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Batchelor's thesis of Business Administration

Financial Management

CLIMATE RISK EVALUATION IN LARGE FINNISH ORGANIZATIONS

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ABSTRACT

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Keywords: Climate risk, climate risk evaluation, climate change, contingency theory, organizational risk adaptation, statistical methods, large Finnish organizations

The objective of this bachelor's thesis is to research climate risk evaluation in organizations. The purpose is to find out the state of climate risk evaluation in large Finnish organizations. The subject is studied from the aspect of the research problem "Are large Finnish organizations prepared for climate change's effects?".

The study is executed with statistical methods including Spearman's correlation coefficient, Sign test and Wilcoxon Signed Rank test. Tests are run with SAS Enterprise Guide 7.1 program and the data used is pre-existing structured questionnaire on subject of weather and climate risk management. Responding organizations function in several different industries and locations in Finland. Theoretical framework of this research consists of organizational theory and organizational adaptation.

The results show that large Finnish organizations are aware of climate change as s risk to their operations and third of organizations are doing climate risk evaluation regularly. Organizations consider climatic changes in Finland more significant to their operations than changes occuring abroad. Compared to previous research it seems that Finnish organizations are better prepared to unexpected weather conditions when measured with the amount of organizations that are doing climate risk evaluation. This research could be continued by studying how climate risk evaluation is executed in Finnish organizations.

TIIVISTELMÄ

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Tutkielman nimi:	Ilmastoriskien arviointi suurissa suomalaisissa yrityksissä
Akateeminen yksikkö:	School of Business and Management
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Hakusanat:	Ilmastoriski, ilmastoriskien arviointi, ilmastonmuutos, kontingenssiteoria, organisatorinen riskeihin sopeutuminen, tilastolliset menetelmät, suuret suomalaiset yritykset.

Tämän kandidaatin tutkielman aihe on tutkia ilmastoriskien arviointia organisaatioissa. Tavoite on selvittää ilmastoriskien arvioinnin tila suurissa suomalaisissa organisaatioissa. Aihetta tutkitaan tutkimusongelman ”Ovatko suuret suomalaiset organisaatiot valmistautuneita ilmastonmuutoksen vaikutuksiin?” näkökulmasta.

Tutkimus on tehty käyttäen tilastollisia menetelmiä kuten Spearmanin korrelaatiota, Sign testiä ja Wilcoxon Signed Rank testiä. Testit on tehty SAS Enterprise Guide 7.1 -ohjelmalla käyttäen valmista strukturoitua kyselyä aiheesta sää- ja ilmastoriskien hallinta. Kyselyyn vastanneet organisaatiot toimivat useilla eri toimialoilla ja alueilla Suomessa. Tutkimuksen teoreettinen viitekehys koostuu organisaatioteoriasta ja organisatorisesta sopeutumisesta.

Tulokset kertovat, että suuret suomalaiset organisaatiot ovat tietoisia ilmastonmuutoksen aiheuttamista riskeistä organisaation toiminnalle ja kolmasosa vastaajista tekee ilmastoriskien arviointia säännöllisesti. Organisaatiot pitävät Suomessa tapahtuvia ilmastollisia muutoksia merkityksellisempänä heidän toimintansa kannalta, kuin ulkomailla tapahtuvia muutoksia. Kun mittarina käytetään ilmastorikien arviointia tekeviä organisaatioita, verrattuna aiempaan tutkimukseen vaikuttaa siltä, että suomalaiset organisaatiot ovat paremmin varautuneita yllättäviin sääolosuhteisiin. Jatkotutkimusta voitaisiin tehdä selvittämällä, miten ilmastoriskien arviointia suoritetaan organisaatioissa.

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1. INTRODUCTION

Climate change is a hot topic at the moment. Every week rises news about the effects of climate change all around the world. The problem is that it has been acknowledged only for a short time that climate change is truly an existing phenomenon and it is still unsure what kind of risks climate change will bring to organizations. These changes in weather can come as a surprise if organizations are not prepared. It is helpful to understand if Finnish organizations have done climate risk evaluation for possible extreme weather phenomena that can influence their operations. This information can be important for climate researchers, for those who are developing climate risk evaluation processes and most importantly for organizations that are thinking whether they should do climate risk evaluation.

Climate change caused by an increased amount of emissions of greenhouse gasses is rising Earth's surfaces average temperature (Finnish Meteorological Institution, 19.07.2018). This rise is affecting weather conditions and can cause extreme weather phenomena. The changed organizations environment can affect negatively on organizations operations. Research problem and sub-questions investigate are large Finnish organizations prepared for climate change's effects with studying opinions about significance of climate change in Finland and weather phenomena resulted from it, are organizations doing climate risk evaluation and how significant are climate risks compared to other risks organizations must take.

1.1 Research Target and Research Problems

The objective of this research is to find out if large Finnish organizations are doing climate risk evaluation and how significant these organizations see climate change's effects on their operations. The theoretical background for the research is formed around organizational theory and climate risk evaluation. The topic of this Batchelor's Thesis is climate risk evaluation in large Finnish organizations.

The research target is to investigate are large Finnish organizations prepared for climate change's effects. The researches results will help to understand do large

Finnish organizations consider the weather phenomena resulted from global warming significant for their operations functionality and how many of the organizations are doing climate risk evaluation. The research results help to understand the current situation of climate risk evaluation in Finland and help targeting right kind of climate awareness education to large organizations.

The research problem of this thesis:

"Are large Finnish organizations prepared for climate change's effects?"

This research problem involved answering the subsequent questions:

"How significant are climate change and weather phenomena resultant from it seen in large Finnish organizations?"

"Is climate change risk evaluation made in large Finnish organizations?"

"How meaningful are climate risks compared to other kinds of risks in large Finnish organizations?

1.2 Methodology and Research Material

This research is done by using statistical methods and previous researches from the topic of organizational theory and organizations adaptation to climate change. Statistical tests are run with SAS Enterprise Guide 7.1 program and analyzed with help of previous researches. The tests used in this research are Spearman's correlation analysis that measures the correlation between two ordinal scale variables, Sing test and Wilcoxon signed rank test to measure if variables have same distribution and summary statistics for analyzing questionnaire results (Holopainen & Pulkkinen 2012, 233-247, Metsämuuronen 2011, 1019-1020). The statistical data used in the research is found from Aila portal. The subject of the structured questionnaire data is Weather and Climate Risk Management in Finnish Organisations 2015 (Gregow, Haavisto,

Harjanne, Luhtala, Mäkelä, Tuomenvirta, Halonen, Raivio, Hildén, Jakkila, Parjanne, Peltonen-Sainio, Kollanus, Lanki, Miettinen, Haanpää, Juhola, Jurgilevich, Räsänen, 2015).

Weather and Climate Risk Management in Finnish Organisations is a study that was part of the ELASTINEN project funded by the Prime Minister's Office in Finland. The aim of the study was to produce information and seek solutions to improve climate risk and weather management in Finland. The research consortium that organized and executed the survey consisted of several scientific organizations. These organizations are Finnish Meteorological Institution, University of Helsinki, Finnish Environment Institute, Natural Resources Institute Finland, National Institute for Health and Welfare, and Gaia Consulting.

1.3 Research Limitations

This research is limited to studying large Finnish companies. The research data used is affecting this limitation because the Weather and Climate Risk Management in Finnish Organisations 2015 (Gregov et al. 2015) questionnaire used in this research is focusing on Finnish companies. The limitation keeps this research in moderate size for a bachelor's thesis. Expanding the research to involve companies outside of Finland would cause problems coming from different cultural backroads in the companies. Large organizations are chosen as a limitation because of greater resources and larger varieties of knowledge they might posses compared to small organizations that could have more limited resources to execute climate risk evaluation.

1.4 Theoretical Framework

The theoretical framework in this research is organizational theory and organizational adaptation. Figure 1. shows how theoretical framework is connected. First the theory for this research is approached with introduction of contingency theory. Contingency theory explains the interaction between organization and its environment (Puusa, Reijonen, Juuti & Laukkanen 2015, 10-11). Organizations environment in this concept

means all that is outside of organizations boundaries rather than only the natural environment. Best organizational structure for a certain organization depends on its organizational environment. For this research contingency theory brings the reason why it is important from organizations point of view to consider preparation for adapting changing climatic conditions. In case of climate change organizations are facing the changed external environment and to keep functioning at their best, need to adapt their organizational structure to meet the new demands of environment (Aldrich & Marsden 1988, 367).

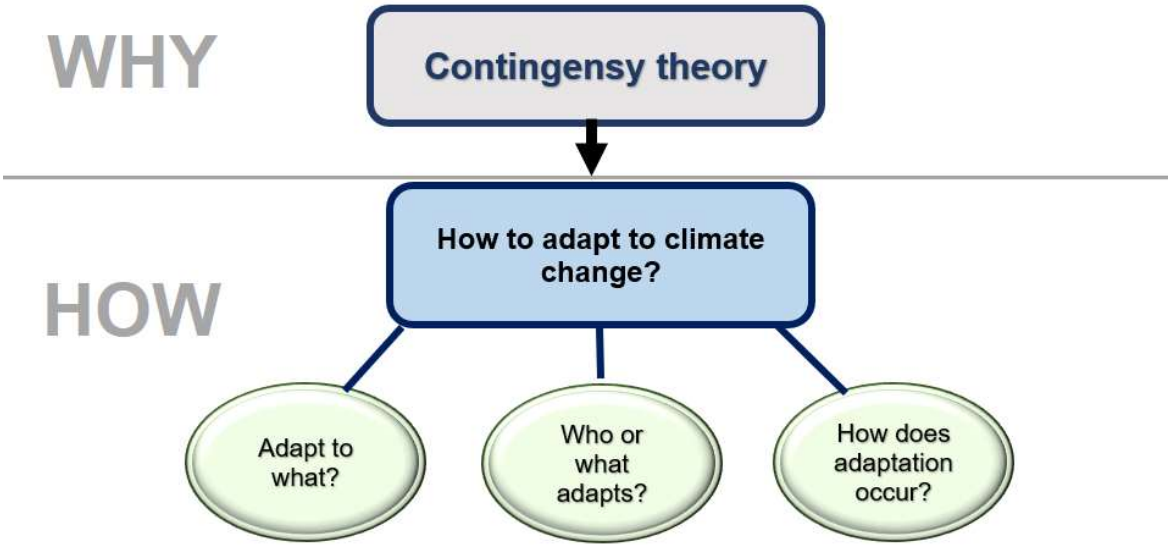

Figure 1. Theoretical framework

After the reason for organizations to do preparation for adapting climate change through climate risk evaluation is explained with contingency theory, next is introduced a theory on how organizations can approach the preparation for climate change. Three questions to help organizations understand how to adapt to climate change are: adapt to what, who or what adapts and how does adaptation occur? Adapt to what question is explaining the concept of climate change that is the reason for adaption. Who or what adapts is describing large Finnish organizations that in this research are the target. The last question how adaptation occurs is explaining adaptation through climate risk evaluation. (Smit, Burton, Klein & Wandel 2000, 223-251)

1.5 Definitions and Concepts

Climate change:

Climate change is a phenomenon that has effects in long-term weather conditions. The human-influenced global warming is mainly caused by an increase in the amount of emissions of greenhouse gases like carbon dioxide, methane, ozone, chlorofluorocarbons, water vapor and nitrous oxide (Casper 2009, 14). These gasses are released into atmosphere in huge amounts daily by organizations and human consuming products that are detrimental to the environment.

Climate risk:

In this research, the meaning of climate risk is a potential risk caused to organization by physical effects of climate change.

Large Finnish organizations:

Organization sizes are often defined with the number of employees. Large organizations are in this research are organizations that have over 250 employees.

Climate risk evaluation:

Climate risk evaluation is a process of evaluating risks that are caused by climate. Organizations risk management evaluation process has four stages: identifying risks, analyze consequences if risks would realize, taking actions to minimize risks and making plans for managing residual risk (Smith 1995, 39-43).

1.6 Research Structure

This researches structure consists of five main chapters and supplementary subchapters. The first chapter is an introduction chapter that introduces the background and motivation for this research and the research problem and sub-

question to give the reader a starting point to examine the subject of this research. The first chapter also includes the research methods and data used in this research and the theoretical framework of the research.

The second chapter presents the concepts and theories applied into the research problem and sub-questions in a subject of organizations climate risk evaluation and adaption to climate change. The chapter introduces the reader to the theories behind this research and helps him to familiarize himself with the concepts that are used in the research. The third chapter presents the statistical methods used in this research, the description of the data that is used to solve the research problems and explains the variable large Finnish organizations. The fourth chapter examines the results of the research. The final fifth chapter presents the conclusions of this research and suggestions for further studies.

2. ORGANIZATIONS CLIMATE RISK EVALUATION AND ADAPTION TO CLIMATE CHANGE

Climate change is a change that affects the Earths average weather conditions in an extended period. It is caused by increased volumes of emission of greenhouse gasses. These emissions are a result of human actions and the main cause is an increase of pollution caused by organizations (Ruosteenoja 2011, 70-71). To adapt to possible extreme weather conditions that climate change might cause to organization, organizations could benefit in doing climate risk evaluation to prepare for uncertainty caused by organizations changed environment. (Casper 2009, 14)

2.1 Organizational Theory

Contingency theory is organizational theory that focuses on explaining the interaction between organization and its environment (Puusa, Reijonen, Juuti & Laukkanen 2015, 10-11). The environment concept in this chapter means organizations environment as all that is outside of organizations boundaries rather than only the natural environment. Lawrence and Lorsch suggest in their research (1967, 1-47) that there is no single best option for organizational structure but that organizational structure must change so that it will adapt to environments features. They also stated that there is not only one most fitted way of leading organization (Lawrence & Lorsch, 1967, 1-47). Contingency theory shows that the structure that is best for a certain organization is dependent on many organizations external and internal aspect and limitations (Tosi & Slocum 1984, 9-26). For this research contingency theory brings the reason why it is important for organizations to consider preparation for changing climatic conditions. In case of climate change organizations face the changed external environment and to keep functioning at their best, need to adapt their organizational structure to meet the new demands of environment (Aldrich & Marsden 1988, 367).

Three different environments in which organizations are functioning are munificent environment, dynamic environment and complex environment. Environmental munificence is a concept where organization can support sustained growth. Organizations that function in munificent environment are trying to pursue

organizational growth and stability. Organizations whose environment is dynamic must deal with uncertainty and unpredictability of environmental change. Complex environment is more heterogeneous making organizations need good information processing skills for strategic activities. Natural environment is an important part of organizations competitive environment (Aragon-Correa & Sharma 2003, 71-88). It is beneficial for organization to know in what kind of environment it functions to make it smoother to adjust to changes in the natural environment. (Starbuck 1976, 1069-1123, Dess & Beard 1984, 52-73)

2.2 Organizations Adaptation to Climate Change

Organizations adaptation to environmental changes originating from climate change is seen in this chapter through Smit, Burton, Klein and Wandel (2000, 223-251) research, where they offered three significant questions to help understand how to adapt to climate change. These questions as shown in Figure 2 are: adapt to what, who or what adapts and how does adaptation occur?

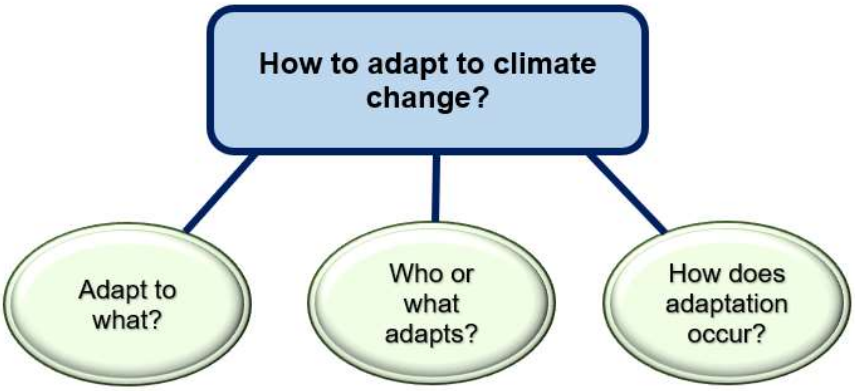

Figure 2. Three significant questions to help organization on climate change adaption planning.

2.2.1 Adapt to What

The answer to the question adapt to what in this research is extreme weather conditions resulted from climate change. According to Smit et al. (2000, 223-251) to

find out the best adaptation strategies for organization it is important to specify what kind of climate change impacts are affecting to it and to which part of the business the impacts influence. Next is defined what is climate change and what kind of negative effects it can have on businesses.

The human-influenced global warming is mainly caused by an increase in amount of emissions of greenhouse gases like carbon dioxide, methane, ozone, chlorofluorocarbons, water vapor and nitrous oxide (Casper 2009, 14) These gasses are released in atmosphere in huge amounts daily by organizations and human consuming products that are detrimental to environment. Biggest amounts of emissions that cause climate warming are made from consuming fossil fuels like petroleum, coal and natural gas (Lowry 2017, 10-11). According to Finnish Meteorological Institute, if the emission levels keep on rising at the same speed as they do now, the Earths average surface temperature will rise between two to six degrees globally by the end of this century (Finnish Meteorological Institution, 23.07.2018).

The concentration of greenhouse gasses in the Earth's atmosphere has already raised considerably above the natural level (Intergovernmental Panel on Climate Change, 2001). It seems that greenhouse gas levels will rise for the next few decades and that would result in about 0,2 Celsius degree rise in average temperature in every decade at the first half of 21st century. If greenhouse emission amounts are cut considerably then in the end of the century the temperatures rising speed would slow down. But to get there, organizations would have to make big changes in how they organize their business, how much and what kind of energy they use and make investments in sustainable solutions. (Hansen, Sato, Ruedy, Lo, Lea & Medina-Elizade 2006, 14288-14293)

Already now the climate change has affected the environment. Water has had its piece of climate change as glaciers have gotten smaller, sea level has raised, ice on rivers and lakes is leaving earlier in the spring and some of the sea ice has been lost. Also, many plants and animal ranges have shifted, and heat waves have become more intense (NASA 2018a). Shorter winters in Finland would mean less profitable seasons for businesses that rely on cold winter period, like winter sport and winter clothes

companies not no forget the negative impact it would have in Lapland's winter tourism. On the other hand, longer and warmer summer could mean wealthier times for agriculture-based businesses. A new type of crops would be possible to harvest in Finland and agricultural season could be longer, but if global warming would bring long hot and dry periods it could destroy the whole harvest leaving unprepared farmers with uncertainty about the success of each harvest season. Powerful storms have potentials to damage electric grids and lead to interruptions in energy supply. Investments in reliability of energy availability should be made to avoid harm caused to business when left out of energy (Linnenluecke, Griffiths, Winn 2012, 17-32).

According to NASA's satellite data (NASA 2008b) sea level is rising at a speed of 3,2 millimeters per year. Sea level has risen more than 200 millimeters from the year 1880. Reason for the rising sea level is extra water in the seas because of melting glaciers and a general warming of seawater that results to an expansion of water. When the water level rises, the coast is retreating closer to inland and coastal habitats of both human and animal are in danger. Cities that are built in low altitude coast are in danger of sinking underwater. Coastal municipalities could face immense costs if they would want to keep in to being inhabited. Climate change is to bring changes on the weather conditions. It can cause extreme weather conditions and if organizations don't have instructions and are not prepared for unpredictable weather phenomena they might end up with huge financial losses. Along with direct effects to organizations operations, it is advisable to evaluate also climate changes effects to organizations supply chain to ensure productions continuation. (NASA 2018b, Rosenzweig, Iglesias, Yang, Epstein & Chivian 2001, 90-104)

2.2.2 What Adapts

Smit et al.'s (2000, 223-251) next question is: who or what adapts? When analyzing adaptation, it is required to define what is adapting. This research is concentrating on examining large Finnish organizations. Organization sizes are often defined with the number of employees. A large organization is defined to have over 250 people working for them. This research uses the same classification for organization sizes. Statistics from 2016 says 0,2 % of Finnish enterprises, excluding agriculture, forestry and fishing are large organizations. Amount of large organizations is 591. Despite the small

number of large organizations, they are the biggest employer in Finland with 473 012 people working for them. Also, large organizations turnover is much higher than other organization size groups. Large organizations turnover is 160 billion euros and 42,0 % of total turnover of Finnish organizations. It is twice as much as the next biggest group medium-sized organizations. Despite small amount of large organizations, they have a large influence on Finland's economy. (Yrittäjät 2018)

2.2.3 How Does Adaptation Occur

Smit et al. (2000, 223-251) last question is: how does adaptation occur? Organizations risk management evaluation process has four stages. First organization identifies the risks and uncertainties that effect on their business negatively. In a comprehensive approach, the organization evaluates its whole value chain. Next stage is to analyze possible consequences if risks would realize. In third stage, organization would take actions to minimize risk and on the final stage organization would make plans on how to manage with residual risk. Organizational risk management requires acceptance of uncertainty. It will create a structured reaction to risk with alternative plans and solutions. (Smith 1995, 39-43)

Businesses are not preparing themselves to face natural disasters and unexpected weather conditions. Organizational decision-making can be compromised by organizations that are in denial of anything bad happening to their businesses. Before devastating weather conditions, even when management is shown statistic prove of possible business harming event to happen, many organizations won't act on to prepare for it. When extreme weather conditions have occurred to the area and organization is left unharmed the management in some cases is then viewing the situation as if the possibility for catastrophe has passed and the probabilities for a similar event to happen would be now lower. To prevent this kind of organizationally hazardous behavior, the decision-makers in organizations should carefully consider the psychological aspect of their decisions and pursue more rational decisions regarding organizations preparedness to natural disasters. Organizations could do risk evaluation and improvements to their critical business facilities and to their main suppliers to enhance business continuity. (FM Globals 2010, Staw, Sandelands & Dutton 1981, 501-524, Agrawala, Broad, Guston 2001, 454-477)

96 % of financial executives' states that their organizations have operations that are exposed to natural disasters (FM Global 2008). 80 % of respondents said that they are not very concerned about natural disaster to effect on them negatively. The supply chains of many organizations have spread all over the world. Organizations are dependent on smooth supply of goods and a natural disaster in any part of the supply chain could compromise their production and affect in customer satisfaction and organizations reputation. Organizations should adapt to climate change by being more adaptive, taking a step to a more flexible way of accepting risk and include climate change and the possibility of extreme weather into companies' corporate strategies and as part of their decision making. Because there is uncertainty in what kind of negative effects climate change can bring to companies in the future, organizations are not likely to execute large climate adaptation strategies, but it could be wise to have climate risk management process that covers climate influenced risks in case of extreme weather phenomena and permanent change in climate. (FM Global 2008, Weinhofer & Busch 2013, 121-144)

3. METHODOLOGY AND DESCRIPTION OF THE DATA

The objective of this research is to find out how significant large Finnish organizations see climate change, and have they prepared for it. The research is performed with utilization of statistical research methods. Statistical methods have been chosen because the research is done with data that includes a large group of organizations. Statistical methods are useful when research is done with big data and result and results are wanted to be more generalized. The results can be summarised with figures and statistics which helps when analyzing large information amount.

3.1 Statistical Methods

Statistical methods sub chapter introduces shortly the statistical methods that are used in this research. This chapter introduces level of measurement, correlation analysis, Sign test and Wilcoxon signed rank test. Spearman's correlation analysis, Sing test and Wilcoxon signed tests are used in chapter four to analyse relevant questions from the questionnaire. Besides these tests analysing distributions is used to examine the variables.

3.1.1 Level of Measurement

Level of measurement is telling the type of data in question. Four best-known measurement levels to measure data are nominal, ordinal, interval and ratio. (Stevens 1946, 677-680) Statistical methods that can be used are dependent on what level of measurement the data is.

In nominal scale variables are categorized only to designated classes, the order of classes is irrelevant. (Holopainen & Pulkkinen 2012, 15-16) Every variable only belongs to one class. When compared two variables the only conclusion that can be derived is whether the variables belong to the same class or not. Classes can be described with numbers, but mathematical calculations cannot be done with the numeric values. Ordinal scale variables can be arranged in classes according to their measurable feature. Like nominal also ordinal variables are not used in mathematical

calculations. Likert scale is an ordinal scale commonly used for measuring opinions and it can be treated as if it was interval scaled (Heikkilä 2014, 175). This allows a wider range of statistical analyses to be made with Likert scale. In an interval scale, the distance between variables is known. That allows some mathematical calculations to made with interval scale. The difference between interval scale and ratio scale is that interval scale doesn't have a zero point. Mathematical calculations are possible to make with ratio scale.

Goodness of the measurement can be described with two concepts: reliability and validity. (Holopainen & Pulkkinen 2012, 16-17) Reliability describes measurements ability to produce non-random results. Reliability is high if measurements results stay invariable when repeated with same or different data. Validity describes how well the study measures what it is supposed to measure. Validity's goodness is influenced by how well research problems have been made.

3.1.2 Correlation Analysis

Correlation is a statistical relationship between variables. (Holopainen & Pulkkinen 2012, 233-247) The strength of that relationship can be inspected mathematically by calculating a coefficient of correlation between variables. A correlation found between variables might propose causal relations existence, but from only correlations, it is not possible to define a causal relationship between the variables. Correlations are measured between -1 and 1. Value -1 meaning perfect negative correlation and 1 perfect positive correlation. When variables have positive correlation, they are moving to same direction. Perfect positive correlation meaning that variables move same distance to same direction. Negative correlation has the opposite effect, the measured variables are moving in the opposite directions. If correlation tests result is 0, it means that there isn't any correlation between variables. (Aldrich 1995, 364-376)

Variables level of measurement defines which correlation coefficient is to be used. (Holopainen & Pulkkinen 2012, 233-247) Pearson's correlation coefficient is the most commonly used method, but for it to be valid method the measured variables must be interval or ratio scale. If the variables level of measurement is less than interval, then Spearman's coefficient of rank correlation method can be used. Spearman's method

doesn't demand variables to be distributed normally and it is often used with data that is not normally distributed (Artusi, Verderio & Marubini 2002, 148-151). In this research, Spearman's coefficient of rank correlation is used. Spearman's correlation is a non-parametric measure and can be described as same as Pearsons correlation method between ranked variables. (Myers & Well 2003, 508)

3.1.3 Sing Test and Wilcoxon Signed Rank Test

Sing test and Wilcoxon signed rank test are used to measure if variables have the same distributions. (Metsämuuronen 2011, 1010-1020) Variables used must be at least ordinal scale and normal distribution is not required. Sing test is a simple nonparametric test that has large scale of affordance. Wilcoxon signed rank test can be used in situations where Student's t-test would be used if variables don't follow a normal distribution. The null hypothesis in these tests is that variables have the same distributions. When executing these tests with SAS Enterprise Guide 7.1 the first step of the tests is to form a new variable that is calculated as a difference between two variables used to the tests later.

3.2 Description of the Data

The data used in this research is found from Aila portal and the subject of the quantitative data is Weather and Climate Risk Management in Finnish Organisations 2015 (Gregow et al. 2015). The data was originally used for producing information and solutions for weather and climate risk management in Finnish organizations. The research data covers weather and climate effects on Finnish organizations operations and risk management, sources and functionality of weather and climate information and development of weather and climate risk preparation. Data collection was done with structured online form and in consists of cross-sectional data. Cross-sectional data is a cross-section of the study population and its collected only once. This research is continuing studying climate risk management but with a focus in large Finnish organizations. The original data included 118 organizations of which 65 are large organizations that are included in this research.

65 of the questionnaire respondents were large organizations, so data sample population used in the test is 65 if not otherwise said. From Table 1 can be seen large organizations divided into organization types. Two biggest respondent groups are private organizations with 36,9 % and public organizations with 60 %.

Table 1. Organization types of responding organizations.

	Private	Public	Society	Other
Organization (N)	24	39	1	1

The questionnaire wasn't pointed to specific industries. Figure 3 shows that large organizations that participated in the questionnaire are operating in 19 different industries. In addition, 9,2 % of the respondents answered their industry to be other than industry options provided. Three biggest industries are agriculture and forestry 13,9 %, emergency service 12,3 %, health care 12,3%. Together the three biggest industries form 38,5 % of all respondents. Seven industries have only one respondent.

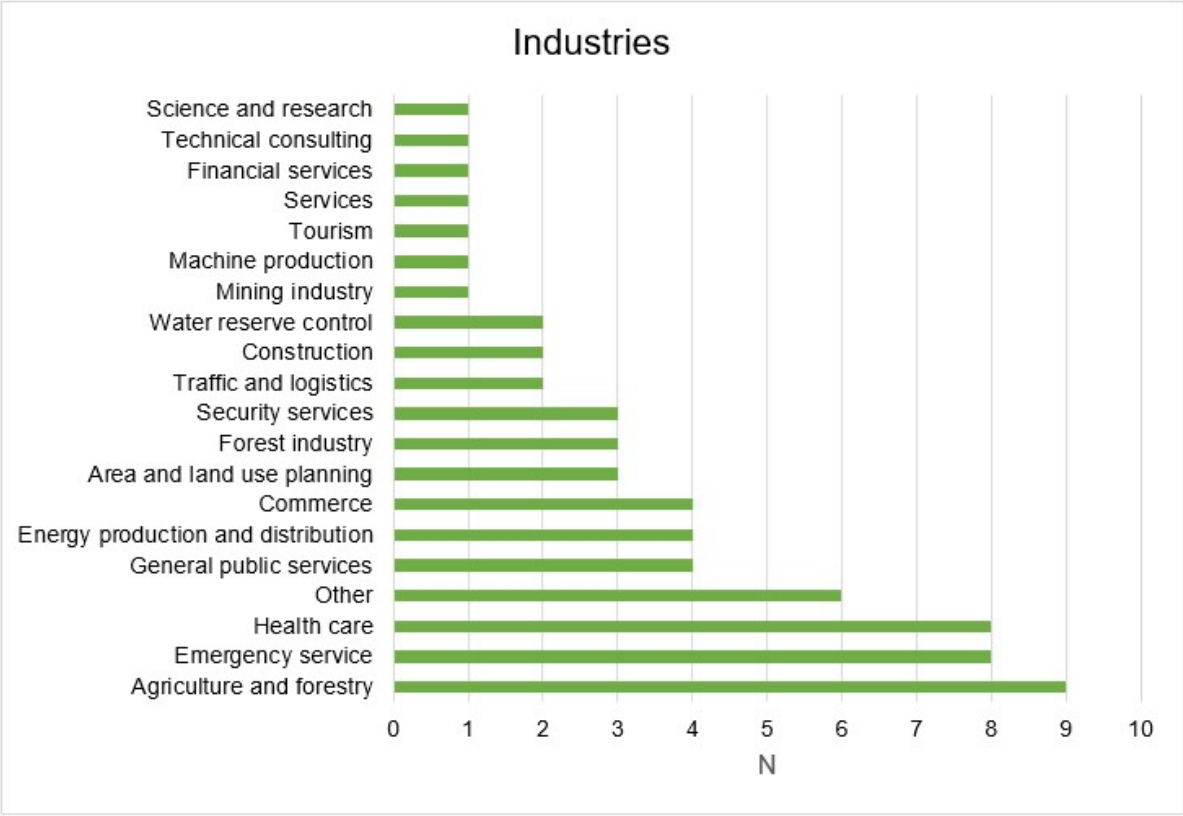

Figure 3. Variable large Finnish organizations divided in industries.

Figure 4 shows the primary area where respondent organizations are operating. In the original questionnaire, the areas were divided into regions of Finland. Because of a large number of regions compared to the amount of responding large organizations, the areas of operating used in this research are cut down to eight. Area lines used are The Regional State Administrative Agencies regions. The majority (53,9 %) of responding organizations are operating in whole Finland. 4,6 % of organizations have answered their primary operating area to be foreign countries. One organization that has answered the primary operating area to be Eastern Finland is forming 1,5 % of respondents and two organizations operating in Lapland form 3,1 % of respondents. Other four areas have each between 7,7 % to 10,8 % of participating organizations answering area to be their primary operating place.

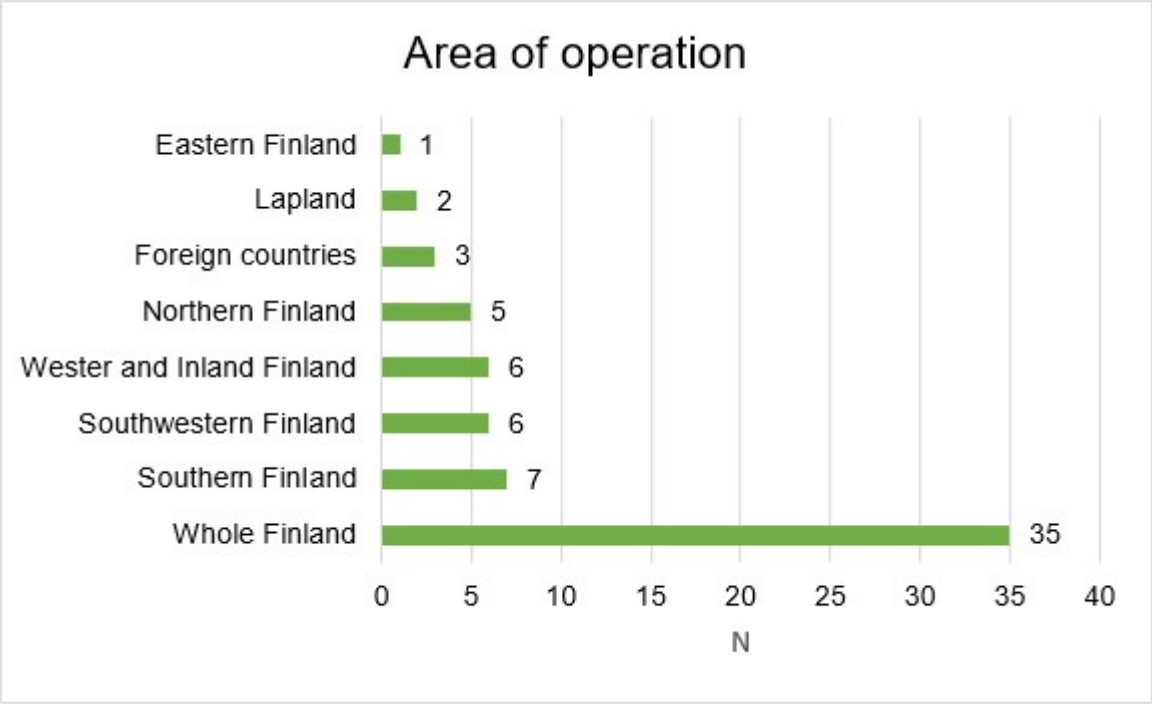

Figure 4. Area of operation of large Finnish organizations.

The questionnaire was targeted at employees who were responsible for organizations risk control. From table 2 can be seen respondents' positions in the organization. The question has four choices: specialist, middle management, top management and other. Two largest group are top management with 36,9 % and specialist with 35,4 % of respondents. 24,6 % of respondents are working in middle management and only 3,1 % answered other as their position in the organization.

Table 2. Respondents position in organization.

	Specialist	Middle management	Top management	Other
Organisation (N)	23	16	24	2

When further examined the position of respondents, the positions are divided into 12 categories of primary area of responsibilities in Figure 5. The biggest category is respondents with the primary area of responsibility as risk management with 16,9 % of answers. From that can be concluded that at least 16,9 % of large Finnish organizations that have participated in the questionnaire are doing risk management. The second most popular answer is other with 13,9 % of respondents. 12,3 % answered CEO or general director. CEO stands for a chief executive officer. Production and other operative function are the primary area of responsibility for 10,8 %. If not including the option 'other' that can hold employees from several different areas of responsibility, the top three most popular categories: risk management, CEO or general director and production and other operative function form 40 % of all large Finnish organizations that have participated in the questionnaire.

Figure 5. Questionnaire respondents and their primary area of responsibility.

4. RESEARCH RESULTS

Research results chapter is divided into three subchapters that investigate relevant data from the questionnaire used in this research. With these questions, the goal is to execute statistical analysis and tests to create a result that can answer to the research problems. Each subchapter provides all tests performed to answer one research problem. First subchapter focuses on research problem “How significant are climate change and weather phenomena resultant from it seen in large Finnish organizations?”. The second subchapter is solving research problem “Is climate change risk evaluation made in large Finnish organizations?”. And the final subchapter is examining research problem “How meaningful are climate risks compared to other kind of risks in large Finnish organizations?” Chapter 5 is combining all the results found in this chapter and answering the research problems.

4.1 Climate Changes Significance to Organizations

The research problem *“How significant are climate change and weather phenomena resultant from it seen in large Finnish organizations”* is approached with inspection of three questions from the data. In first question, the respondents are asked to evaluate how significant to organizations operations are permanent changes in the average climate of Finland such as the rise of average temperature, change in rain quantity, decrease in ice and snow coverage and changes in wind and cloud conditions. The second question investigates the same phenomena, but from aspect where climate change and weather phenomena resulted from it is to affect only outside of Finland. The third question is seeking answers to the problem which are the most harmful weather phenomena to large Finnish organizations.

Figure 6 shows how large Finnish organizations have answered the first question. The biggest group, 33,9 % of respondents answered that climate change in Finland has a significant impact on organizations operations. Only 4,6 % answered that climate change in Finland doesn’t have any impact on organizations operations. Organizations that are evaluating climate change to be between somewhat significant to very significant are making up 78,5 % of all large Finnish organizations. A big part of the

large Finnish organizations is influenced by the possible impacts of climate change on Finland.

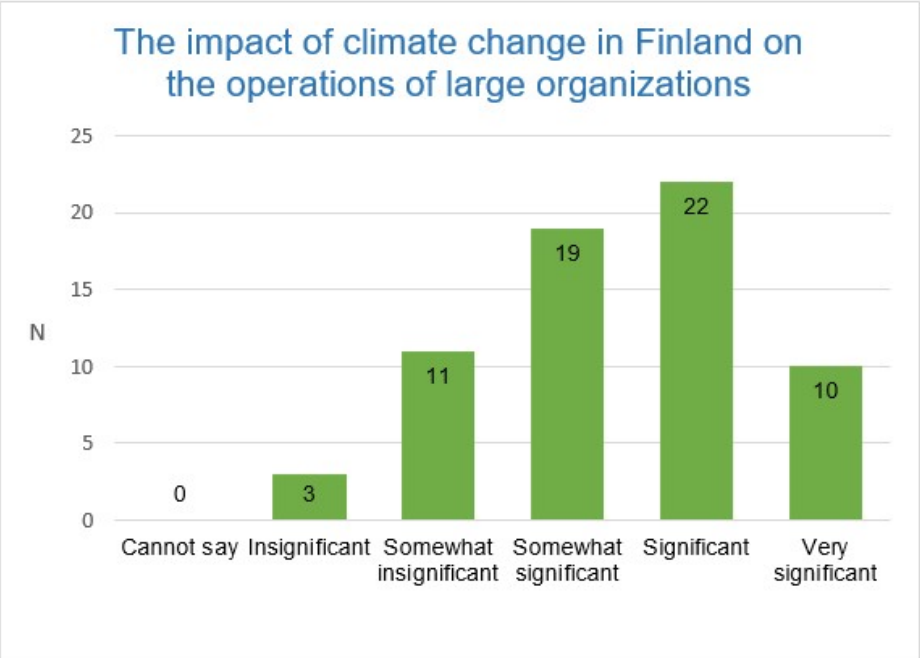

Figure 6. The impact of climate change in Finland on the operations of large Finnish organizations.

In the second question, respondents are asked to answer how significant to organizations operations are permanent changes in average climate outside of Finland such as the rise of average temperature, change in rain quantity, decrease in ice and snow coverage and changes in wind and cloud conditions. This question differs from the first one only by its effects position outside of Finland. Figure 7 shows howsignificant large Finnish organizations consider climate change and weather phenomena resulted from it outside of Finland to be to their operations. This question is missing one answer, so the data samples population is 64 instead of 65. Also, a difference to Figure 6 is that one of the respondents answered, ‘Cannot say’. Largest response rate, 26,6 %, from the respondents got category ‘Somewhat insignificant’. 18,8 % of respondents considered climate change affect outside of Finland to be insignificant. Compared to Figure 6 the percentage of how many organizations think climate change has no effect on their operations increased by 14,2 % when climate changes effect is moved away from Finland. Organizations that evaluate climate change to be between somewhat significant to very significant are making up about

half (53,1 %) of all large Finnish organizations. The result is 25,4 % lower than in case where climate change is affecting Finnish climate.

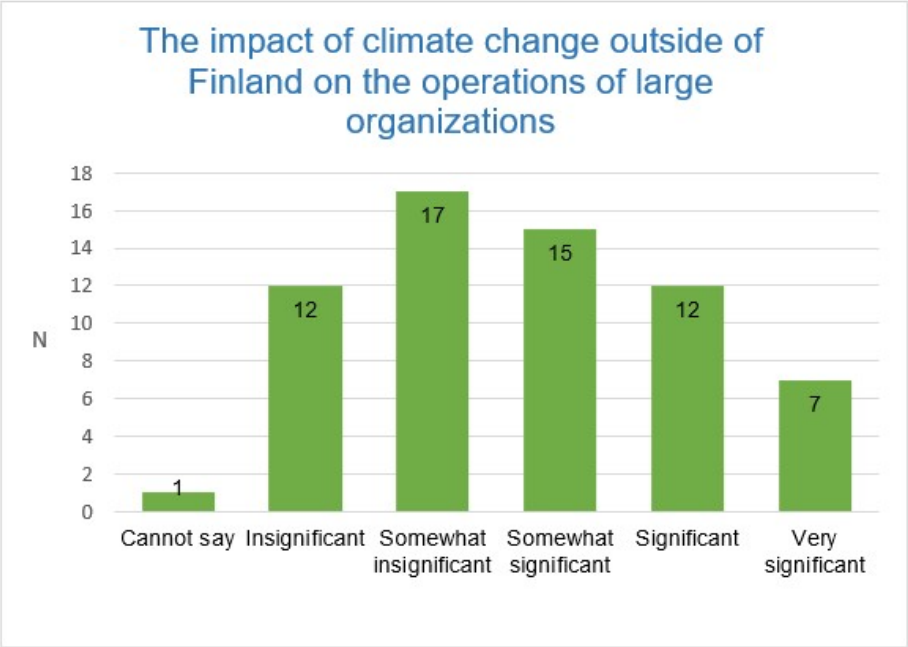

Figure 7. The impact of climate change outside of Finland on the operations of large Finnish organizations.

Tables 3 and 4 are showing summary statistics of large organizations and other size organizations in question of how significant the impacts of climate change and weather phenomena resultant from it are seen. In these summary statistics tables minimum means ‘Very significant’ and maximum means ‘insignificant’. The smaller the value is the more significant the climate change is to organizations operations. In table 3 mean value is lower in variable ‘The impact of climate change in Finland on the operations of organizations’, conforming the results of figures 6 and 7 that climate change is more significant to organizations operations when climate affects are seen in Finland. Standard deviation is also lower in the same variable compared to variable ‘The impacts of climate change outside of Finland on the operations of organizations’. When compared large and other size organizations both variables have higher mean in large organizations. Standard deviation on the other hand is, in both variables, lower in large organizations.

Table 3. Summary statistics of impacts of climate change on large organizations.

Large Organization						
Variable	Mean	Standard Deviation	Minimum	Maximum	N	Median
The impact of climate change in Finland on the operations of organizations	2.61538	1.0853039	1	5	65	3
The impact of climate change outside of Finland on the operations of organizations	3.28125	1.3149778	1	6	64	3

Table 4. Summary statistics of impacts of climate change on other size organizations.

Other Size Organizations						
Variable	Mean	Standard Deviation	Minimum	Maximum	N	Median
The impact of climate change in Finland on the operations of organizations	2.17308	1.2162487	1	6	52	2
The impact of climate change outside of Finland on the operations of organizations	3.19608	1.3859236	1	6	51	3

Third question to investigate the research problem is: Which weather conditions are most harmful for the organization? In this question the respondents could choose multiple options. Distribution of answers is seen in Table 5. The most harmful weather condition is storm wind with 17,9 % answer rate. The least harmful weather condition in hail storm, that none of the participating organizations included in most harmful weather conditions.

Table 5. Weather conditions that large Finnish organisations considered to be most harmful to them.

Most harmful weather phenomena	Organizations (N)
Storm wind	32
Flood	28
Heavy rain	26
Heat wave	16
Prolonged dryness	15
Large snow amount	13
Severe cold	10
Lightnings	10
Lack of ground frost	8
High temperature considering the season	6
Freezing rain	5
Other	5
Low tempereture considering the season	4
Lack of snow	4
Ground frost	1
Hailstorms	0

4.2 Climate Change Risk Evaluation in Organizations

The research problem: *"Is climate change risk evaluation made in large Finnish organisations?"* is examined first with Spearman's correlation analysis to find out if significance of climate change to organizations operations have correlation with organizations that are making climate risk analysis. Next the research problem is approached with examining how many large Finnish organizations are doing climate risk evaluation. Last examination for this research question is in what timespan risk evaluations are done in large Finnish organizations that are doing climate risk evaluation.

Correlation analysis is done between question: 'Impact of climate change in Finland on the operations of large organizations' and 'Is risk evaluation made in organization?'. 'Impact of climate change in Finland on the operations of large organizations' is chosen rather than the question about impacts of climate change outside of Finland, because the results from previous research problem state that Climate change in Finland is more significant that climate change in other counties. Before executing correlation analysis variable's Impact of climate change in Finland on the operations of large

organizations' values are turned around to match the scale of variable 'Is risk evaluation made in organization?'. Variables chosen for the test are ordinal scale, so the analysis is done with Spearman's correlation analysis. Because of P-value 0.1699 with risk level 0,05 is too high, results are not statistically significant. There is no correlation between the two variables. Original test report can be found from Appendix 4.

Next is examined how many of large Finnish organizations are doing climate risk evaluation. From Figure 8 can be seen that 40 % of the participating organizations have evaluated climate risk sporadically or single. Second largest group of organizations with 35 % are those who evaluate climate risks regularly. 97 % of large Finnish organizations have done climate risk evaluation. Original table analysis results can be seen from Appendix 3.

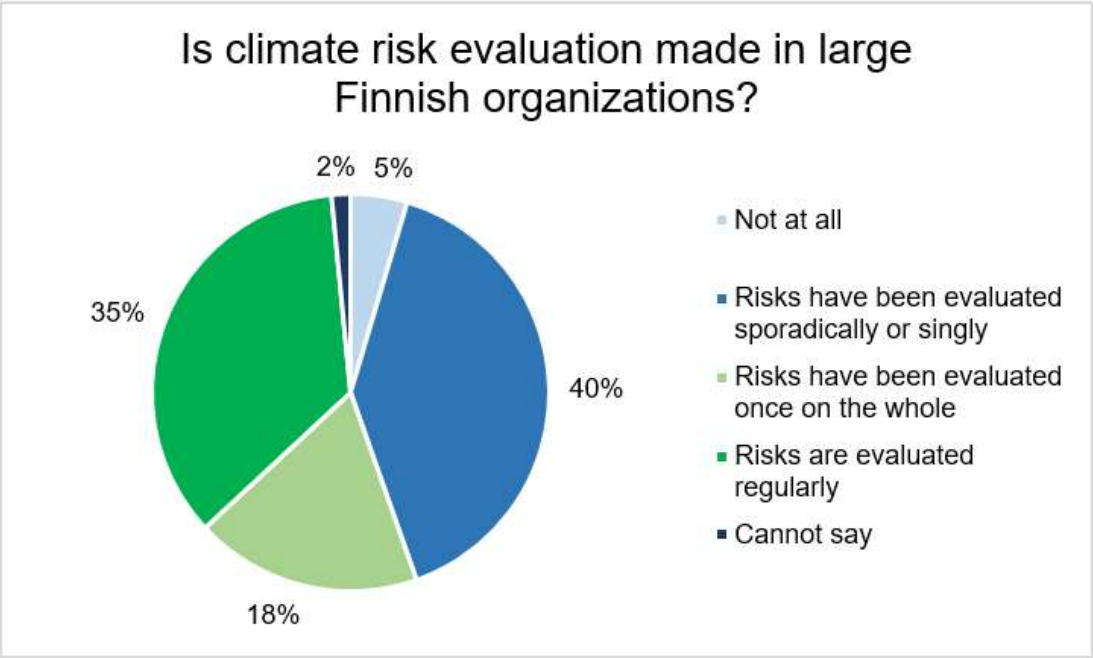

Figure 8. How many of large Finnish organizations included in this research are doing climate risk evaluation.

Last the research problem is investigated with taking large Finnish organizations that are doing climate risk evaluation regularly and finding out in what timespan those organizations are doing risk evaluation. Of all 65 large Finnish organization 19 organizations are doing climate risk evaluation regularly. In the question 'In what

timespan risk evaluation is done?' participation organizations can choose multiple options. The question is not only measuring climate risk evaluation but all risk evaluations that organizations are making. Table 6 shows how organizations have answered. Most common answer was that risk evaluation is done in less than five years timespan. Longer the timespan is the less popular the answer is among respondents. On 'Oven 50 years' timespan only three on the participating organizations are doing risk evaluation. Original test result can be found from Appendixes 5-9.

Table 6. In what timespan risk evaluation is done in large Finnish organizations that are doing climate risk evaluation regularly.

Timespan	Less than 5 years	5-10 years	10-15 years	Over 20 years	Over 50 years
Organizations (N)	18	12	6	4	3

4.3 Organizations Thoughts on Climate Risks Compared to Other Risks

The research problem: *"How meaningful are climate risks compared to other kind of risks in large Finnish organizations?"* is first approached with testing correlations. Next is examined are climate risks as meaningful as other kind of risks in large Finnish organizations.

Correlation analysis is used to find out if organizations that answered to have high impact of climate change in Finland on their operations have also answered that climate risk compared to other risks that organization must take is high. With analysing correlations, it is important to remember that correlations don't measure causality. Before executing correlation analysis variable's 'The impact of climate change in Finland on the operations of large Finnish organizations' values are turned around to equal the value presentation of variable 'How big is climate risk compared to other risks that organization must take'. Only large organizations are taken into the test.

Correlation analysis is done with 5 % risk level and Spearman's Correlation test. Spearman's correlation analysis is chosen because the variables used are ordinal scale. Table 7 shows that P-value is lower than acknowledged risk level. From that can be concluded that there is correlation between 'The impact of climate change in Finland

on the operations of large Finnish organizations' and 'How big is climate risk compared to other risks that organization must take. Correlation coefficient 0,47534 is moderate correlation.

Table 7. Correlation table of 'the impact of climate change in Finland on the operations of large Finnish organizations' and 'how big is climate risk compared to other risks that organization must take'.

The impact of climate change in Finland on the operations of large Finnish organizations	
How large is climate risk compared to other risks that organization must take	Spearman Correlation: 0,47534
	P-value: <.0001

Next is tested if variables distributions are the same. Because variables are ordinal scale the chosen tests are Sing test and Wilcoxon signed rank test. Sign test and Wilcoxon signed rank test are used to examine are climate risks as meaningful as other kind of risks in large Finnish organizations. H=0 is that climate risks are as meaningful as other kind of risks in large Finnish organizations. P-value in both tests is <.0001 so null hypothesis is rejected, climate risks are not as meaningful as other kind of risks in large Finnish organizations. See Appendix 10 for original test results.

Summary statistics is executed to compare means and medians. Summary statistics is done to variables 'the impact of climate change in Finland on the operations of large Finnish organisations' and 'how large is climate risk compared to other risks organization must take'. Turned variable 'the impact of climate change in Finland on the operations of large Finnish organisations' is used in the summary statistics to make both variables values matching. Both variables include only large organizations. Table 8 shows that median of first variable is 3. Value 3 means 'somewhat significant'. With mean being between 'somewhat significant' and 'significant'. Second variable has a medium 2 which means 'small'. Mean is 2.64615 which is closer to value meaning 'as meaningful' than value 'small'. From these means and medians can be resulted that large Finnish organizations see impact of climate change in Finland to be between somewhat significant and significant but compared to other risks that organizations must take climate risks are something between small and as meaningful. Climate risks

are a bit smaller than other risk to organizations. See Appendix 11 for original test results.

Table 8. Summary statistics

Variable	Mean	Std Dev	Minimum	Maximum	N	Median
The impact of climate change in Finland on the operations of large Finnish organizations	3.38462	1.0853	1	5	65	3
How large is climate risk compared to other risks that organization must take	2.64615	0.92586	1	5	65	2

Figure 9 shows how respondents have answered to question 'How meaningful are climate risks compared to other risks that organizations have to take. The respondents taken in to this test are all 65 large Finnish organizations. By far the largest group of organizations 53,9 %, answered that climate risks are small compared to other risks they must take. Still 43,1 % of organizations consider climate risks to be as meaningful or larger than other risks they must take.

Figure 9. How large is climate risk compared to other risks that organization must take?

5. CONCLUSIONS

Conclusions chapter combines togethers research results found in chapter 4. In this chapter the research problems are answered and connected with theory. The research problem is *"Are large Finnish organizations prepared for climate change's effects?"* This problem is solved by answering to sub questions. The three sub questions are: *"How significant are climate change and weather phenomena resultant from it seen in large Finnish organizations?", "Is climate change risk evaluation made in large Finnish organizations?"* and *"How meaningful are climate risks compared to other kind of risks in large Finnish organizations?*

"How significant are climate change and weather phenomena resultant from it seen in large Finnish organizations? ":

Large Finnish organizations consider climate change and weather conditions resultant from it that are influencing Finland more significant than those affecting abroad. As only 4,6 % of participating organizations primary operation area is abroad it might be the reason why organizations consider the impact of climate change outside of Finland to be less significant than climate change that is influencing Finland. Because of the primary operation area for most of the organizations is inside Finland borders most of the organizations operations are not directly influenced by changed weather conditions. If considered from the aspect of whole value chain, climate change affected weather phenomena abroad can still influence on how smoothly Finnish organizations are capable of handling operations. As some of the suppliers can operate on an area where extreme weather conditions are happening.

Climate changes influences on Finland are considered significant by respondent organizations. 33,9 % answered that climate change that affects Finland has significant impact on the organizations operations and only 4,6 % of respondents answered that it doesn't have any impact on their operations. Climate changes possible effects to organizations operations are well recognised, but as 18,8 % of respondents answered that climate changes effects on weather phenomena outside

of Finland is insignificant, it might mean that these organizations don't have any operations or suppliers abroad or that they have not considered the possible effects that changed weather conditions might bring to organization. More information to organizations about how changed climate conditions abroad can affect on their operation might be relevant.

"Is climate change risk evaluation made in large Finnish organizations?"

Climate risk evaluation helps organizations to be prepared if climate conditions change. Climate risk evaluation is beneficial because it helps organizations determine in what kind of natural environment they are functioning. If risk evaluation reveals harmful changes in climate that might affect on business, then as described in the theory chapter, contingency theory explains that in changing environment organizations must change their structure to fit into new conditions and keep operating at their best (Aldrich & Marsden 1988, 367). In these research results the higher the impact of climate change in Finland to the operations of organizations is does not correlate with are the organizations doing climate risk evaluation. If operating according to contingency theory, those organizations that consider climate changes impacts higher should do climate risk evaluation to collect the benefits of early adapter. The approach of not evaluating environment for high impact change might lead to more profitability to the organizations that have familiarized themselves to all possibilities and have a strategy to work with if changes occur.

35 % of large Finnish organizations are doing climate risk evaluation regularly and only 5 % of respondents are not doing climate risk evaluations at all. 41,9 % of large Finnish organizations that are doing climate change evaluation regularly answered that risk evaluation is done in less than 5-year timespan. It is to be noticed that risk evaluation timespan includes also other than climate risk, so it is not certain that all of organizations that answered are also doing climate risk evaluation on the same time span. Compared to FM Globals (2010) research that shows that businesses are not preparing themselves to face natural disasters and unexpected weather conditions, large Finnish organizations seem to be better prepared at least according to how many of large Finnish organizations are doing climate risk evaluation.

Continuous climate risk evaluation gives organizations head start compared to their competitors if climate conditions are changed. It gives organizations possibility to notice early the business risks rising from changed climate conditions. If climate risk evaluation is done to the whole value chain it is easier to see upcoming climate risks that have indirect effects, for example to organizations supply chain, that might be hard to notice without risk evaluation.

"How meaningful are climate risks compared to other kind of risks in large Finnish organizations?"

Tests resulted that biggest group of large Finnish organizations consider climate risks less significant than other risks they must take. 5,9 % of respondents answered climate risk to be small or non-existent. Still 43,1 % of organizations consider climate risks to be as meaningful or larger than other risks they must take. There is a correlation between how significant the impact of climate change in Finland on the operations of large Finnish organizations is and how big is climate risk compared to other risks that organization must take. It means that the more significant organizations consider climate change's affects to Finland's climate to be the more significant they consider climate risk to be compared to other risk they must take. Though it doesn't necessarily mean that there is a causal connection.

While emissions that cause climate change are polluted already, the impacts of climate change on operations of large Finnish organizations are realized mostly in future (Finnish Meteorological Institution, 23.07.2018). This might effect on why organizations consider other kind of risks they must take more significant than climate risks. When the amount of organizations that are doing climate risk evaluation is used as measurement for preparedness, compared to previous studies large Finnish organizations seem to be better prepared for climate change. While organizations seem to be aware of climate change as a risk to their operations, it is still seemingly less recognised that weather phenomena abroad caused by climate change could have indirect impacts to organizations operations. Large Finnish organizations could benefit on additional information on how changes in climate abroad could impact on their operations.

This research was executed with questionnaire that has a population 65 large Finnish organizations. The data size was somewhat small and to increase researches reliability, the study could be repeated with a larger population. Research on this subject could be continued by doing a deeper investigation on how climate risk evaluations is executed on large Finnish organizations. Also, a good point of view for further studies is why large Finnish organizations see climate change's effects abroad to be less significant than climate changes effects in Finland. Is it because lack of supply chain that reaches outside of Finland, possibility to fast change suppliers if necessary or lack of knowledge on how climate change could influence on organizations operations even from a far distance?

BIBLIOGRAPHY

Agrawala, S., Broad, K., Guston, D., H. (2001) Integrating Climate Forecasts and Societal Decision Making: Challenges to an Emergent Boundary Organization. *Science, Technology, & Human* Values 26, 4, 454-477.

Aldrich, H., E., Marsden, P., V. (1988) Environments and Organizations. In: Handbook of sociology. Smelser, N. (ed.). Newbury Park, Sage.

Aldrich, J. (1995) Correlations Genuine and Spurious in Pearson and Yule. *Statistical Science* 10, 4, 364-376.

Aragon-Correa, J., A., Sharma, S. (2003) A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review* 28, 1, 71-88.

Artusi, R., Verderio, P., Marubini, E. (2002) Bravais-Pearson and Spearman correlation coefficients: meaning, test of hypothesis and confidence interval. *The International Journal of Biological Markers* 17, 2, 148-151.

Casper, J. K. (2009) Greenhouse gasses: worldwide impacts (global warming). New York, Facts On File.

Dess, G., G., Beard, D., W. (1984) Dimensions of Organizational Task Environments. *Administrative Science Quarterly* 29, 1, 52-73.

Finnish Meteorological Institution (19.07.2018) Ilmiö [www document]. [Accessed 23.07.2018]. Available: http://ilmasto-opas.fi/en/ilmastonmuutos/ilmio

FM Global (2008) The 2008 natural disaster business risk study. Windsor, FM Insurance Company Limited.

FM Global (2010) Flirting with natural disasters: Why companies risk it all. Windsor, FM Insurance Company Limited.

Gregow, Hilppa (Ilmatieteen laitos) & Haavisto, Riina (Ilmatieteen laitos) & Harjanne, Atte (Ilmatieteen laitos) & Luhtala, Sanna (Ilmatieteen laitos) & Mäkelä, Antti (Ilmatieteen laitos) & Tuomenvirta, Heikki (Ilmatieteen laitos) & Halonen, Mikko (Gaia Consulting Oy) & Raivio, Tuomas (Gaia Consulting Oy) & Hildén, Mikael (Suomen ympäristökeskus (SYKE)) & Jakkila, Juho (Suomen ympäristökeskus (SYKE)) & Parjanne, Antti (Suomen ympäristökeskus (SYKE)) & Peltonen-Sainio, Pirjo (Luonnonvarakeskus) & Kollanus, Virpi (Terveyden ja hyvinvoinnin laitos) & Lanki, Timo (Terveyden ja hyvinvoinnin laitos) & Miettinen, Ilkka (Terveyden ja hyvinvoinnin laitos) & Haanpää, Simo (Helsingin yliopisto) & Juhola, Sirkku (Helsingin yliopisto) & Jurgilevich, Alexandra (Helsingin yliopisto) & Räsänen, Aleksi (Helsingin yliopisto): Sää- ja ilmastoriskien hallinta organisaatioissa 2015 [sähköinen tietoaineisto]. Versio 1.0 (2016-05-17). Yhteiskuntatieteellinen tietoarkisto [jakaja]. http://urn.fi/urn:nbn:fi:fsd:T-FSD3105

Hansen, J., Sato, M., Ruedy, R., Lo, K., Lea, D., W., Medina-Elizade, M. (2006) Global temperature change. *Proceedings of the National Academy of Sciences of the United States of America* 103, 39, 14288-14293

Heikkilä, T. (2014) Tilastollinen tutkimus. Helsinki, Edita.

Holopainen, M., Pulkkinen, P. (2012) Tilastolliset menetelmät. 5th-7th ed. Helsinki, Sanoma Pro Oy.

Intergovernmental Panel on Climate Change (2001) Climate Change 2001: Third Assessment Report (Volume II), Impacts, Vulnerability and Adaptation. Cambridge, Cambridge University Press.

Lawrence, P., R., Lorsch, J., W. (1967) Differentation and Integration in Complex Organizations. *Administrative Science Quarterly* 12, 1, 1-47.

Linnenluecke, M., K., Griffiths, A., Winn M., I. (2012) Extreme weather events and the critical importance of anticipatory adaption and organizational resilience in responding to impacts. *Business Strategy and the Environment* 21, 1, 17-32.

Lowry, J. (2017) Avoiding carbon apocalypse through alternative energy. Cham, Springer International Publishing.

Metsämuuronen, J. (2011) Tutkimuksen tekemisen perusteet ihmistieteissä. Researcher edition. 4th ed. e-book 1st ed. Helsinki, International Methelp Oy.

Myers, J., L., Well, A., D. (2003). Research Design and Statistical Analysis. 2nd ed. New Jersey, Lawrence Erlbaum Assosiates.

NASA (2018a) Effects [www document]. [Accessed 27.07.2018]. Available: https://climate.nasa.gov/effects/

NASA (2018b) Sea level [www document]. [Accessed 28.07.2018]. Available: https://climate.nasa.gov/vital-signs/sea-level/

Puusa, A., Reijonen, H., Juuti, P., Laukkanen, T. (2015) Akatemiasta markkinapaikalle: johtaminen ja markkinointi aikansa kuvina. 6th ed. Helsinki, Talentum.

Rosenzweig, C., Iglesias, A., Yang, X., B., Epstein, P., R., Chivian (2001) Climate Change and Extreme Weather Events; Implications for Food Production, Plant Diseases, and Pests. *Global Change and Human* Health 2, 2, 90-104.

Ruosteenoja, K. (2011) Miten ja miksi ilmasto muuttuu? In: Virtanen, A. & Rohweder, L. (ed.) Ilmastonmuutos käytännössä hillinnän ja sopeutumisen keinoja. Helsinki, Gaudeamus Helsinki University Press.

Smit, B., Burton, I., Klein, R., J., T., Wandel, J. (2000) An Anatomy of Adaptation to Climate Change and Variability. *Climatic Change* 45, 223-251.

Smith, N., J. (1995) Engineering Project Management. 2nd ed. Oxford, Blackwell Science.

Starbuck, W., H. (1976) Organisations and Their Environments. In: Dunnette, M., D. (ed.) Handbook of Industrial and Organizational Psychology. Chicago, Rand McNally.

Stevens, S., S. (1946) On the Theory of Scales of Measurement. *Science* 103, 2684, 677-680.

Staw, B., M., Sandelands, L., E., Dutton, J., E. (1981) Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis. *Administrative Science Quarterly* 26, 4, 501-524

Tosi, H., L., Slocum, J., W. (1984) Contingency Theory – Some Suggested Directions. *Journal of Management* 10, 1, 9-26.

Yrittäjät (2018) Enterprises support Finland and increase well-being. [www document]. [Accessed 09.08.2018] Available https://www.yrittajat.fi/sites/default/files/yrittajyyskalvot_2018_en.pdf

Weinhofer, G.,Busch, T. (2013) Corporate strategies for managing climate risks. *Business Strategy and the Environment* 22, 121-144.

APPENDICES

Appendix 1. The impact of climate change in Finland (q9_7) on the operations of large Finnish organizations (largeOrganization 0) and other size Finnish organizations (largeOrganization 1).

Table Analysis

Results

The FREQ Procedure

Table of largeOrganization by q9_7								
		q9_7						
		1	2	3	4	5	6	Total
largeOrganization								
0	Frequency	17	20	9	2	3	1	52
1	Frequency	10	22	19	11	3	0	65
Total	Frequency	27	42	28	13	6	1	117
Frequency Missing = 1								

Appendix 2. The impact of climate change outside of Finland (q9_8) on the operations of large (largeOrganization 0) and other size Finnish organizations (largeOrganization 1).

Table Analysis

Results

The FREQ Procedure

Table of largeOrganization by q9_8								
		q9_8						
		1	2	3	4	5	6	Total
largeOrganization								
0	Frequency	4	17	8	11	9	2	51
1	Frequency	7	12	15	17	12	1	64
Total	Frequency	11	29	23	28	21	3	115
Frequency Missing = 3								

Appendix 3. Is risk evaluation made (q14) in large Finnish organizations (largeOrganization 0) and other size Finnish organizations (largeOrganization 1).

Table Analysis

Results

The FREQ Procedure

Table of largeOrganization by q14							
		q14					
		1	2	3	4	5	Total
largeOrganization							
0	Frequency	2	23	6	19	1	51
1	Frequency	3	26	12	23	1	65
Total	Frequency	5	49	18	42	2	116
Frequency Missing = 2							

Appendix 4. Correlation of 'Impact of climate change in Finland on the operations of large organizations' (q9_7_turned) and 'Is risk evaluation made in organization' (q14).

Correlation Analysis

The CORR Procedure

largeOrganization=1

2 Variables:	q14	q9_7_turned

Simple Statistics						
Variable	N	Mean	Std Dev	Median	Minimum	Maximum
q14	65	2.89231	1.00192	3.00000	1.00000	5.00000
q9_7_turned	65	3.38462	1.08530	3.00000	1.00000	5.00000

Pearson Correlation Coefficients, N = 65 Prob > |r| under H0: Rho=0		
	q14	q9_7_turned
q14	1.00000	0.19675
		0.1162
q9_7_turned	0.19675	1.00000
	0.1162	

Spearman Correlation Coefficients, N = 65 Prob > |r| under H0: Rho=0		
	q14	q9_7_turned
q14	1.00000	0.17230
		0.1699
q9_7_turned	0.17230	1.00000
	0.1699	

Appendix 5. Large organizations that do risk evaluation (SummamuuttujaSuuriYritysJaRiskiEvaluaatioTehtySaannollisesti) in less than five-year timespan (q15_1).

Table Analysis
Results
The FREQ Procedure

Table of Summamuuttuja by q15_1				
		q15_1		
		0	1	Total
Summamuuttuja(SuuriYritysJaRiskiEvaluaatioTehtySaannollisesti)				
2	Frequency	5	18	23
Total	Frequency	5	18	23
Frequency Missing = 95				

Appendix 6. Large organizations that do risk evaluation (SummamuuttujaSuuriYritysJaRiskiEvaluaatioTehtySaannollisesti) in 5-10-year timespan (q15_2).

Table Analysis
Results
The FREQ Procedure

Table of Summamuuttuja by q15_2				
		q15_2		
		0	1	Total
Summamuuttuja(SuuriYritysJaRiskiEvaluaatioTehtySaannollisesti)				
2	Frequency	11	12	23
Total	Frequency	11	12	23
Frequency Missing = 95				

Appendix 7. Large organizations that do risk evaluation (SummamuuttujaSuuriYritysJaRiskiEvaluaatioTehtySaannollisesti) in 10-20-year timespan (q15_3).

Table Analysis

Results

The FREQ Procedure

Table of Summamuuttuja by q15_3				
		q15_3		
		0	1	Total
Summamuuttuja(SuuriYritysJaRiskiEvaluaatioTehtySaannollisesti)				
2	Frequency	17	6	23
Total	Frequency	17	6	23
Frequency Missing = 95				

Appendix 8. Large organizations that do risk evaluation (SummamuuttujaSuuriYritysJaRiskiEvaluaatioTehtySaannollisesti) over 20-year timespan (q15_4).

Table Analysis

Results

The FREQ Procedure

Table of Summamuuttuja by q15_4				
		q15_4		
		0	1	Total
Summamuuttuja(SuuriYritysJaRiskiEvaluaatioTehtySaannollisesti)				
2	Frequency	19	4	23
Total	Frequency	19	4	23
Frequency Missing = 95				

Appendix 9. Large organizations that do risk evaluation (SummamuuttujaSuuriYritysJaRiskiEvaluaatioTehtySaannollisesti) over 50-year timespan (q15_5).

Table Analysis

Results

The FREQ Procedure

Table of Summamuuttuja by q15_5				
		q15_5		
		0	1	Total
Summamuuttuja(SuuriYritysJaRiskiEvaluaatioTehtySaannollisesti)				
2	Frequency	20	3	23
Total	Frequency	20	3	23
Frequency Missing = 95				

Appendix 10. Sign test and Wilcoxon signed rank test to test if climate risks are as meaningful as other kind of risks in large Finnish organizations. (the impact of climate change in Finland on the operations of large Finnish organizations = q9_7_turned, how big is climate risk compared to other risks that organization must take = q19)

Distribution analysis of: Calculation(q19-q9_7_turned)

The UNIVARIATE Procedure
Variable: Calculation(q19-q9_7_turned)

largeOrganization=1

Tests for Location: Mu0=0				
Test	Statistic		p Value	
Student's t	t	-5.51619	Pr > |t|	<.0001
Sign	M	-15	Pr >= |M|	<.0001
Signed Rank	S	-429.5	Pr >= |S|	<.0001

Appendix 10. Summary statistics of 'the impact of climate change in Finland on the operations of large Finnish organizations' (q9_7_turned) and 'how big is climate risk compared to other risks that organization must take' (q19).

Summary Statistics

Results

The MEANS Procedure

largeOrganization=0

Variable	Mean	Std Dev	Minimum	Maximum	N	Median
q9_7_turned	3.9423077	1.1274379	1.0000000	6.0000000	52	4.0000000
q19	3.0769231	1.1856355	1.0000000	5.0000000	52	3.0000000

largeOrganization=1

Variable	Mean	Std Dev	Minimum	Maximum	N	Median
q9_7_turned	3.3846154	1.0853039	1.0000000	5.0000000	65	3.0000000
q19	2.6461538	0.9258572	1.0000000	5.0000000	65	2.0000000