korostuvat kun kyberhyökkäykset ja tietomurtoyritykset lisääntyvät. Tietosuojan ja henkitietojen yhteensovittamisen haasteet kasvavat kun tietoja avataa (avoin data)."

"Kyberrikollisuus tulee olemaan vakavasti otettava uhka."

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Lisääntyvät selkeyden, avoimuuden ja avoimen datan vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. yhteiskuntasitoumus, vähenevä luottamuus hallintoon, kasvava digitalisaatio, muuttuvat arvot, consumer oriented policy



Kuva 3 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Lisääntyvä selkeys jne. vaatii yllä olevan lisäksi tietosuojan parantamista mutta myös yhteiskunnan eri toimijoiden roolien selkiyttämistä ja yhteisiä toimintamalleja."

"Selkeys, avoimuus ja avoin data vaativat katasterin sijaintitarkkuuden ja ominisuustiedon oikeellisuuden parantamista. Ehkä ne vaativat jonkin asteista julkista luotettavuutta, joka tapauksessa ainakin nykyistä tarkempia metatietoja

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

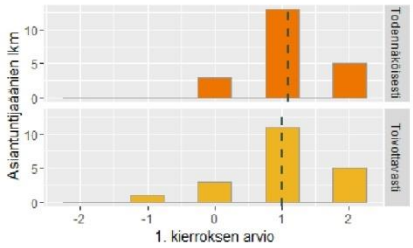
erityisesti siitä, mikä tieto on tarkkaa ja luotettavaa ja mikä tässä likimääräistä ja mahdollisesti puutteellista." "Avoin data ja kuluttajakäyttäytymisen muutos yhdessä digitalisaation laajamittaisen hyödyntämisen kanssa muuttavat katasterin merkityksen olennaisesti. Jatkossa katasteri on yhteiskunnan tarjoama itsepalveluväline, jonka tietosisältöä hyödynnetään mobiilisti ad hoc siellä, missä tiedontarve syntyy. Viranomaispinta häviää lähes näkymättömiin ja pian katasterin käyttäjät eivät edes tiedä, mistä tieto tulee. Riittää, että se on ajantasaista ja luotettavaa sekä helppokäyttöistä." "Uskon myönteiseen kehitykseen ja avoimuuden sekä open datan positiiviseen vaikutukseen yksityissektorilla, jolloin katasteriin liittyvät julkishallinnon tehtävät säilyvät ja jopa lisääntyvät. Yksityissektorin kasvun myötä myös julkissektori ja valtiohallinnon ylläpitämän katasterin tuottavuushyödyt kasvavat." "Avoin data ja sen käytön tehostuminen taitaa olla jo aika lähitulevaisuuden muutoksia. Sen päälle rakennettavat palvelut - mitä tuovat tullessaan?" "Tiedon luotettavuus, ajantasaisuus ja tiedon avoimuus korostuu." "Lisääntyvä selkeys, avoimuus ja avoin data ovat mahdollisusu katasterin kehittämiseen käyttäjäystävällisemmäksi ja toimivammaksi." "Ihmiset tiedostot omistuksensa, ihmiset alkavat itse ylläpitää tietoja, ihminen itse vastaa omaisuudestaan ja sen tiedoista. Avoimmuus, digitalisaatio tarjoaa rekisteritiedot nähtäville ja tarkasteltavaksi-> voi korjata itse tai lähettää virhetietoa datasta-> datan laatu paranee myös tätä kautta." "Arvojen muutos Suomessa: Omakoti- ja vapaa-ajan asuntojen arvostuksen väheneminen tulee vähentämään katasterijärjestelmään kohdistuvaa "kysyntää". Samaan suuntaan vaikuttaa maa- ja metsätalouden tilakokojen, tai ainakin tilojen käyttöyksikköjen koon kasvaminen." "Digitalisaatio ja consumer oriented policy tuo paljon helppoutta asioiden hoitoon." "Digitalisaation tuo aivan uudet tarpeet; vaikeinta vanhasta poisoppiminen." "Avoimuuden lisääntyminen tuo paineita ottaa asianosaisia mukaan rekisterin ylläpitoon." "On hyvä, että paikkatietoa on käytettävissä. Sen lisäksi, että sitä käyttävät ammattilaiset ja asiantuntijat, pitäisi samaa tietoa voida jakaa yleiseen, kansalaisten käyttöön. Useinmiten ihmiset haluavat kokea, että isoveli ei valvo ja he voivat itse vaikuttaa oloihinsa. Tähän omatoimisuuden ja innovaatioiden lisäämiseen tulee antaa panosta ja voimavaroja. Ihmisiltä tuleva tieto ja toiveet voidaan ottaa avosylin vastaan - vain siten saadaan avointa, kehityskelpoista tulevaisuutta."	

Muut katasterijärjestelmään tulevaisuudessa vaikuttavat poliittiset muutokset:	**Perustele antamasi vastauksesi tai halutessasi kommentoi muiden vastauksia.**
"Tietynlainen valvonnan tarve tuntuisi lisääntyvän, esim. omistusrakennetta halutaan varmasti kontrolloida." "Yksityinen maanomistus tulee vahvistuman globaalisti, toisaalta kilpailu maasta (siis sen puute) voi johtaa illegaaleihin ratkaisuihin." "Katasterin ylläpitoa tulee keskittää valtiohallinnolle. Suomen puitteissa kysymys on kuitenkin toimialasta (maanmittaus), jolla tuotot eivät ole isoja ja synergiaedut ovat katasterin hoidon keskittämisessä tuntuvia. Samalla Suomen laaja pinta-ala voidaan hoitaa eivätkä laadukas tietojärjestelmä ja data jää yksin palvelemaan ns. Ruuhka-Suomea." "Jos julkisen sektorin vajeita ei saada hyväksyttävälle tasolle - voi tulevaisuudessa esim. vanhuuden turvan rahoittaminen siirtyä omistetun omaisuuden realisoimiseen tai että sen tuotto ohjataan palvelun maksajalle tms. Olisiko "tuotamme mitä kulutamme itse" - ajattelulla ison kasvun mahdollisuuksia. Tuulivoiman, aurinkovoiman ja vesivoiman kuuluminen maanomistajalle aina tulevaisuudessakin? Kuinka syvälle maanomistajan oikeudet ulottuvat - entä korkealle?" "Omistukseen kohdistuvat ei toivotut piirteet, kuten pelko hybridisodankaynnista." "Samaan aikaan vaatimus tietojen avoimuudesta ja toisaalta henkilötietosuojan parantamisesta (EU-tietosuoja-asetus) voivat aiheuttaa vaikeuksia katasterijärjestelmän palveluihin." "Poliittiset päätökset esim. rekisteritietojen sisällöstä ja perusteista." "Mennäänkö globaalimpaan vai suljetumpaan suuntaan. Mitä tapahtuu EU:lle. Pysyykö maahanmuutto hallittavissa rajoissa. Säilyykö maailmanrauha." "Paineet yhteisen EUn katasterijärjestelmän luomiseen kasvavat kun globalisaatio ja EUn kiinteistömarkkinat kehittyvät." "Metsien käytön tehostaminen sekä taloudellisessa, ekologisessa että sosiaalisessa mielessä vaikuttaa siihen suuntaan että metsätilojen kokoa pyritään kasvattamaan ja muodostamaan yhteismetsiä. Myös maatalouden tilakokoja kasvatetaan maatalouden tehostamiseksi.Katasteritiedon kiinnostavat jatkossa entistä harvempia kansalaisia." "Byrokratian keventäminen, asiakirjat yhdestä ja samasta paikasta, "saman sateenvarjon alta", helppous ja avoimuus viranomaisasiakirjojen katseluun ja asioiden hoitamiseen." "Venäjän tilanne, Naton tulevaisuus, lisääntyvä siirtolaisuus/ pakoilaisuus/ sääilmiöt."	

Taloudelliset muutokset

Osaamistalouden korostumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kansainvälinen koulutustason kasvu; innovaatioiden korostaminen kilpailutekijänä; data- ja tietopohjainen arvon luominen; uusi globaali tietoeliitti — luova luokka; elinkäinen oppiminen



Kuva 4 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Pitkälti samat kuin poliittisten megatrendien kohdalla. Lisäksi katasterin ylläpito tulee todennäköisesti hajautumaan tiedon tuottajille ja jopa "joukkoistumaan".

"Osaamisen kasvu, verkostoituminen ja globalisaatio ovat tulevaisuuden asioita."

"Osaamistalouden kehittyminen mm. luo erityisesti avoimen datan ympäristössä runsaasti tuoteinnovointia, joka voi olla ainakin osittain kansainvälistäkin."

"Mahdollisuus joukkoistamiseen, halu tai/ja taito tehdä itse."

"Osaaminen, digitalisaatio, " vanhanaikasen maanmittausjärjelmän ja kiinteistöjärjestelmän modernisointi" nyt on kankeaa (oma kokemus) tarvitaan todellista muutosta vaikka kiinteistön oston ja ja kauppakirjan voi hoitaa metin kautta pankkitunnuksilla, mutta pankkitunnukset ovat jo vanhanaikasta kamaa."

"Osaamistalouden korostuminen; katasteri yhtenä tärkeänä lähtöaineistona uudentyppisissä sovelluksissa."

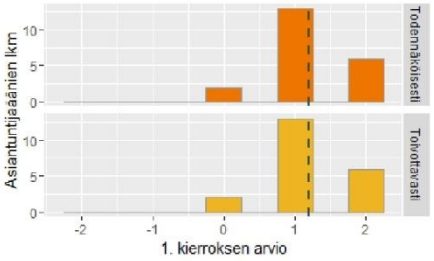
"Perusrekisteriviranomaiset luovat palveluita jotka leikkaavat eri viranomaisten vastuulla olevia palveluita, ja asiakkaan palvelukokemus on sellainen, ettei hän huomaa eri viranomaisia omassa palvelukokonaisuudessa lainkaan. Myöskin yritykset voi luoda kansalaisille uusia palveluita, yhdistämällä eri viranomaisten toteuttamia avoimen lähdekoodin komponetteja uusiksi palvelukokonaisuuksiksi. Reaaliaikaisten päästä-päähä-prosessien kehittäminen."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Liiketoiminnan ekosysteemien muodostamisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. uusiin arvoketjuihin pohjautuva yhteistyö; systeemi-innovaatiot; uudet verkkopohjaiset yritykset uusien markkinoiden rajapintana; neljännen sektorin syntyminen; monimutkaisuuden hallinta



Kuva 5 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Liiketoiminnan ekosysteemien muodostaminen vaikuttaa toimintamallien ja yhteisten prosessien kehittämiseen ja toimijoiden roolijakoon."

"Liiketoiminnan ekosysteemissä on mahdollista em. edellytysten täyttyessä luoda ja kehittyä runsaasti omistajaa, ostajaa, välittäjää ja rahoittajaa palvelevia uusia sovelluksia."

"Katasterijärjestelmän tulee tukea uusia innovaatioita."

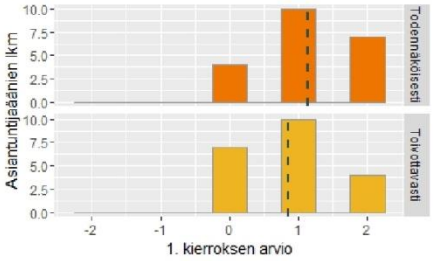
"On hyvä tunnistää, mitä asioita hallinnoivat yritykset ja mitä tarpeita on esim. nk. julkisella sektorilla. Hyvä yhteistyö varmasti entistä arvokkaampaa ja rajapintojen määrittäminen. Mutta myös työnjako tärkeätä, että ei tehdä päällekkäisiä asioita."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Lisääntyvien työelämän muutoksien vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. dynaamiset ja joustavat työtavat; uudet johtamis- ja organisaatiomallit; yhteityötä korostavat työtavat; automatisaation kehitys



Kuva 6 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

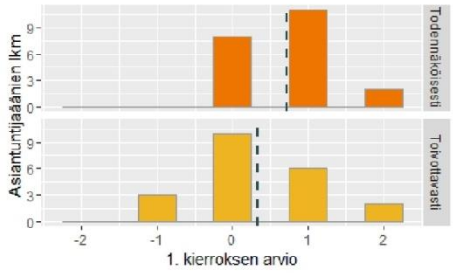
Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

"Työelämän muuttuminen yhdessä teknologisen kehityksen kanssa tulee mullistamaan katasterin ylläpitomenetelmät ja siihen liittyvän tiedonkeruun. Monikanavainen ja automatisoitu tiedonkeruu korvaa lähes kokonaan ihmistyönä tehtävän työn. Katasterin ylläpidossa nykyisin tutut käsitteet "kiinteistötoimitus", "lainhuudon myöntäminen" tai "rekisterinpitäjän päätös" häviävät ja korvaantuvat tietovirtojen hallintaan liittyvillä käsitteillä."

"Työelämän ketteröityminen olisi suotavaa, mutta työmarkkinajärjestöjen jarrutus saattaa haitata."

Globalisaation syvenemisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. taloudelliset valtakeskusten muutos; epävarma talous; kansainvälisen keskiluokan nousu; kansainvälisesti hajautetut ja levinneet arvoketjut; kansainväliset rahavirrat – vaikeasti hallittava rahoitussektori



Kuva 7 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Globalisaatio ja reaaliaikaisuus; moni taloauden megatrendi tulee edellyttämään katasterijärjestelmältä näitä tulevaisuudessa."

"Globalisaation syventäminen voi johtaa myös tuotannon kapenemiseen ja mahdollisesti pohjoismaisen hyvinvointimallin näivettymiseen. Edellytykset ylläpitää hyvin toimivaa pohjoismaista hyvinvointivaltiota saattavat rapautua."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

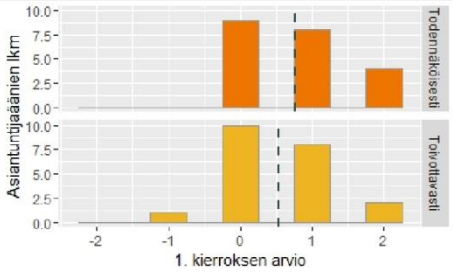
Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Uusien kulutustapojen muokkautumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. muutokset kuluttajien rahankäytössä ja kulutustottumuksissa; kehitysmaiden kasvava varallisuus; hiljattain teollistuneiden valtioiden nopeasti lisääntyvä kulutus; kestävä kuluttaminen länsimaissa; muutokset (hybridi- ja virtuaalimallit); yhteiskulutuksen kasvava merkitys

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.



Kuva 8 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Muutokset rahankäytössä ja kulutuksessa: Maan omistamisen arvostus vähenee. Kiinnostus kiinteistöjen rajoihin vähenee."

Muut katasterijärjestelmään tulevaisuudessa vaikuttavat taloudelliset muutokset:

"Raaka-ainevarojen omistaminen voi nousta nykyistä merkittävämpään rooliin."

"Katasterin ylläpidon kustannusten väheneminen ja nykyaikaiset toimintatavat vaikuttavat taloudelliset.
Maksut kansalaisille laskevat tuloksellisuuden ja tuottavuuden kasvun myötä."

"Suomessa olennainen kysymys on asunto-osakkeiden ja kiinteistöjen digitaalisten palvelujen ja mahdollisesti myös lainsäädännön yhdistyminen (sähköinen asunto-osakerekisterihanke jo käynnissä)."

"Väestön osaamisen yleinen kasvaminen ei välttämättä auta ymmärtämään katasterijärjestelmän yrityskäsitemaailmaa, jollei katasterin tietosisältöä yksinkertaisteta merkittävästi. Tämä myös mahdollistaisi tavallisten kansalaisten toteuttaa kiinteistönvaihdanta, omien tietojen tarkistamiseen ja korjaamiseen ilman ammattilaisten apua. Tulevaisuudessa maanomistaja voisi tehdä omalle kiinteistölleen lohkomisen itsepalveluna ja myydä sen jälkeen kokonaisen kiinteistön ostajalle."

"Julkisen sektorin rahoitusasema heikkenee. Katasterijärjestelmän ylläpidon pitää tehostua taloudellisessa mielessä."

"Henkilöstön vähentäminen lisää paineita katasterijärjestelmän kehittämiseen."

"Väestön vanheneminen , väestö,jotatietokoneaika ei ole saavuttanut , miten asia hoidetaan."

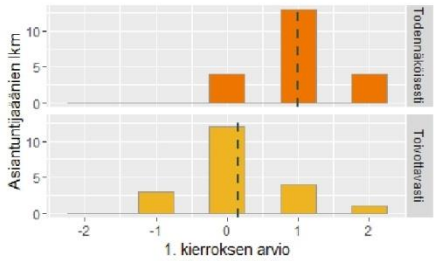
"Kiertotalous, kulutuksen väheneminen, vanhan tavaran arvostaminen."

Perustele antamasi vastauksesi tai halutessasi kommentoi muiden vastauksia.

Yhteiskunnalliset muutokset

Kasvavat väestön vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. maailman väestömäärän kasvu; väestön ikääntyminen; länsimaiden väestönmäärän lasku; kasvavat maahanmuuttovirrat sekä väestörakenteen muutokset



Kuva 9 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

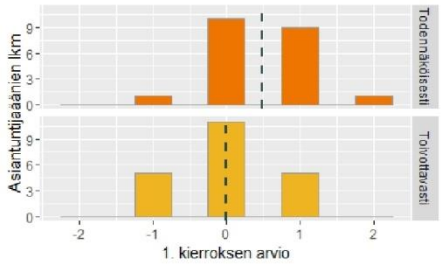
"Väestön muutokset eivät ehkä juurikaan vaikuta katasteriin, mutta ikääntyvä ja vähenevä väestö tarkoittanee omistuksen siirtymistä perikunnille suhteellisesti kasvavassa määrin, mikä vaikeuttaa kontaktin saamista ja yhteisymmärryksen saavuttamista kiinteistöjä koskevissa asioissa."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Syvenevän yksilöllisyyden vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. individualismi globaalina ilmiönä; muuttuvat ihmissuhdekuviot: muutama vahva ja useat kevyemmät ihmissuhteet; massamarkkinoista mikromarkkinoihin; itseriittoisuus ja tee-se-itse –talous



Kuva 10 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

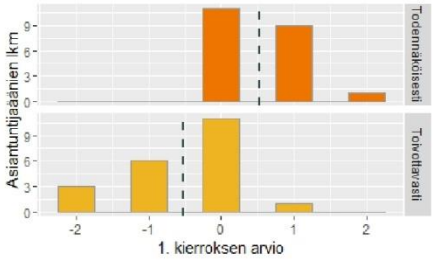
"Vapaa-ajan asuntojen ja omakotitalojen omistamishalukkuus vähenee. Sen seurauksena katasterijärjestelmään liittyvä kysyntä ja tarve vähenee."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Sosiaalisten ja kulttuuristen erojen korostumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kasvava rikkaiden ja köyhien polarisaatio; epävarmuus osa normaalia elämäntapaa; sosiaalinen hajanaisuus eri elämäntilanteissa; kilpailevat ja yhdistyvät arvojärjestelemät



Kuva 11 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Sosiaalisten ja kulttuurillisten erojen kasvaessa katasterijärjestelmän merkitys omaisuuden suojaa antavana järjestelmänä vahvistuu."

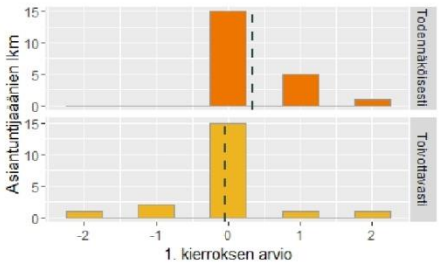
"Kiinteistöt ovat merkittävä osa valtakunnallista paikkatietoinfrastuktuuria niin taloudellisesti kuin toiminnallisesti myös tulevaisuudessa."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Terveydenhuollon uudistumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kasvava tietoisuus ja henkilökohtainen vastuu terveysasioissa; muuttuvat tautiesiintymät; kasvavat terveydenhuoltokulut — kulujen painottuminen yksilölle; terveydenhuoltosektorin uudelleen organisointi; uudet lähestymistavat diagnoosiin ja hoitoon; uudet yhtyvät markkinat



Kuva 12 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

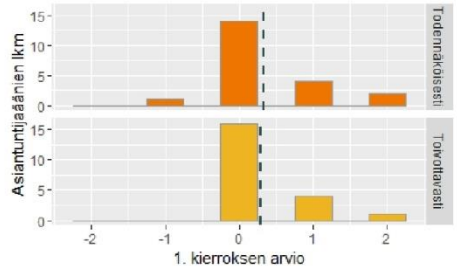
	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Sukupuoliroolien muuttumisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. perinteisten sukupuoliroolien rikkoutuminen; naisten kasvava rooli työpaikoilla; sosiaalisten ja kommunikaatiotaitojen kasvava arvostus; tasapainoisen ja terveellisen työelämän kasvava merkitys; uudet perhemuodot ja elämäntyylit

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐



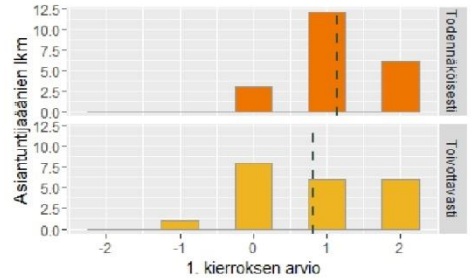
Kuva 13 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Väestön muutokset ja sukupuoliroolien muuttuminen tuo katasterin itsepalvelukäyttäjiksi uusia käyttäjäryhmiä. Näiden ryhmien aikaisempi kokemus katasterin sisältämistä asioista on vähäistä ja erityisesti maahanmuuttajien joukossa voidaan kokea epäluottamusta katasterin sisältämän tiedon oikeellisuuteen. Epäilys voi johtua lähtömaan epäselvistä ja korruptoituneista yhteiskunnallisista olosuhteista."

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Lisääntyvän liikkuvuuden vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kansainvälisen liikkuvuuden kasvaminen; liikkumisen esteiden lisääminen; intermodaaliset (eri kuljetustapoja hyödyntyvät) kuljetukset; digitaaliset liikenneverkostot; uudet ajoneuvokonseptit ja -teknologiat; älylogistiikan ratkaisut



Kuva 14 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Kansainvälisyys tässäkin... varmasti tulee välttämättömäksi noudattaa tiettyjä kansainvälisiä standardeja. Muutoin katasterijärjestelmä ei palvele yhteiskuntaa."

"Älyliikenteen kehitys paikannusjärjestelmineen tuo hyötyjä myös katasterille ja sen digitalisoinnille. Rajapyykittömät kiinteistöt tulevat mahdollisiksi."

"Liikkuvuus, mobility as a service , palvelut digitaalisina ilman kankeita "pankkitunnuksia."

"Sähköisten tekniikoiden voimakkaasta tulosta on hyvä olla erittäin tietoinen, varautua, ennakoida, luoda uutta, mahdollistaa."

"Liikkuvuus otataan käyttöön katasterin päivityksessä."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

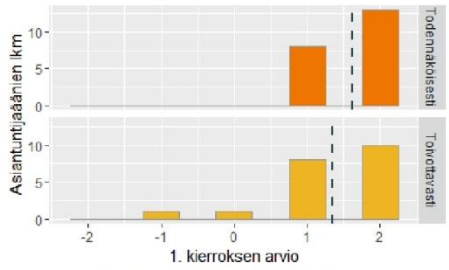
Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

"Lisääntyvä liikkuvuus: katasteri olennainen tietolähde esim. uusien digitalisten kehittämisessä ja mallintamisessa."	
Muut katasterijärjestelmään tulevaisuudessa vaikuttavat yhteiskunnaliset muutokset:	**Perustele antamasi vastauksesi tai kommentoi halutessasi muiden vastauksia.**
"Maanomistuksen merkityksen väheneminen, koska maa on tulevaisuudessa yhä harvemman ihmisen tulonlähde tai välitön tuotannontekijä." "Se voi olla perinnön kautta saatu ihmetyksenaihe Joulupöydässä sukulaisten kanssa esi-isiä muistellessa. Edellä mainitusta johtuen maanomistus ja siihen liittyvä tieto voi olla jopa kiusalliseksi ja hankalaksi koettava asia kansalaisille." "Jos yrittäjyys lisääntyy ja vienti kasvaa, niin yhteiskunta pysyy stabiilina, kun entistä isommalla osalla ikäluokkaa ja ihmisiä varallisuus kasvaa ja katasterin merkitys ymmärretään laajemmin. Siitä tulee tunnettu ns. jokamiehelle, vähän samaan tapaan kuin jo nyt tilanne on maaseudulla ja maakuntakeskuksissa." "Katasterijärjestelmää uhkaa jatkuvasti lisääntyvä sääntely niin EU:n kuin valtionhallinnon yhteisen ohjauksen kautta. Valtionhallinnon yleinen IT-ohjaus ei anna riittävästi liikkumavaraa toteuttaa asiakaskokemusta parantavia palveluita. Lainsäädännön kehittäjät eivät pysy teknologisen kehityksen vauhdissa." "Young generation kiinteistön omistukset, tietoa kasteri-asioista sosiaalisen median kautta."	

Teknologiset muutokset

Digitaalisen kulttuurin leviämisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. digitaalisten teknologioiden leviäminen ja yhdistyminen kaikille elämän osa-alueille; digitaalisten elämäntyylien laajempi erovaisuus; digitaalisten natiivien uudet sosiaaliset kommunikointitavat; osallistuvuuden ja järjestäytymisenmuodot; Web 3.0 tuleminen



Kuva 15 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Digitaalinen kulttuuri ja tietotekniikan yleistyminen tuovat esiin vaatimuksen katasterin ja sen tietojen helposta ja "jokapäiväisestä" käytettävyydestä."

"Digitalisaatio ja tietotekniikan arkipäiväistyminen siirtää katasterin kaltaiset yhteiskunnan tietovarastot konesalien uumenista pilvien kautta olohuoneen sohvalle. Tiedosta tulee ilma jota hengitämme eikä se herätä intohimoja paitsi silloin, jos katasterin tiedoissa on jotain vikaa tai puutteita."

"Digitaalisen kulttuurin leviäminen voi vaikuttaa kasterijärjestelmään myös lyhyellä aikajaksolla."

"Avoimuus ja viestintä oleellisia. Järjestelmiä, tiedon keruuta ja hallintaa on kehitettävä tukemaan tätä kehitystä."

"Digitaalisen kulttuurin leviäminen: tavat joilla ihmiset haluavat käyttää tietoa ja sisältöhyödyt muuttuvat ja monipuolistuvat."

"Digitalisaatio ja avoin data ovat merkittävimmät muutostrendit."

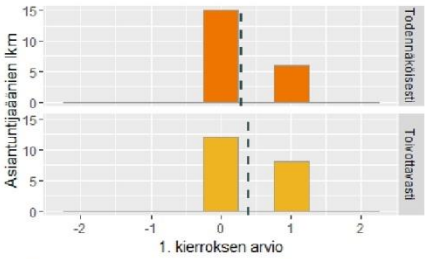
	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Luonnon imitoinnin hyödyntämisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. luonnon rakenteet ja prosessit innovation lähteinä; bioniikka yhdistettynä designiin ja teknologiaan; parviälykkyys; biologian vaikutus tuotantosysteemeihin — hajauttaminen ja kierrätystalous

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐



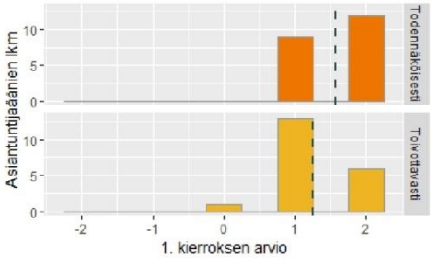
Kuva 16 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

Perustele ja täsmennä yllä antamasi vastauksesi, miksi?

Jokapaikan tietotekniikan yleistymisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. siirtyminen pilvipalveluihin; uudet käyttöliittymät ja älykkäät ympäristöt; älykkäiden infrastruktuurien luominen; Esineiden internet = ekosysteemi, jossa esineet ja laittet kommunikoivat keskenään; keinoälyn ja robotiikan läpimurrot

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐



Kuva 17 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

"Teknologian kehittyminen ja tietotekniikan arkipäiväistyminen mahdollistavat entistä paremmin katasterijärjestelmän palvelukyvyn."

"Valtiohallinnon sähköistyminen ml. land administration (maanhallinta) muuttaa katasteritehtäviä, mutta ei vähennä niiden merkitystä, vaan pikemminkin kasvattaa."

"Katasterin integrointi erilaisiin web-liittymiin ja tulevaisuudessa erilaisiin virtuaalimaailmoihin."

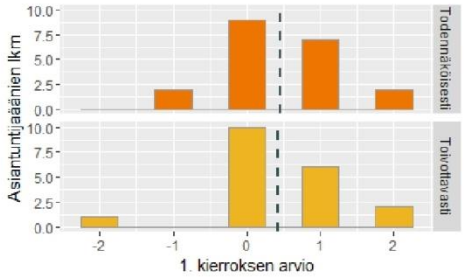
"Katasterijärjestelmän tietojen saaminen vapaasti yhdessä paikantamisen kanssa avaa merkittäviä mahdollisuuksia luoda täysin uusia diginatiivien tarvitsemia tietoja joita on yhdistetty muiden palveluiden kanssa ja joita voidaan käyttää mobiilisti maastossa."

"IoT:n vaikutusta ja mahdollisuuksia katasterijärjestelmän kehittämisessä on ainakin tällä hetkellä vaikea tunnistaa. Ehkä joku innovoi myös niitä jatksossa."

"Voitaisiinko luotettavaa katasteria luoda joukkoistamalla, aivan uusilla tavoilla kerätä tietoa."

Teknologian yhdentymisen vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. miniatyrisaatio ja nanoteknologia teknologian yhdentymisen ajureina; materiaalien ja rakennustapojen dynaamiset innovaatiot; bioteknologian laajentuminen; laajempi nanoteknologian, bioteknologian, informaatioteknologian sekä kognitiivisten tieteiden yhdentyminen



Kuva 18 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Tekniset mahdollisuudet tulevat muuttamaan ihmistä, rekistereitä ja palveluja. Ihminen oppii niitä käyttämään. Tekniikka voidaan valjastaa uusiin tapoihin taisaalta tekniikka tarjoaa mahdolloisuudet. Totutuista tavoista luovutaan koska valtavirta niin haluaa ja se on teknisesti mahdollista.Taloudellisuuden tarve (ihmistyö vähenee) jatkuu ja siihen saahaan hyvin tukea tekniikan kehittymisestä. Yksiköt tekevät itse, viranomaistoiminta muuttaa muotoaan suorittajasta mahdollistajaksi. Yhteistyö lisääntyy ja puretaan päällekkäisiä rakenteita. Palvelut muuttuvat asiakasprosesseihin joissa asiakkaalla on tarve ja järjestelmät palvelevat ilman että asiakkaan tarvitsee tietää substanssia."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Muut katasterijärjestelmään tulevaisuudessa vaikuttavat teknologiset muutokset:

"Big Datan hyödyntäminen kehittyy. Kiinteistökohtaisten tietosirujen ym. kautta kiinteistöjärjestelmän ylläpito helpottuu ja automatisoituu. Tiedot esim. autojen tosiaikaisesta liikkumisesta muuttavat esimerkiksi tiemaksujen perimistä ja mahdollistaa kaduilla tai maanteillä tietullit."

"Katasteri muuttuu osaksi paikkaa jossa olet, kunhan tiedot avataan."

"Aitoon 3D-maailmaan siirtyminen tulee tulevaisuudessa asettamaan katasterijärjestämän kehittämiselle suuria paineita. 3D:stä on jo nyt tullut kaupunkialueiden de facto-menettely ja se tulee jatkossa leviämään myös haja-asutusalueille kaiken tyyppisessä suunnittelussa (ympäristö, liikenne, jne.)."

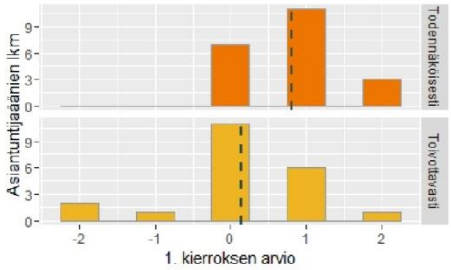
"Katasterijärjestelmän info peruskoulutuksessa,; miten toimitaan kun leikisti ostetaan kiinteistö ja alutaan sille rajat ja halutaan siitä omistuskirjoitus."

Perustele antamasi vastauksesi tai kommentoi halutessasi muiden vastauksia.

Ympäristömuutokset

Ilmastonmuutos ja ympäristövaikutusten kasvun vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. ilmaston lämpeneminen ja kasvat hiilidioksidipäästöt; ympäristöongelmien kasvunriski juuri teollistuneissa sekä kehitysmaissa; kasvava nälänhätä; tiukentuvat säädökset; clean-tech investoinnit; strategiat ilmastonmuutoksen lieventämiseksi ja siihen sopeutumiseksi



Kuva 19 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

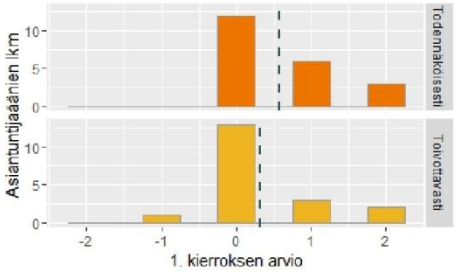
"Ympäristövahinkojen ja katastrofien selvittämisessä maanomistustiedolla on myös jatkossa merkittävä rooli."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

Energian ja resurssien mullistuksien vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. kasvava energian ja resurssien kulutus; strategisten resurssien niukkuus; vaihtoehtoisten energiaratkaisujen ja uusiutuvan energian käyttö; energiatehokkuuden nousu; keskittämätön infrastruktuuri



Kuva 20 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Energian tuotannon puolella on työllistävän teollisuuden energian tarpeen tyydyttäminen taloudellisesti ja keskitetysti keskeistä työpaikkojen ja vientiteollisuuden näkökulmasta. Tämä kaikki tulee kansalaisten yhteiseksi hyväksi."

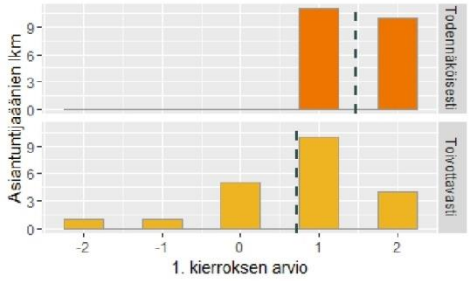
	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

"Maapallon resurssien riittävyydestä tulee tehdä yhteistyöstä maailmanlaajuisesti. Tehokkaampaa tietojen jakoa ja hallittavuutta. Uusia malleja tiedon hyödyntämiseen. Avoimuus."

Etenevän urbanisaation vaikutukset Suomen katasterijärjestelmään vuoteen 2035 mennessä...

mm. suurkaupunkien ja kaupunkitaajamien kasvaminen; maaseudun kasvavat rakenteelliset ongelmat; mukautettujen infrastruktuuriratkaisujen kehittäminen; kestävä kaupunkikehitys; uudet elämäntyylit sekä asumisen ja osallistuminen muodot



Kuva 21 Asiantuntijoiden arviot megatrendin todennäköisestä ja toivottavasta vaikutuksesta katasterijärjestelmään ensimmäiseltä kierrokselta. Katkoviiva kuvaa vastausten keskiarvoa.

"Urbanisaation eteneminen lisää 3D-kiinteistöjen ka -kokonaisuuksien synnyttämisen ja hallinnan tarvetta."

"Etenevä urbanisaatio lisää katasterin tietoyksiköiden lukumäärää olennaisesti. Samalla vaatimus tiedon tarkkuudesta kasvaa."

"Urbanisaatio asettaa haasteita myös katasterille datan kasvun myötä. Ilmastonmuutoksen seurauksena rantaviivojen siirtyminen ei ole niin merkittävää kuin luulisi, sillä maannousu jatkuu yhä."

"Asumisen ja omistamisen muodot tulevat muuttumaan lähitulevaisuudessa. Blockchain tulee myös asumiseen, kiinteistövaihdantaan. Maaseudun asuntojen ja kiinteistöjen arvojen kehitys?"

" Rakennukset osana katasteria?? Suunnitelmatiedot osana katasteria? Katasteri ja paikkaan sidotut tiedot voidaan yhdistää vahvasti toisiinsa."

" Katesterin pitää turvata omistus yhteiskunnan ja maailman 'muutostilanteissa'; mitä, missä, kuka omistaa."

	Vähenevät voimakkaasti		Eivät muutu nykyisestä		Lisääntyvät voimakkaasti
	-2	-1	0	1	2
Todennäköisesti	☐	☐	☐	☐	☐
Toivottavasti	☐	☐	☐	☐	☐

Perustele ja täsmennä yllä antamasi vastauksesi, miksi? Kommentoi tai väitä vastaan muiden argumentteja.

"Etenevä urbanisaatio voi tuoda ongelmia , tiiviys luo liian paljon maanalaisia, maanpäällisiä ja muita mahdottomia kiinteistöjä, joille rajat ovat läpinäkyviä." "Kaupungistuminen lisää luotettavan katasterin tarvetta. Maanomistaja ei asu lähellä." "Sidonnaisuus paikkaan vähenee. Ihmiset kasaantuvat metropoleihin joissa on vetovoimaa. Syrjäseudut autioituvat." "Etenevä urbanisaatio: lisää kaupunkimaisen ympäristön suunnittelun ja rakentamisen tarveta ja tätä kautta asettaa katasterille esim. vaatimuksia 3D-ulottuvuudesta sekä entistä paremmasta kytkennästä kaupunkiympäristöön, ns. kaupunkimalliin."	
Muut katasterijärjestelmään tulevaisuudessa vaikuttavat ympäristömuutokset: "Tiettyjen ympäristöuhkien liioittelun tiedostaminen kansalaisten keskuudessa on siinä mielessä oleellista, että yhteiskunnan voimavaroja ei tuhlaudu epäolennaiseen kuten ylenmääristen kunnallis- ja hallintovalitusten käsittelyyn sekä ympäristöbyrokratiaan. Yhden luukun periaate ympäristölupa-asioissa vähentää kustannuksia. sama koskee monenkertaisen valittamisen estämistä lain säännöksin, jolloin saman asian luvanvaraisuutta ja lupaehtoja ei tarvitse tutkia useita kertoja esim. kaavoituksen eri vaiheissa." "Puhtaan veden saannista tulee maailmalla olemaan vielä tulevaisuudessa merkittäviä haasteita, joilla saattaa olla merkittävä vaikutus katasteritietojen käytölle yhdessä muiden ympäristöaineistojen kanssa." "Maanjäristykset jolloin katasterijärjestelmät järkkyvät ja toimistot tuhoutuvat. Miten tiedot tallennetaan että ne säilyvät luonnonkatastrofista."	**Perustele antamasi vastauksesi tai kommentoi halutessasi muiden vastauksia.**

Kiitos vastaamisesta!

Lähde Z_punkt 2016 / Megatrend Update