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Central Finland's forestry cluster's response for the transition from plastic economy to more sustainable solutions

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Bachelor's thesis
May 2020
School of Business
Degree Programme in International Business

Jyväskylän ammattikorkeakoulu
JAMK University of Applied Sciences

jamk.fi

Description

Author(s)	Type of publication	Date
Ahonen, Iida	Bachelor's thesis	May 2020
		Language of publication: English
	Number of pages: 34	Permission for web publication: x

Title of publication

Central Finland's forestry cluster's response for the transition from plastic economy to more sustainable solutions

Degree programme

International Business

Supervisor(s)

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Assigned by

JAMK Centre for Competitiveness

Abstract

Transition from plastic economy to more sustainable solutions has been happening for years now and the Central Finland's forestry cluster has experienced changes due to it. The transition has started to become increasingly apparent to the general public.

The purpose of the research was to define what changes Central Finland's forestry cluster has implemented for the transition. Forestry is a noticeable part of Central Finland and its economy.

In the research, the different spheres of the forestry cluster were researched: the university, industry, government, and the hybrid organizations. The approach to this research was qualitative. The information was gathered from secondary sources, like news articles and publications, as well as from primary sources like interviews.

The results exhibited that the Central Finland's forestry cluster has responded to the transition in various different ways. The industry sphere has reacted strongly by investing in research and developing new products. The government sphere has responded, for example, by making new policies and directing funding. The education sphere has responded by making research on the topic as well as adapted their educational offering with the transition. The hybrid organizations have conducted a lot of research as well as developed new products to the market.

Keywords/tags (subjects)

Sustainability, forestry, plastic economy, Central Finland

Miscellaneous

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Kuvailulehti

Tekijä(t)	Julkaisun laji	Päivämäärä
Ahonen, Iida	Opinnäytetyö, AMK	Toukokuu 2020
	Sivumäärä 34	Julkaisun kieli Englanti
		Verkkojulkaisulupa myönnetty: x

Työn nimi
Keski-Suomen metsätalousrykelmän vastaus muutokseen muovitaloudesta kestävämpiin vaihtoehtoihin

Tutkinto-ohjelma
Kansainvälinen liiketalous

Työn ohjaaja(t)
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Toimeksiantaja(t)
JAMK Centre for Competitiveness

Tiivistelmä

Muutos muovitaloudesta kestävämpiin vaihtoehtoihin on ollut käynnissä jo hetken aikaa, ja Keski-Suomen metsätalousrykelmä on nähnyt muutoksia sen takia. Muutos on alkanut myös tulla yhä ilmeisemmäksi yleisölle. Tutkimuksen tarkoitus oli määritellä, mitä muutoksia Keski-Suomen metsätalousrykelmä on tehnyt muutoksen eteen. Metsätalous on näkyvä osa Keski-Suomea ja sen taloutta.

Tutkimuksessa tutkittiin metsätalousrykelmän eri toiminta-alueita: yliopistoa, elinkeinoelämää, hallintoa sekä hybridiorganisaatioita. Tutkimuksen näkökulma oli laadullinen. Tietoa tähän tutkimukseen kerättiin sekundäärisistä lähteistä, kuten uutisartikkeleista ja julkaisuista sekä primäärilähteistä, kuten haastatteluista.

Tutkimuksen tulokset näyttävät, että Keski-Suomen metsätalousrykelmä on vastannut muutokseen useilla eri tavoilla. Elinkeinon toiminta-alue on vastannut vahvasti investoimalla tutkimukseen ja kehittämällä uusia tuotteita. Hallinto on reagoinut esimerkiksi tekemällä muutoksia heidän linjauksiinsa sekä ohjaamalla rahoitusta. Yliopiston toiminta-alue on vastannut tuottamalla tutkimustyötä sekä mukailemalla heidän koulutustarjontaansa muutoksen mukana. Hybridiorganisaatiot ovat tuottaneet paljon tutkimustyötä ja uusia tuotteita markkinoille.

Avainsanat (asiasanat)
Kestävyys, metsätalous, muovitalous, Keski-Suomi

Muut tiedot

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1 Introduction

The objective of this research is to find out the different ways that the Central Finland's forestry cluster has responded to the starting transition from plastic economy to more sustainable solutions.

1.1 Background

Global warming and plastic gathering in oceans have gotten research facilities around the world to start looking for alternative options for oil. Research facilities have, for example, found ways to use pulp to make plastic-like material. (Tornberg 2018) Use of pulp, a renewable natural resource, instead of oil, a non-renewable resource, saves nature and creates more sustainable solutions.

Figure 1 – The location of Central Finland (Google Maps, Map image n.d.)

Central Finland is one of Finland's provinces. It is located in the middle of Finland and its land area is 19 949 square kilometers, forests cover 69 per cent of its area, inland waters cover 16 per cent of its total area. Central Finland holds 7 per cent of the entire forest land area in Finland and 9 per cent of Finland's inland waters. There are 5

national parks in Central Finland. The bioproduct factory located in Äänekoski, Central Finland is the larges investment in the history of Finnish forest industry. (Keski-Suomi – Me teemme itsestämme numeron!, Tilastotietoa ja tunnuslukuja Syksy 2019 2019) Central Finland is strongly specialized in forest- and metal industries. The share of jobs in the forestry sector is double compared to that of Finland as a whole. Other forestry related fields are also a big employer in Central Finland. The share of jobs in the wood industry is over 1.75 times higher than in Finland as a whole and the paper industry and printing is over 1.5 times higher. (Keski-Suomi ennakoi – Tilasto- ja ennakointitietoa Keski-Suomesta, Vahvuusalat 2020)

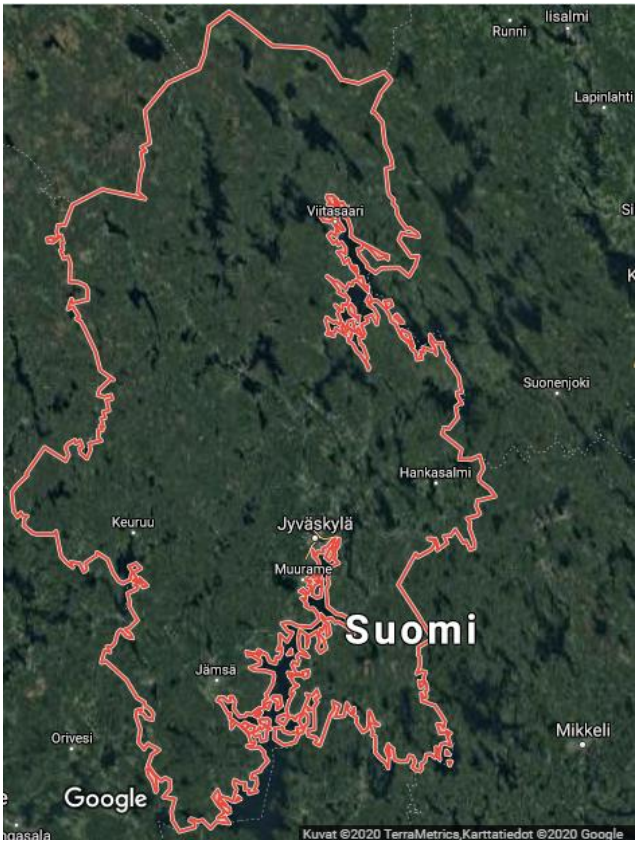

Figure 2 – Satellite picture of Central Finland (Google Maps, Satellite Image n.d.)

Finland's land area is 69 per cent covered in forests. 89 per cent of the forests 78 million square meters cut annually goes to forest industry and the 11 per cent goes for energy, meaning firewood for small houses or wood chips for heating and power plants. The forests in Finland are mainly owned by private individuals or families.

(Suomen metsävarat 2019) Due to Finland's location in Northern-Europe the trees that grow in Finland have to be adjusted to cold and long winters and short growing seasons. The short growing season slows down the forestry cluster's activities. The three main trees that grow in Finland are pine fir and birch. In the northern areas of Finland conifers are the most common trees due to the climate. Birch trees are more common in the southern Finland.

The strengths for Central-Finland's forestry cluster include the education on bioeconomy related fields, research institutes, companies working in bioeconomy, and the help from the public sector. The obstacles for the bioeconomy cluster include legislation, directives, policies, economical uncertainty, lack or resources, administrative structures and missing common strategy. To improve the bioeconomy cluster's success there should be more collaboration between organizations like research and educational institutes, capital providers, government and public agencies. (Poranen 2015, 85–88)

1.2 Motivation for research

Plastic is vital for humans since it is utilized by most industries, like the medicine, food and vehicle industries. The plastic creates a problem due to the way it is produced and used. Plastic ending up in the oceans, rivets, coasts, beaches and lands after use is a global problem. (Desai & Sidhu 2018)

Humans can ingest microplastic from shellfish, sugar, honey, German beer and other groceries. The air is also filled with microplastic, where it can then be inhaled by humans. People working in the textile industry have been reported having plastic fibers in their lungs where they can cause different diseases. The full extent of the repercussions that ingesting or inhaling plastic are still unknown. (Kelly & Wright 2017)

Plastic can take 20 to 600 years to decompose. Plastic bags take 20 years to decompose while straws take 200 years and plastic bottles take 450 years. Fishing line takes 600 years to decompose. Even though plastic bags take less time to decompose than

some of the other examples they are eaten by different marine wildlife creating other threats to the environment. According to estimations 60 to 70 per cent of plastic that ends up in oceans sinks to the bottom, breaks to pieces and mixes in with the plankton, an important part of the marine food chain. It was estimated that only 7.7. million tons of the 15 million tons of waste that ended up in landfill sites was biodegradable. There is 8.3 billon tons of plastic produced in the world. An estimated 6.3 billion tons of plastic waste generated, 79 per cent of which is accumulated in landfills or natural environment, 9 per cent is recycled and 12 per cent is incinerated. (Kirk, Mills, Molloy & Wright 2018)

The issues with the environment have always interested me and I'm always curious to learn new things we can do to make sure that the planet will remain as a place where all animals and plants can live in. Also coming from Central Finland, I have grown up surrounded by forests and I want to learn more about how the forests can be utilized sustainably. I want to learn more about the ways that forests can be used to replace some of the plastic products we use.

1.3 Research questions

The research question:

How has the central Finland's forestry cluster responded to the transition from plastic economy to more sustainable solutions?

The research will be qualitative. The research question is answered using the Triple Helix -model. The Triple Helix -model helps to answer the research question in a holistic way. The Triple Helix -model takes into consideration the industry, government and the academia. These three are all included in the cluster. The theoretical framework is the most suitable because it focuses on the different parts of the cluster and can help dissect the information in a helpful way. It can also help with making sure all of the aspects related to answering the research question properly will be considered.

When thinking about possible thesis research questions I came across an article about a plastic replacement invention. The thesis idea started to develop from there. I have lived in Central Finland my entire life so the geographical area came naturally. As for choosing the forestry cluster specifically from the bioeconomy cluster, a lot the early research I did about the subject mentioned forestry products as ingredients for plastic replacements. Also, the forestry cluster is permanent in Central Finland so choosing the forestry cluster felt natural.

1.4 Structure of the thesis

The second chapter of this thesis is the literature review where the key concepts related to this research are explained. The theoretical framework used in this thesis is also described in that chapter. The data collection and analyzing methods are explained in the methodology chapter, which is the third chapter. The fourth chapter is the results chapter that combines the results from the data collection. In the fifth chapter, the discussion chapter, the findings, practical implications, limitations of the research, and the recommendations for future research are discussed.

2 Literature review

2.1 Clusters

Clusters are defined as “geographic concentrations of interconnected companies and institutions in a particular field”. Clusters’ geographical limits fit in a political area but clusters can cross state or national borders. There are three ways that clusters affect competition: by increasing productivity of the companies within the cluster; by guiding the pace and direction of innovation and by encouraging new businesses to form, expanding and strengthening the cluster. Clusters stimulate cooperation and competition between companies and organizations. (Porter 1998.) Companies are started inside the cluster because the necessary components for the company already exist there. There are suppliers, competition, knowledge, experienced workforce and a

marketplace with possible gaps in the market that can be identified among other things.

Clusters include suppliers; financial institutions; end-product or service companies; firms in related industries; producers of complementary products; specialized infrastructure providers; government and institutions offering education, training information, research and technical support as well as standards-setting agencies. (Porter 2008, 213.) Having clusters gives companies better access to suppliers, specialized information and employees. The companies can save money by getting their materials from local sources from inside the cluster. When they buy from local suppliers the shipping costs are lower. The shipping time also gets lower when the companies buy from suppliers located near them. Clusters also attract employees with expertise in the field that the cluster works. (Porter 1998.)

According to Sölvell (2015) clusters are related to knowledge creation and creativity in a certain geographical region where there are no sectorial limitations. Clusters can create unexpected and unplanned interaction between actors that would have not otherwise interacted. Those interactions can lead to new ideas and creative products, concepts, designs and business ideas. Clusters are proven to contribute significantly to the innovation process inside an area. Sölvell argues that clusters should be looked at as a set of the following five complementary actors.

1. Firms and individual entrepreneurs that increase innovation, takes those innovations to the market and then subjects them to the competition and demand of the marketplace.
2. Research organizations that create seeds for innovation.
3. Education organizations, referring to schools and polytechnics. Universities act as both education and research organizations.
4. Capital providers that provide the capital for the operations of some of the previously mentioned actors. Capital providers are angel networks, private and public funding and banking institutions.
5. Government and other public bodies that make and implement policy decisions crucial for the innovation climate to the clusters such as regulations, infrastructure investment and cluster programs. (94)

Networks play a big role in clusters. That is a channel through which a lot of the information is shared. According to Dahl and Pedersen (2004) engineers acquire and share information between their social contacts. Informal contacts could be an important source of information in their day-to-day work lives. Engineers share information, that the companies they work for might not want them to share, to their engineer social contacts. Knowledge that comes from within the cluster flows easier in it than it does outside of it. That is why the concentration on innovative activities is higher in clusters. Informal networks formed between people across firms can cause outflow of knowledge from the company. Clusters are often connected to the leading-edge universities in the area of business. (3-19)

2.2 Sustainability

Brundtland (1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Cambridge Dictionary (2019) defines sustainability as "the quality of causing little or no damage to the environment and therefore able to continue for a long time". Sustainability, when looking at the environment, is maintaining the current condition as high as possible.

The principle of sustainability is that the Earth's resources and capabilities are limited and cannot be used and damaged forever. The planet's resources are bound to run out at some point and the exploitation of those resources can weaken life's ability to thrive. Water resources get polluted, compromising the health of humans, plants and animals. The difference between sustainability and environmental protection is that sustainability has a more holistic and proactive focus on the condition of environment than environmental protection has. Environmental protection has a habit of focusing more on specific environmental threats and correcting the bad done to the environment. The "Brundtland Commission" said sustainability to have three co-equal elements: environment, economy and equity. (Portney 2015. 4-6.) Equity, in this context, means that everyone is treated equally. Everyone has the same rights and is treated fairly. Economy, here, means the financial system and building the

financial system in a way that is maintainable in the long run. Environment means the nature and the conditions and surroundings we humans live in.

In an interview with Business Insider Jeffrey Hollender, the co-founder and former CEO of Seventh Generation as well as the current co-CEO of Sustain Natural, defined sustainability as " a systematic approach to thinking about the total impact a business has on the planet, as well as society". He says that sustainability is about how people are treated as well as lowering carbon dioxide emissions. According to Hollender, sustainability is important for both for the good of humanity and business. He also says that being sustainable is good for the company and will help the company perform better financially. (Chin, Frank & Silverstein 2018.) When looking at sustainability of a company, people often think about the carbon dioxide footprint and how it can be lowered but there is much more to sustainability than that. When looking at company's sustainability one has to take into consideration the way people are treated in the company as well as their contributes to other threats to the environment such as loss of biodiversity, waste disposal problems, deforestation, water pollution and other issues the environment is facing.

Sustainability is offering the best thing possible for humans and the environment now and in the indefinite future. There are three types of sustainability.

1. Institutional sustainability, referring to the ability of the strengthened institutional structure to continue to deliver their results the same way they do now.
2. Economical and financial sustainability, referring to the ability of the technical cooperation to produce economic benefit the same way they do now.
3. Ecological sustainability, referring to whether the use of natural resources is something that can be continued without harming the nature in the long run.

(Schutte 2009)

Sustainability is formed from environmental factors, economical factors as well as the social well-being factors. (ibid.)

2.3 Plastic economy

Plastic economy is the production of plastic resources, usually natural gas; oil and coal, and the conversion of those resources into plastic items used in manufacturing and consumer goods. Plastic can be reusable or single use depending on their using purpose and manufacturing process. The world is trying to move from plastic economy to more sustainable solutions, like the new plastic economy where most of the plastic produced is reused, recycled, and then used to other materials. (Rethinking the future of plastics 2019)

According to Dvorak, Hopewell and Kosior plastic production takes an estimated 4 per cent of the current oil and gas production. Plastic durable, light weight, inexpensive material made from fossil oil and gas. From the plastic produced today, 50 per cent is made for single-use purposes, like for example packaging materials. Some plastic materials can be recycled using chemicals to break the material into its chemical components. While some plastic materials are biodegradable, they require specific conditions to do so. (2009)

According to Hardesty, Van Sebille and Wilcox, plastic production has doubled every eleven years after the production started during the 1950s. Hardesty and colleagues estimate that the plastic produced between the years 2015 and 2026 will be equivalent to the amount of plastic produced from the start of production to 2015. Plastic waste in nature effects birds, whales, microorganisms and other animals. Plastic waste affects humans' health in an indirect way. (2015)

2.4 Forestry

Cambridge Dictionary (n.d.) defines forestry as "the science or industry of growing and managing forests". Forestry includes taking care of the soil the trees grow on, planting the trees according to the type of soil and climate as well as the goals of the landowner, managing and taking care of the forest and, when the time is right, logging. The trees that are planted are usually seedlings grown in nursery gardens. A

landowner can also choose to maintain their forest in a more natural way and let the trees spread their seeds and let those seeds grow on their own. This type of foresting is less time consuming for the person taking care of the forest but can give less profitable results since the trees will be ready to be logged at different times in one area as supposed to when the forests are planted by humans or machines all the trees are ready to be logged at the same time in the same area creating more profit for the landowner.

Forestry involves land using, labor and capital with the goal of producing goods and services from forests. He argues that forests can be considered as economic resources because they can be used to help produce goods and services. Forests can be used in several different ways. Forests can be used, for example, for aesthetic and recreational reasons, for the timber they produce (for making paper, fuel or lumber) as well as for industrial use saved for future generations. Forests can be used for more than one purpose. (Pearse 1990, xiii, xiv, 4.)

Forestry is defined as “the art and science of managing forests so as to yield, on a continuous basis, a maximum in quality and quantity of forest products and services”. Aditi says that forestry is satisfying the man’s needs by handing of forest land. He says that forestry includes logging, marketing, manufacturing and using wood products. Forests can be used for aesthetic reasons, for its material producing purposes and for environmental protecting reasons. (Aditi 2019)

2.5 Theoretical framework: Triple Helix -model

Triple Helix -model is idea of collaboration between three parties: the industry, university/academia and the government/state. The Triple Helix -model requires a specific type of country to work. The model first was applied in the developed technology-orientation supporting pioneer countries. This worked because the industries in technology were new. (Macias, Ozturgut & Sanchez 2017, 49)

There are three types of Tripe Helix policy models that differ in the relationships that the three parties have. In the first type of policy, called the etatistic model, the state covers the industry and academia and guides the relationship between the two. Strong versions existed in the Soviet Union and weaker versions exist in Latin America and some European countries like Norway. The second type of policy, called the "laissez-faire model, considers the parties as completely separate entities with separate relationships between each of the parties. The third policy model sees the parties as individual entities that overlap. The place where they all overlap is the "Tri-lateral networks and hybrid organizations". (Etzkowitz & Leydersdorff 2000, 111)

Tripe Helix -model studies the relations between university – industry – government networks and offers neo-evolutionary model of a knowledge-based economy. According to the Tripe Helix -model the three knowledge-based economy evolutionary determining assortment surroundings are economic wealth creation, reflective control as we as organized knowledge production. Because the communication between the parties comes automatically the social coordination and party dynamics are derived internally. (Deakin & Leydesdorff 2011)

The role of the university according to the Triple Helix -model is to produce knowledge for the industry. The role of the government is to regulates, coordinates and detects systems. The role of the industry is to act as the leading carrier of economy manufacturing and trading. (Leydesdorff 2012, 13) The government regulates the industry and the university. The university provides research for the industry and the government. The industry provides research topics, jobs and training positions for the university and profit for the government.

Etzkowitz and Ranga (2013) present the idea of 'multi-sphere' (hybrid) institutions. These hybrid institutions function where the university, government and industry spheres intersect. They combine elements from each of the sphere. The creation of harmony, innovation spaces and knowledge are conceptualized as the consequence of the collaboration between the industry, government and the university spheres, and the spheres getting closer together and eventually starting to overlap. In practice the involvement of the different spheres can be unequal. The stronger sphere can

absorb the role of the weaker sphere or enhance the development of the weaker sphere. Technology transfer is an innovation system, in which universities generate and transfer technology such as nanotechnology, biotechnology, medical technologies and ICT. Universities growing capacity to provide technology gives them the opportunity to provide more than just knowledge and human resources. Universities are able to also act as key innovation stakeholders. In order to facilitate the universities' capitalization of knowledge and interfacing the knowledge with the external world, science parks, technology transfer offices, business incubators, venture capital capacities and start-up accelerators have been created. Universities also provide courses on entrepreneurship creating more entrepreneurs to different industries, creating more jobs benefitting the industry and making more tax revenue benefitting the government. There are also cases where industries have taken the role of universities, providing education and training solutions. In countries with weak or non-existent regional governments, it is even possible for universities, regional development agencies or firms to step up and create achievable objectives for the future. (239-250)

3 Methodology

3.1 Research approach

The research approach for this research question will be qualitative. Qualitative methods are used when gathering and analyzing non-quantitative data. Qualitative research aims to describe reality as experienced by the respondents and explore social relations. (Adams, Khan & Raeside 2014, 6.) The intention of qualitative research is to understand a certain phenomenon and explain the relations and structure of the factors contributing to the phenomenon. (Kananen 2015, 59).

3.2 Research context: Central-Finland's forestry cluster

Central Finland has three educational institutions that provide education in the field of forestry: Pohjoisen Keski-Suomen ammattiopisto, Gradia Jämsä and JAMK University of Applied Sciences. (Opintopolku 2020)

There is 1 446 000 hectares of forestry land in Central-Finland. 964 000 hectares of those are owned by private individuals and 28 000 hectares are strictly protected forests that cannot be used for economic purposes. In 2014, the annual total use of raw wood was nearly 6 million square meters, 4.7 million square meters of which were roundwood. The remaining 1.3 million square meters of wood went to household firewood and forest chips. (Tiitinen-Salmela 2016, 8)

Central-Finland's forestry started to develop in the turn of the 1850s and 1860s when using a steam engine as a power source for the sawmill was allowed. At the same time the first paper factories and mechanical pulp mills were founded in Finland. Only a small part of Central-Finland's population owned forestland but a lot of jobs were created for non-land-owning citizens. After the war former weapon factories were transformed into factories that designed and produced new modern paper machines for both domestic and foreign markets. (Vihola n.d.)

There are a lot of individual forest owners and small companies that maintain the threes in the forests that are then sold to companies that then produce the wood further. The biggest forestry companies operating in Central Finland are Stora Enso, UPM Kymmene, Valmet and Metsä Group.

3.3 Data collection and analysis

This research will be done by conducting two semi-structured interviews with people that represent different sectors of the triple helix. Secondary data will be collected from reliable sources. The interviews are conducted to gather information that might not be possible to get from secondary sources like news articles and relevant

webpages. The interviews will also be used partly to validate the information gathered from the secondary sources.

The people interviewed in this research are Outi Pakarinen and Markku Paananen. Outi Pakarinen is the acting development manager of bioeconomy in Regional Council of Central Finland. Markku Paananen is a specialist at JAMK's institute of bioeconomy and school of technology, he is also a forest owner, a member of the Central Finland's forest council as well as a board member of Meto Metsäalan asiantuntijat Keski-Suomi ry. The interview questions are be the same for both interviewees since the questions take into consideration all of the spheres of the triple helix. The interview questions were developed using the theoretical framework. The questions are both in Finnish and English in the appendices. The interviews were conducted in Finnish since it is the mother language of both the interviewee and interviewer. The interviews lasted for around 40 and 55 minutes and were conducted the 12th of May and the 14th of May. With the permission of the interviewees, the interviews were recorded. The recordings were then transcribed. Both gave their permission for their names to be used in this thesis.

I started off by gathering and dividing the data into different categories. To help analyze the data, I divided the results by the categories in which they belong in the results chapter: industry, government, universities, hybrid organizations and what remains to be done. I categorized the data while I was collecting it.

The interviews were recorded with the permission of the interviewees. After the interviews were done, they were transcribed. Once I had transcribed the interviews, I moved the transcripts to Excel to further analyze them. Then I went trough the transcript and found the parts that fit into each category and added to their responding codes. The codes I used were Ind for industry, Gov for government, Uni for universities, Hyb for hybrid organizations and Rem for what remains to be done.

3.4 Verification of the results

The sources used for the literature review were mostly scholarly publications. For the results chapter the secondary data was gathered from reliable sources and then fact checked by making sure the same information can be found from other sources as well. The interviewees were due to their involvement in the forestry cluster.

Internal validity

The interview questions were made to answer the research question according to the theoretical framework. To make the results link to the theoretical framework the results chapter was divided to correlate to the spheres of the triple helix model. This also ensured that the results will be comprehensive.

External validity

This research, and therefore the findings of this study, is focused on the Central Finland's forestry cluster and do not take into consideration other parts of the bioeconomy cluster or other geographical areas. The theoretical framework does work to analyze other clusters but this study was focused only on the specific one.

Reliability and objectivity

The findings of this research can be reproduced by other researchers. The data was gathered from a variety of reliable sources. If other researchers were to use the same data as I did, they could achieve the same findings as I did. I interpreted the data as objectively as I could. I took into consideration the position of the interviewees while analyzing the data and made sure not to include their personal opinions, only the facts they presented.

4 Results

4.1 Industry

Due to climate issues, social pressure and responsibility as well as changes in the forest industry, a lot of companies working in the forestry cluster are starting to develop and research new products and materials they can do that could replace plastic and other products that are harmful to the environment. Forest industry is facing some changes due to the changes in printed media. Need for paper production is going down now that books and newspapers are moving more and more online for people to read. The need is not gone but it has gotten smaller. At the same time the world is becoming more aware of the downsides of plastic and want to see alternative options in the market. New companies are made with the intention of providing people more sustainable options made from sustainable resources, such as pulp and other wood-based materials. Some of Central Finland's biggest companies in the forestry cluster are also working on developing new products to create more sustainable solutions. They are collaborating with each as well as investing in research and research facilities in order to achieve that. In the resent years, especially, there has been a lot more companies established that provide sustainable options and some of the already existing companies have started to work on also providing more sustainable products. A lot of possibly plastic replacing products and materials have entered the market in recent years and there are many more that are being researched.

Sukarwood makes products like packaging, hangers and laps from pulp. Sukarwood uses the excess parts from their production in their other products. Their products are 100 per cent recyclable. (Sukarwood 2020) Plastic is widely used in packaging, hangers and other products because it is water resistant, lightweight, durable and flexible, easy to work with and cheap.

Spinnova is a company that makes clothes from wood fiber. Spinnova worked together with VTT in the beginning of their journey. Spinnova has since partner up with companies like Marimekko and Bergans. Spinnovas products are completely natural,

quickly biodegradable and use 99 per cent less water in their value chain than cotton. (Spinnova 2020) Plastic is not often considered when the climate impacts of clothing are talked about. Clothes contain often synthetic fabrics like nylon and polyester that are made from plastic fibers. Clothing items that most often include plastic are workout clothes, water-resistant outside-clothing, fleece clothes as well as any clothing items, like T-shirts, jeans and dresses, that are made from cotton-synthetic mix. The plastic in clothing does not only create an issue at the end of the product's life cycle. Microfiber are released when the clothing items containing plastic are washed. The microplastic particles do not get cleaned from the water supply in the wastewater treatment plants since they are small enough to bypass the filters there. Due to the small size of these particles their spread is difficult to control. It is said that 35 per cent of plastic particles that end up in oceans are from synthetic textiles. (Chow 2019)

Metsä Board has developed a plastic-free alternative for food service and food packaging called the Eco-Barrier-Board that can be recycled with paper and paperboard. (Metsä Board Prime FBB EB – New plastic-free eco-barrier paperboard n.d.) Another one of Metsä Board's inventions is the Lidloc. The Lidloc is a cardboard cup -concept that works as a carriable cardboard cup without needing a plastic lid due to it's build-in add on that folds into a lid. (Metsä Boardin Lidloc aukoo uusia uria kartonkikuppien suunnittelussa 2020)

Stora Enso produces market pulp from renewable sources. The market pulp can be used for clothing, fabrics, yarns, fibrous sausage casings, cellophane and sponges among other things. (Market Pulp accessed on 2020) They also have created a product called the DuraSense. DuraSense is a wood-fiber biocomposite that can be used to produce furniture, interior, storage solutions like boxes and covers, consumer goods like toys and garden equipment, food contact plastics like mugs and kitchen utensils as well as industrial and automotive components like power tools and electrical products. (Biocomosites 2020) Stora Enso also manufactures formed fiber and in the early 2020 they plan to launch a product called PureFiber that can be used for single-use-take-away items like food bowls and drink lids, Trays and inserts to hold

food and non-food products as well as herbal pots and trays for agriculture. (Formed fiber 2020)

Metsä Spring, a joint venture of Metsä Group and Itochu Corporation, has opened a demonstration plant in Äänekoski, where they plan to prove the functionality of a textile fiber produced from northern wood. In order to prove that, they needed to open a whole new kind of industrial pilot plant in Finland. They are still building the factory but once it is planned to test a unique manufacturing method to produce a biodegradable, recyclable as well as ecologically and socially competitive staple fiber for the textile industry. Their material would be comparable to lyocell, another wood-based clothing material. Metsä Group has reportedly researched wood-based textile fiber production for around ten years now. The factory's capacity is going to be producing 40 kilos an hour and a ton a day of the material. Their goal is to, at some point, open a factory in Finland that could produce 50 000 tons of the material a year. The LCA, life cycle assessment, of the product has been done and the results appear to be good both for the products environmental effects as well as social effects. (Metsäjätti laajentaa vaatekuitubisnekseen 2020)

Metsä Spring and Valmet have begun a joint venture to develop a wood-based 3D product that could compete with similar products on the market that require fossil resources to produce. They plan on focusing specially on products like packaging. They plan on developing a manufacturing technology that will make the production highly automated and digital as well as fine adjusting the properties of the material. The companies are currently focused on researching and testing the material and how it performs economically and technically. The next phase of the project would be to build a pilot plant in Finland that is integrated into an already existing pulp or board productions site. The companies want the product to be a high-quality product that is also safe, easily recyclable, sustainable and biodegradable with a manufacturing process that requires no fossil. (Metsä Spring and Valmet announce collaboration to develop a new wood-based product as alternative to fossil-based materials 2020)

4.2 Government

The Central Finland's government has contributed to the change from plastic economy to more sustainable solutions by their policies and by directing funding into research and development as well as for innovations in the forestry cluster.

According to Pakarinen bioeconomy is one of the main development themes in Central Finland's regional strategy and the regional programme. The importance of bioeconomy has been acknowledged by the Regional Assembly and the Regional Board and therefore has been approved by political decision makers. In the Regional Council of Central Finland the development of bioeconomy is not only the duty of the development manager, instead the development is closely related on regional planning, development projects and so on. In a programme level, the Regional Council grants project funding and a lot of that money has been directed towards bioeconomy. The Regional Council of Central Finland gives funding to other parts of bioeconomy as well, like agriculture, primary production, circular economy and renewable energy but there is a strong investment in the forest economy.

Accodring to Paananen, the Central Finland's provincial strategy and the provincial program strongly support activities that aims for the transition for forestry and sustainable development all around. These aspects are taken into consideration in the planning of the use of provincial areas enabling the forestry activities.

4.3 Universities

Educational institutions produce research and innovations related to the transition from plastic economy to more sustainable solutions. According to Paananen, there is a break point in the system. Often when a university finishes a research or makes an innovation, the idea is not put into practice. The innovations and the research remain at a theoretical phase. There is often no one that works to put the idea into something practical and eventually commercial. The universities often make the theory

and the universities of applied sciences task would be to turn the theory into practice.

According to Pakarinen, even though JAMK's bioeconomy institute is mostly focused on agriculture and primary production, they have strong expertise in forestry especially considering their collaboration with Pohjoisen Keski-Suomen ammattiopisto. Pakarinen also mentioned that there has been strong research and education in University of Jyväskylä, in their department of chemistry, to the chemical composition of the wood and its possible utilizing purposes.

Paananen mentioned that Central Finland has education and degree programmes in forestry. JAMK has a very visible investment in the forestry cluster through their bioeconomy institute. One of their educational units is dedicated to this. JAMK has other educational units that relate to the transition as well, for example their industrial technology unit studies and research possible new products that can be made from biomass, the processing of biomasses and things related to the processing. The technology unit also researches different sustainability issues. JAMK also tries to educate their students on these issues even though the degree programme would not directly relate to the topic.

According to Paananen the University of Jyväskylä's department of biological and environmental sciences produce a lot of research related to the transition from plastic economy to more sustainable solutions. By doing that research they do their part in the innovation system, the research just often remains as basic academic research and the commercialization remains undone. Universities of applied sciences should take the new information and transform it into the direction of commercial applications.

4.4 Hybrid organizations

Technology research institute VTT, a hybrid between government and academia spheres, has created a biodegradable material, that can replace plastic in different

products. The material consists of wood-based cellulose fibers, polylactide and bio-based additives. The material is suitable for example for the production of furniture since it can be shaped and colored. VTT has collaborated with Plastec Finland and KO-HO Industrial Designs to make a designer chair using the material. Once the product reaches the end of its life cycle the material can be reused, composted or burned for energy. (VTT on kehittänyt täysin biohajoaven muovin korvikkeen 2018)

According to Pakarinen VTT has taken foaming technology forward in the recent years e.g. with funding from the Regional Council of Central Finland. This technology allows new types of products to be made from wood that can replace plastic products. Pakarinen also mentioned that the Regional Council of Central Finland has given funding to other VTT's development projects related to the forest economy.

Paananen mentions that VTT activates the business field and internationally networks actors from Central Finland to these development projects. VTT could still improve with working with JAMK and the University of Jyväskylä. There could be more joint ventures and shared resources, like equipment and staff, between them. The research done by Luke is fairly limited considering the scope of forestry in Central Finland. Luke has recently been focused on fisheries.

Tornberg reported that VTT had launched a pilot plant in Jyväskylä, specialized in developing new type of pulp-based materials. There were over 30 international companies involved in the project including Metsä Group, UMP-Kymmene, Stora Enso, Valmet and Kemira. The aim of the pilot plant is to figure out how paper and carton factories can be used to produce non-woven fabric, porous insulation and packaging materials to even possibly replace plastic-based materials. (2018)

In 2019 VTT revealed that they had developed an optical fiber out of cellulose fiber. Changes in buildings' moisture can be detected with the optical cellulose fiber. Cellulose fiber's material can react with measurable substances and absorb them which is hard to achieve with class- or plastic fibers. In their press release VTT mentioned that the development of the product is still at its early stages so all of the possibilities for application are not all yet been discovered. (VTT's press release 2019) VTT is also

working on creating a sustainable packaging material from wood pulp. (Kestävät ja älykkäät pakkausratkaisut n.d.)

Sami & Samu is a joint project of VTT, JAMK University of Applied Scienses, Central Finland Health Care District, UPM, Walki, Kiilto Clean, Serres, Milliyne, Paptic, Re-polar, Sakupe and Welmu. The project's goal is to find combat the issue of antimicrobial resistance the hospital environment using wood-based plastic materials as well as reduce the use of plastic in hospitals by developing bio-based materials to replace it. (Sami & Samu 2020)

Sitra's contribution to the transition has been mostly by promoting the innovations made by other actors in the Central Finland's forestry cluster.

5 Discussion

The objectives of this research were to find out all the ways the different spheres of the Central Finland's forestry cluster had reacted and done during the transition from plastic economy to more sustainable solutions. I only had one research question: How has the Central Finland's forestry cluster reacted to the transition from plastic economy to more sustainable solutions. To answer this question, I researched the different spheres of the cluster according to the triple helix model. I researched university, industry and government as individuals and then the hybrid organizations, which are a combination of two or all three spheres. The information was gathered from secondary data and by conducting interviews.

5.1 Summary of the main findings

The main goal of the current study was to determine how the forestry cluster in Central Finland had responded to the transition from plastic economy to more sustainable solutions. This study has shown that the cluster has seen a lot of changes from the transition. Companies especially have responded in a strong way. New

companies have been founded in the cluster when people have seen a marketplace for plastic replacing products. Many of the existing companies have changed their practices to cater to this new market. Companies are doing a lot of research on their own as well as collaborating with research centers, governmental institutions, universities or other companies. The transition is still in process and lot of the new products and materials that have been discovered or created are still not on the market. They are still being researched and the production of those products and materials is still being piloted. A lot has been done and a lot of solutions have been found, now it is just about finishing the research, perfecting the formulas and the production. There are some products from Central Finland that can already be purchased by the general public but there are a lot more products yet to come.

The government has contributed to the transition by establishing policies that support the forestry cluster in the transition. They have also given funding for research and development projects that look for new innovations in the field as well as possible ways to implement those innovations. By establishing the policies, they also give incentive for others to invest in the transition in the forestry cluster. Universities have contributed by providing research and resulting innovations. Hybrid organizations have contributed by making research and developing products that can be commercialized. Hybrid organizations have put a lot of the theory that has been developed and turned into practice.

5.2 Practical and managerial implications

The findings suggest that there are still improvements to be made. The industry in Central Finland's forestry cluster has responded strongly, the government has made changes to their policies, hybrid organizations have made a lot of research and found possible practical implication ways for the innovations and the universities have done a lot of research as well as slowly changed their education offering. There is still research to be made and the practical implementations of the discoveries need to be brought to the market. The rate of how many innovation and research papers are further explored and then turned into products needs to also improve. The education

and government spheres have not individually necessarily done that much but they have collaborated together with the other spheres and they have accomplished a lot.

5.3 Limitations of the research

There were some limitations in regard to the secondary data collected for some spheres and finding reliable sources. As for reliability, I used reliable sources and interviewed people in the field. I made sure the information was correct by using reliable sources as well as verifying the information by making sure other sources told the same information as well. The interviews were also used to confirm some of the information from the secondary sources.

When it comes to the external validity of the information, the research was limited to the forestry cluster of Central Finland. The research model can be used in other studies as well but the results are limited to the specific cluster.

I answered the research question as objectively as I possibly could. When analyzing the data, I took into consideration both the positive and negative. I do not have personal or professional connections to the subject so it was easy to look at the subject from an objective point of view when analyzing the data.

5.4 Recommendations for future research

Researching how other geographical areas have responded to the transition from plastic economy to more sustainable solutions would be useful. While doing my research I found out about a lot of products and materials that had been discovered but could not include them in this paper since they were from outside the Central Finland's cluster.

It could also benefit researching how the entirety of the bioeconomy cluster has responded to the transition. There were some innovations from the other parts of the

bioeconomy cluster that had responded to the transition. Due to my focus on the forestry cluster I did not come across that many but there were some.

I think it would be beneficial to research the environmental and economic benefits and possible downsides of the transition from plastic economy to more sustainable options. For example, it would also be beneficial to research the limitations of the forestry cluster and the bioeconomy cluster in the sense of how much of their resources can be utilized while still remaining sustainable and environmentally friendly. Also, in what scale can the products be produced in a way that makes sense when considering the original reason for the transition, helping the environment. Also it is important, from profitable and therefore economically sustainable point of view, to consider if the products are competitive to plastic in price and performance and if not how big of a difference can there be in those qualities for the more sustainable solutions to still be accepted by the general public and be used by enough people that companies can continue producing them with profit.

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Appendices

Appendix 1: Interview questions

Interview questions:

- Miten sinä näet muutoksen muovitaloudesta kestävämpiin vaihtoehtoihin Keski-Suomen metsätalous rykelmässä?
- Miten Keski-Suomen maakuntahallitus on edistänyt muutosta Keski-Suomen metsätalous rykelmässä?
- Miten koulutusta tarjoavat tahot, Gradia; JAMK ja Jyväskylän yliopisto erityisesti, ovat edistäneet muutosta Keski-Suomen metsätalousrykelmässä
  - heidän koulutustarjontansa suhteen?
  - heidän tutkimus- ja kehitystyönsä sekä niistä saatujen innovaatioiden suhteen?
- Kuinka VTT:n kaltaiset tutkimus- ja kehityslaitokset ovat edistäneet muutosta Keski-Suomen metsätalous rykelmässä?
- Kuinka Keski-Suomen metsätalous rykelmän yritysten käyttäytyminen on muuttunut muutosvaiheen aikana? Kuinka he ovat vaikuttaneet muutokseen?
- Kuinka Elinkeinoelämän keskusliitto on vaikuttanut muutokseen Keski-Suomen metsätalous rykelmässä?
- Kuinka organisaatiot, kuten Keski-Suomen liitto, Business Finland (Business Jyväskylä), Sitra ja Suomen Akatemia ovat vaikuttaneet muutokseen Keski-Suomen metsätalous rykelmässä?
- Mitkä ovat suurimmat muutokset, joita olet tähän mennessä huomannut Keski-Suomen metsätalous rykelmän muutoksessa? Kuka teki ne?
- Mitä muutokseen voidaan vielä tehdä Keski-Suomen metsätalous rykelmässä? Kuka ne voi tehdä?

Interview questions translated to English

- How do you see the transition from plastic economy to more sustainable options in Central Finland's forestry cluster?
- How has the Central Finland's government contributed to the transition of the Central Finland's forestry cluster?
- How have educational parties, Gradia; JAMK and the University of Jyväskylä especially, contributed to the transition of the Central Finland's forestry cluster
  - in terms of their educational offering?
  - in terms of R&D activities and resulting innovations?
- How have the R&D institutions like VTT contributed to the transition in Central Finland's forestry cluster?
- How has the behavior of companies in Central Finland's forestry cluster changed during the transition? How have they contributed to the transition?
- How has the Confederation of Finnish Industries contributed to the transition in Central Finland's forestry cluster?

- How have organizations like the Regional Council of Central Finland, Business Finland (Business Jyväskylä), Sitra and Academy of Finland contributed to the transition in Central Finland's forestry cluster?
- What are the biggest changes you have noticed so far in the transition in Central Finland's forestry cluster? Who made them?
- What can still be done in Central Finland's forestry cluster to make the transition? Who can do them?