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SLOVENIAN FOREST INDUSTRY AND SMART SPECIALIZATION STRATEGIES:

Sustainable Competitive Advantage analysis in a triple helix framework

Master's Thesis in
Science of Economics and Business Administration

Industrial Management

VAASA 2015

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ABBREVIATIONS

BCFI	Balanced Critical Factor Index
C	Cost
CFI	Critical Factor Index
F	Flexibility
FGR	Forest genetic resources
IUS	Innovation Union Scoreboard
KET	Key enabling technology
MSI	Manufacturing Strategy Index
NIS	National Innovation System
NSCFI	Normalized Scale Critical Factor Index
Q	Quality
R&D	Research and development
R&I	Regional innovation
RBV	Resourced-based view
RIS3	Research and innovation strategies for smart specialization
S&R	Sense and Respond
S3	Strategies for smart specialization
SCA	Sustainable Competitive Advantage
SCFI	Scaled Critical Factor Index
SFI	Slovenian Forest Institute
T	Time
ZGS	Zavod za Gozdove Slovenije

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Major subject: Industrial Management
Year of Entering the University: 2013
Year of Completing the Master's Thesis: 2015 **Pages:** 103

ABSTRACT: Sustainability has long been an area studied and investigated by scholars and professionals. Recently, sustainability has become a global mission rather than being just a term. Sustaining a competitive advantage over the competitors and economic development for long term success requires a great amount of cooperation between partners. Therefore, building networks and value chains where parties from different backgrounds link up and operate for economic development both at micro and macro levels become crucial.

The potential of the Slovenian forest industry, the sleet disaster experienced in 2014, and the smart specialization projects conducted by the EU all together create an environment which is full of lessons to learn, problems to identify and also opportunities waiting to be discovered. The disconnection or the lack of communication between the three spheres: companies, universities and the public actors; forming the triple helix of Slovenian forest industry, might constitute a severe problem on the way to sustainable development, especially while the country and the forest industry are experiencing such conditions. Therefore, this study investigates the Slovenian forest industry with a triple helix framework using Sense and Respond (S&R) method. The data obtained from the different actors of the industry was analysed in order to gain insights in the cooperation level of these actors. The findings are discussed under the light of qualitative investigation of Slovenian smart specialization strategies, as to form a basis for the empirical research.

The results of analysis suggest there is a level cooperation between the three spheres of triple helix representing the Slovenian forest industry, with a greater potential for development in cooperation of public actors with other parties. The strategic positioning of all the parties involved in triple helix should be done accurately. Especially at the times when cooperation and mobilization are needed nationwide, for permanent prosperity, temporary sacrifices should be made.

KEYWORDS: Sense and Respond; Smart specialisation; Triple helix; Strategic decision-making; Operations strategy

1. INTRODUCTION

Sustainability has long been an area studied by scholars and investigated by professionals. Despite having various definitions in different contexts, the common meaning of the term is meeting today's needs with a sense of life quality without consuming the future. Recently, sustainability has become a global mission rather than a term. While it is concerned with the environment and the society, for the business world it means development, economic growth and success in general. The idea of continuous development and success has been attractive for businesses. This encouraged organizations and companies to develop strategies to achieve sustainability. However, as the competition gets more aggressive, it becomes a struggle for survival. Having an advantage over competitors within the market is not sufficient for a company to succeed, as the competitive advantage can be duplicated and change hands. Therefore, it becomes a question of whether the company is able to sustain the competitive advantage. Additionally, sustainability is about managing the resources of a company with an efficient configuration in response to changing environment. This particular configuration is ensured by set of strategic decisions called operations strategy. (Barnes 2008:28; Davis, Aquilano & Chase 2003:30–32.)

Smart specialisation, on the other hand, is a strategic approach to sustain economic development through research and innovation in particular areas. The foundation of smart specialisation concept can be traced back to the work of Etzkowitz (2002) where he discusses the roles of knowledge in society and university in the economy with the triple helix thesis of relations among university, industry and government (Stanovnik 2014). According to the model developed by Etzkowitz and Leydesdorff (1995), via cooperation between the actors of triple helix, private sector adopts new technologies and competitive advantage in the market (e.g. internationally), while universities develop academic knowledge and analytical skills, gain academic competitive advantage, image, reputation and funding for academic activities. Public sector (government according to the model) also benefits from the cooperation by gaining strategic advantages such as economic development, resources, new jobs, higher tax revenues and thus regional (na-

tional) development. Therefore, the triple helix approach is a model aiming at realizing mutual benefits for university, industry, and government despite different interests.

Slovenia is one of the most forested countries in Europe with forests covering more than a half of its territory. 76% of Slovenian forests are private property, while the remaining 24% is owned by the state or communes. State-owned forests are larger and undivided, which enable professional management. However, the private forest estates are mostly small and fragmented. Until recently, the country has been successful in conserving its forests in a healthy sustainable and predominantly natural state. However, country's forest management did not result in a successful use of wood or the well-developed wood technology. Wood is the only abundant natural renewable resource in Slovenia, however, is not sufficiently used or sustained (Humar & Kraigher 2009). Although the Slovenian wood-processing and furniture industries have a good reputation, they have been limited in terms of value added products as well as the other forest-based sectors. Especially after the sleet disaster in 2014, which damaged half of country's forest reserves, the need for sustainable forest management for both during the recovery process and for future has become a matter of priority.

The potential of the Slovenian forest industry, the sleet disaster experienced in 2014, and the S3 projects conducted by the EU all together create an environment which is full of lessons to learn, problems to identify and also opportunities waiting to be discovered. The disconnection or the lack of communication between the three spheres companies, universities and the public actors, forming the triple helix, might constitute a severe problem on the way to sustainable development, especially while the country and the forest industry are experiencing such condition.

These issues discussed above, together trigger the motivation for conducting this study. In order to better understand the conditions of triple helix environment in Slovenian forest industry as well as the relations between involved actors, Sustainable Competitive Advantage (SCA) analysis were made using the Sense and Respond (S&R) method. Also, a literature review was carried out to gain insights in theoretical background of main terms engaged in this study. Furthermore, a qualitative investigation of Slovenia

was conducted, in terms of country overview, smart specialisation strategies, forests industry and reserves.

1.1. Research questions

This thesis work was initially conducted to find answers to the following research questions which were brought forward by the issues discussed above:

1. What are the smart specialization strategies being considered in Slovenia regarding the sustainable development and management of country's forest industry?
2. What is the level of cooperation between the actors of Slovenian forest industry in terms of competitive priorities and operations strategies?
3. What are the directions for potential development of the critical resource areas?

In addition to these questions, this study investigates the general characteristics of Slovenian forest industry with a closer look to the effects of the sleet disaster in 2014. It is important to observe whether the disaster caused a change or shift in strategic position of the actors in Slovenian forest industry in a triple helix framework. After building the theoretical foundations and identifying qualitative characteristics, the second and the third questions are answered with quantitative methods applied in empirical data. It is also important to mention that a new Critical Factor Index (CFI) method was used in the study to compare results and to present whether similar features exist between the new and traditional models.

1.2. Structure of the thesis

This thesis consists of six main chapters which begins with an introduction and continues with theories and terminology relevant to the case, in order to provide an appropriate background and foundation for the empirical research. In Chapter 1, a general outline of the research is introduced with the motivation. Also, research questions and the structure of the thesis are given in this chapter. The technical and theoretical back-

grounds of the study are presented in Chapter 2. In addition to the development of smart specialisation theory and triple helix model, theoretical background in strategic management and operations strategy are discussed in this chapter in order to link theory to practice. In Chapter 3, the country profile of Slovenia is given with further information on smart specialisation strategies in the country, forest resources and industry with effects of the sleet disaster experienced recently. In Chapter 4, in addition to the traditional methods used in this study, a new method is introduced. The process of data collection with validity and reliability of the methods are also presented in this chapter. The results of the analysis and comparisons of the two methods are discussed and illustrated in Chapter 5. Finally, in Chapter 6, the findings of the study are discussed and relative implications were proposed. The conclusion of the thesis is given after limitations and recommendations for further research at the end.

2. THEORETICAL FRAMEWORK

It is important to understand the background and the development of the theories and methods used in this research, before moving on to the analysis. This chapter, therefore, provides the theoretical framework of the study. The following sections are given in a sequence that links the theories to each other.

2.1. Smart specialization

Smart specialisation is a concept that has emerged as a policy agenda for science, technology, and innovation as a response to important changes in the world economy (Stanovnik 2014). It is a strategic approach to sustain economic development through targeted support to research and innovation (EUA 2014). Foray and Goenaga (2013) define smart specialisation as an innovative policy concept which aims to favour some technologies, fields, population of firms and process of identification and selection of such desirable areas for innovation policy intervention. Also, vertical prioritisation for R&D and technological activities is a difficult task; therefore, smart specialisation focuses on defining a method to help policy-makers identify these areas (Foray & Goenaga 2013).

The foundation of smart specialisation concept can be traced back to the work of Etzkowitz (2002) where he discusses the roles of knowledge in society and university in the economy with the triple helix thesis of relations among university, industry and government (Stanovnik 2014). However, the term "smart specialisation", in today's context, was first mentioned by Foray and Van Ark as a part of the "Investing in European Research" reports delivered by "Knowledge for Growth" expert groups in 2007. According to Stanovnik (2014), the theoretical roots of smart specialisation are grounded in the classical economic growth theories, trade specialisation, and economic research on industrial development, as well as the modern strands of economic though from evolutionary economics to agglomeration economics. Furthermore, as an economic framework being focused on small countries (regions) aiming to illustrate how public policies, framework conditions, especially R&D and innovation investment policies, smart

specialisation can influence economic, scientific, and technological specialisation, and thus enable a region gain productivity, competitiveness, and economic growth (Stanovnik 2014).

Smart specialisation strategies are needed for having European added value at the regional level, including cross-regional collaborations. In today's changing world EU targets becoming a smart, sustainable and inclusive economy, helping the EU and the Member States delivering high levels of employment, productivity, and social cohesion. The European Parliament defined smart specialisation strategy as the national or regional innovation (R&I) strategies which set priorities for building competitive advantage by developing and matching research and innovation strengths to the needs of businesses in order to respond to emerging opportunities and the developments in the market. It can thus be a form of, or be included in a national or regional research and innovation strategic policy framework. These strategies are developed by national or regional managing authorities and stakeholders and higher education institutions, as well as industry and social partners in an entrepreneurial discovery process. (European Commission 2014.)

Smart specialization is an upgraded version of the existing methodology for Structural Funds programming, based on 15 years of experience in supporting innovation strategies in the regions, and economic thinking by major international institutions such as the World Bank, and the IMF. It is about identifying the unique characteristics and assets of each country and region, highlighting their competitive advantages, and strengthening regional innovation systems to maximise knowledge flows and spread the benefits to the regional economy. (European Commission 2014.)

In the context of Europe 2020 strategy that EU has set out its vision for Europe's social market economy, smart specialisation emerges as a key element for place-based innovation policies. Therefore, it can be defined as national or regional research and innovation strategies for smart specialisation (RIS3) which are integrated place-based economic transformation process that have the following five qualities (Foray, Goddard, Beldarrain, Landabaso, McCann, Morgan, Nauwelaers & Ortega-Argiles 2012.):

- Focus on policy support and investments on both key national and regional priorities, challenges and needs for knowledge-based development;
- Based on each country's or region's strengths, competitive advantages and potential for excellence;
- Support technological and practice-based innovation targeting stimulating investment for private sector investment;
- Influence on stakeholders, making them fully involved and encouraging innovation and experimentation;
- Including sound monitoring and evaluation systems, thus evidence-based.

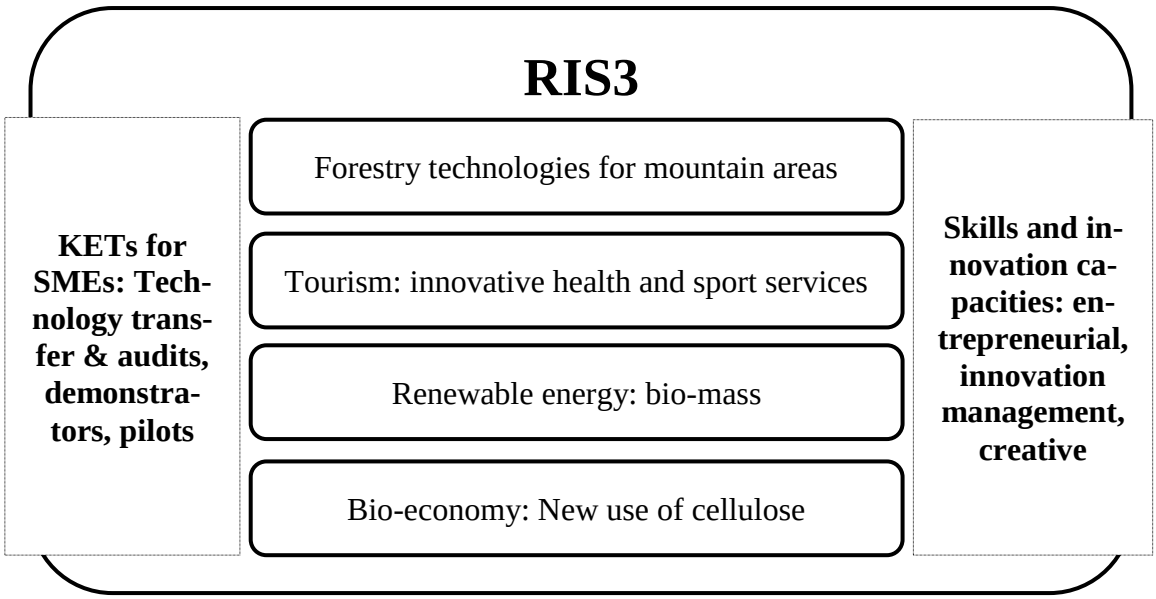

Figure 1. Hypothetical structure of RIS3 (Rainoldi 2013).

In order to make smart specialization strategies work in the regions, there should be some sort of structural change and a process which is not mutually-exclusive. Firstly, there is a transition stage in which an existing sector moves to a new one based on co-operative institutions, processes, the collective R&D, engineering, manufacturing capabilities etc. Secondly, technological upgrading of an existing industry is required. This is called modernization, which involves the development of specific applications of a

Key Enabling Technology (KETs) for better efficiency and quality. KETs are seen as important component for smart specialisation strategy due to their horizontal nature and transformative potential. For instance, the Finnish pulp and paper industry values nanotechnology as it has the potential of being a promising source for valuable applications and advances in the sector. Thirdly, diversification takes place in cases where the discovery concerns potential economies of scope and spill-overs that are likely to occur between an existing activity and a new one. Lastly, R&D and innovation in a certain field can make low growth activities suddenly become more attractive as a radical foundation of a new domain that also involves entrepreneurial activity. Therefore, smart specialization is about creating variety rather than creating technology (Foray et al 2012.)

The economic transformation that smart specialisation aims at can be summarised in four general principles (4Cs). The four Cs of smart specialisation which are also the leading elements of RIS3 process are (tough) choices and critical mass, competitive advantage, connectivity and clusters, and collaborative leadership. The following can be implemented as an approach to RIS3 depending on the specificity of the regional context (Foray et al 2012.):

- Analyses of the regional context (including potential for innovation),
- Building a sound and comprehensive governance structure,
- Development of a common vision for the future of the region,
- Selection of the most important priorities for the regional development,
- Establishment of appropriate policy mixes,
- Integration of audit and evaluation systems.

2.1.1. Smart specialization at the regional level

The European Union and its development endeavours including all the major and minor projects have a lot to offer to the society, industries, and also to the educational institutes. When it comes to smart specialisation, the collaboration between all the parties involved become a more crucial requirement for reaching the targeted outcomes. RIS3 process should be interactive, regionally-driven and consensus-based, since the innova-

tion process is a collective social endeavour (Foray et al 2012). According to Statovnik (2014), despite having borders to other regions with plenty of complementary assets, S3 processes are mostly defined within the parameters of each region.

> *Although regional development is also a collective social endeavour in which national and supra-national levels play their part, the regional level is the most important part of the process, not least because no one has a greater commitment to or knowledge of a region than the individuals and organisations that are based there.*
>
> Foray et al. 2012

Stanovnik (2014) suggests, although some focus on the regional level, the regional-national alignment of strategies and policies is crucial. Especially in the regions with strong innovation potential, a well-organised network of institutions and stakeholders, making a balanced choice of "smart" priorities is one of the key challenges, since it requires considering economic strengths, and being flexibly open to new opportunities. Moreover, the key challenge in less advanced regions is to provide the appropriate framework to build capabilities and encourage entrepreneurial discovery process and cooperation between stakeholders with government. Furthermore, it is necessary to develop linkages between regions and nations as a part of internationalisation process. (Angelova, Jurlina Alibegovic & Redzepagic 2014.)

There are a number of organizations that constitutes the regional knowledge ecology. These are public authorities, investors, enterprises, international experts, actors of knowledge, civil society (Foray et al 2012). There are three main players involved in RIS3 process for each region (if we consider regions as micro-level): higher education sector, private sector, and public sector. These actors form the triple helix which is the traditional joint-action management model that would develop the required environment for supporting and utilizing the innovation activities as well as the R&D efforts (Foray et al 2012). Triple Helix model is further discussed in the following sections.

Public, private and higher education sectors are involved in the mechanism for producing a regionally-attuned smart specialisation strategy. In order to make the region a living laboratory for new, more sustainable ways of working and living, contributing to local, national and European development objectives, these key regional actors should be both internally and externally well-connected. Failing this, from the public sector point of view, there would be lack of coherence between national and regional policies, political leadership, and a shared vision at the local level. In addition, a disconnection would mean no coordination, poor motivation, less demand and less interest in innovation for the private sector. Lastly, the engagement of players in the higher education sector such as schools, universities and research centres would be discouraged and the focus would shift towards rewards for academic research and teaching. Resulted by disconnection, these would lead to ineffective partnership, lack of shared understanding and entrepreneurs staying out of the regional planning. On the other hand, once regional research and innovation strategies for smart specialisation are aligned with national strategies with a strong connection, building of the infrastructure for growth, generation of intellectual and human capital assets for the region as well as development of skills required can be achieved. In addition, generation of evidence-based policies which support smart innovation and coherent policies that link territorial development to innovation and higher education would be possible. (Foray et al 2012.)

According to Yegorov and Ranga (2014), based on their study about EU cooperation in Ukraine, in order to transform the existing industry-government and university-government pairs into a functional university-industry-government trilateral partnership and a well-established triple helix system, both national and EU support, as well as the synergies between these two are critical. The concept of triple helix and its development is further discussed in the following section.

2.2. Triple-helix concept

Universities, as the main knowledge centres, have been a crucial factor spreading the knowledge to society since the first university was established in 19th century. Especial-

ly after the industrial revolution, research activities became another main role of the universities in addition to education, namely first academic revolution. After, applied and industry-based researches started the university-industry cooperation. Today, it is not possible to neglect the benefits of this cooperation for both the past and future. However, it brought forward the need for a framework or model to manage this relationship efficiently over time. The triple helix approach is one of these models aiming at realizing mutual benefits for university, industry, and government despite different interests.

Triple helix concept was first initiated by Etzkowitz (1993), adding university-industry relationship government as the third dimension. Etzkowitz and Leydesdorff (1995) proposed the model as a formula so that these three could benefit from the cooperation although they are different in terms of organization structure, mission, vision, targets and success factors. According to the model, with such cooperation, while private sector adopts new technologies and competitive advantage in the market (e.g. internationally), universities develop academic knowledge and analytical skills, gain academic competitive advantage, image, reputation and funding for academic activities. Public sector (government according to the model) also benefits from the cooperation by gaining strategic advantages such as economic development, resources, new jobs, higher tax revenues and thus regional (national) development. On the other hand, the triple helix model does not only focus on building relationships for cooperation between these parties, but developing a new organizational structure accordingly. Neoclassical economic approaches suggest universities and research institutes produce knowledge and industries convert this knowledge into application. However, exchanging roles is one of the important features of Triple Helix model, as for instance, universities converting knowledge and theory into practice and industries producing knowledge.

Etzkowitz and Leydesdorff (2000) distinguish three types of configuration of Triple Helix models. The first configuration, namely statistic model, suggests the dominant government control of the relationship with university-industry cooperation, and public governance of building and conducting the relationships. The second model named “laissez-faire” is based on separation of relationship and cooperation between university

and industry from government intervention or keeping it at the least possible level. However, these two models are not adequate for building the cooperation and manage them sustainably. According to Etzkowitz and Leydesdorff (2000) the first model is viewed as a failed developmental model since it discourages innovation and the second model is another version of it to reduce the role of the state. Therefore, there is need for an environment where government intervention is less, cooperation are more encouraging, and technically and financially supportive. The third model fulfils this need as an alternative aiming at realizing an innovative environment which consists of university spin-off companies, different (trilateral) initiatives for knowledge-based economic development, and strategic alliances among companies (with different size, area and level of technology), government laboratories, and academic research groups (Etzkowitz and Leydesdorff 2000; Etzkowitz 2003, 2008).

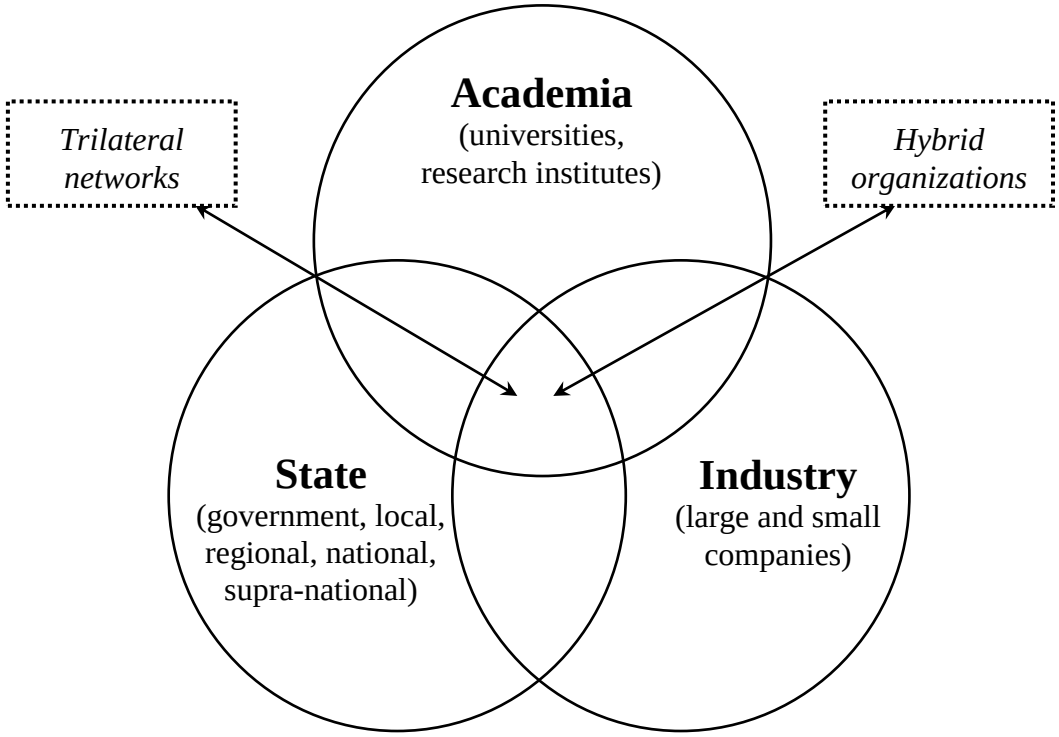

Figure 2. Balanced Triple Helix model (Etzkowitz & Leydesdorff 2000; Ylinenpää 2013)

Etzkowitz (2002b, 2003) identifies a four-stage development for triple helix:

I. Internal transformation in each of the helices: Universities play a new important role in society with their contribution to effective use of knowledge. The traditional boundaries between academia and industry are elided by the entrepreneurial universities supported and sponsored by governments. Strategic R&D alliances among companies and government are considered as parallel developments.
II. Influence of one helix upon another: The Patent and Trademark Law became an indirect industrial policy through which universities are encouraged to participate in and assist industrial innovation after the Bayh-Dole Act of 1980 which was established as a stable framework for academic technology transfer by the US federal government. Secure rules of the game for the disposition of intellectual property encouraged the spread of technology transfer to a broader range of universities.
III. Creation of a new overlay of trilateral networks and organizations from the interaction among three helices: In order to fill the gaps in the innovation system by brainstorming new ideas groups such as Joint Venture Silicon Valley, the Knowledge Circle of Amsterdam, the New England Council are formed.
IV. A recursive effect of these triple helix networks, both on the spirals from which they emerged and the larger society: The capitalization of knowledge changes the way academic scientists view the results of their research and the role university has regarding industry and government.

In the Triple Helix, in order to improve the conditions for innovation in a knowledge-based society, industry operates as the locus of production; government as the source of contractual relations guaranteeing stable interactions and exchange; the university as a source of new knowledge and technology. The Triple Helix denotes a transformation in the relationship among and within each of these three spheres. (Etzkowitz 2003.)

The three spheres in triple helix model of innovation and the interplay between these are viewed differently in different environments depending on the relations being bottom-up or top-down (Etzkowitz 2002a). Considering them as separate institutions, triple helix is based on academic, industrial, and governmental spheres and the knowledge flow among them. According to this, interactions take the form of contacts over defined organizational boundaries mediated by organizations such as industrial liaison, technology

transfer, contract offices and office of external relations. Another perspective is that these three institutions take each other's roles and performing accordingly with universities creating research parks or performing as local innovation organizer. (Etzkowitz 2002a; Nilsson et al. 2003.)

The triple helix thesis is expressed in the following ten propositions by Etzkowitz (2003):

- Arrangements and networks among the three institutional spheres provide the source of innovation rather than any singly driver.
- Invention of organizational innovations, new social arrangements and new channels for interaction become as important as the creation of physical devices in accelerating the pace of innovation.
- The interaction between linear and reverse linear dynamics results in the emergence of an interactive model of innovation integrating research and practice.
- The capitalization of knowledge occurs in parallel with the cogitization of capital.
- Capital formation occurs in new dimensions as different forms of capital are created and transmuted into one another: financial, social, cultural, and intellectual.
- Globalization becomes decentralized and takes place through regional networks among universities, multinational corporations, and international organizations.
- Developing countries and regions have the possibility of making rapid progress by basing their development strategies on the construction of niche knowledge sources, supported by the political economy.
- Reorganization across institution spheres, industrial sectors, and nation-states are induced by opportunities in new technologies that emerge from syntheses among previous interdisciplinary innovations in an on-going flow.
- Universities increasingly become the source of regional economic development and academic institutions are re-oriented or founded for this purpose.
- The ability to make the transition from one technological paradigm to another as the potential of an earlier regime becomes exhausted is the hallmark of a Triple Helix region.

Over the last two decades, theoretical and empirical research for triple helix has grown significantly providing a general framework for complex innovation dynamics. However, Ranga and Etzkowitz (2013) discuss that the research does not provide an explicit analytical framework for the conceptualization of triple helix interactions into an innovation system. Triple helix systems in the format of "innovation system" are defined as a set of components, relationships among these components, and functions of the system.

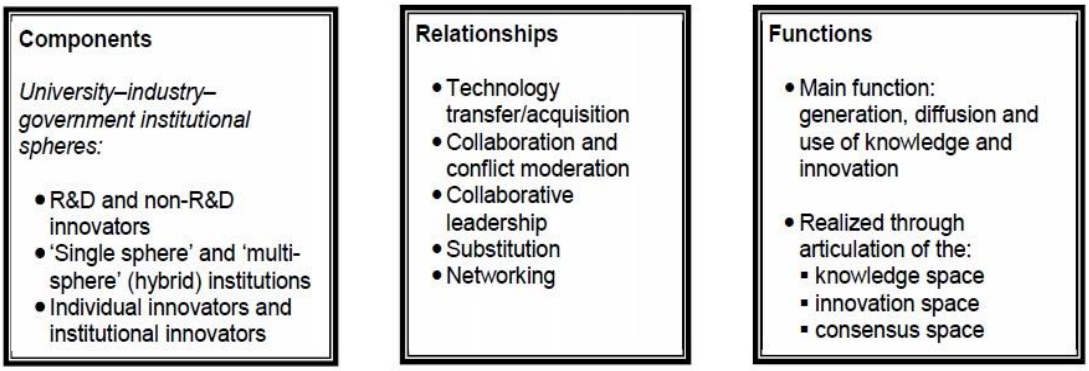

Figure 3. A synthetic model of Triple Helix systems (Ranga & Etzkowitz 2013).

According to Carlsson (2003) the innovation systems perspective was used to better understand how institutional arrangements facilitate interactions among economic actors in the market. The refined concept "national innovation systems" (NIS) includes a set of innovation actors such as: firms, universities, research institutes, financial institutions, government regulatory bodies etc. However, NIS became blurred by time since business and technology internationalization extended beyond national borders, and the integration of innovation systems grew, driven by economic and political processes. As a result of national innovation systems approach failing to capture the interaction between innovation actors, segmented levels of the system were introduced. Regional Innovation Systems is one of these new concepts emerged in the context of the increasing regionalisation of the early 1990s. According to Doloreux and Parto (2005) the concept includes a set of regional actors targeting to reinforce regional innovation capability and com-

petitiveness through technological learning, regional technology alliances arising from geographical distribution of economic and technological effects, or autonomous business environments. (Ranga & Etzkowitz 2013.)

In order to understand the behaviour and specific contributions of Triple Helix actors to production and use of knowledge for innovation, Ranga and Etzkowitz (2013) suggests three important distinctions between:

- Individual and institutional innovators,
- R&D and non-R&D innovatiors, and
- "single-sphere" and "multi-sphere" (hybrid) institutions.

According to these distinctions, innovation organizers, holding a key institutional position and coming from any sphere, coordinate a mix of top-down an bottom-up processes and innovation stakeholders of different backgrounds and perspectives. Entrepreneurial scientists, combining academic and business elements, attend advancing the frontiers of knowledge and mining its practical and commercial results for industrial and financial returns. R&D innovators can also be found in each of the university, industry and government institutional spheres and in the non-profit sector such as charities, foundations, trade associations. On the other hand, non-R&D innovators are generally associated with company units such as design, production, marketing, sales and others which are involved in non-R&D activities. Lastly, single-sphere institutions are described within a single institutional sphere, which are characterized by solid boundaries and with low level of interaction with other sphere, while multi-sphere (hybrid) institutions operate at the intersection of the spheres and synthesize elements of each sphere. (Ranga & Etzkowitz 2013.)

Governments are taking either a more or a less active role in knowledge-based economic development as the triple helix of innovation emerges in different societies. In countries following a linear model, intermediate mechanisms convert research into use. Instead of the traditional direct approaches, an indirect and decentralized innovation policy might be more effective as there are regional differences and incorporate bottom-up

initiatives. Nonetheless, the common goal is exploring how to build upon existing resources to create niches of technological innovation and secure a place within the division of labour in the global economy. (Etzkowitz 2008:137)

The production and diffusion of knowledge through a variety of channels allows a better circulation of people, ideas and capital in Triple Helix spaces. This also stimulates organizational creativity and combination of regional and local resources for reaching mutual objectives and new institutional formats. (Yegorov & Ranga 2014.)

2.3. Strategic management

Strategy refers to the plans set by the top level management for developing and sustaining competitive advantage. Strategic management, on the other hand, is a broader term since it includes top management's analysis of organization's environment and plan for strategy implementation and control. In other words, strategic management is the process which includes what must be done before a strategy is formulated. This process can be summarized in five steps: external analysis, internal analysis, strategy formulation, strategy execution, and strategic control. (Parnell 2014:1–11.)

Strategic thinking in management involves two processes: planning and thinking. According to Mintzberg (1994) planning concerns analysis, while thinking involves synthesis. Traditional strategy was mainly about building long-term defensible positions, while today's conditions require strategies to focus on continuous adaptation and improvement (Eisengardt and Brown 1998). (Steptoe-Warren, Howat & Hume 2011.)

2.3.1. Strategic gap analysis

A strategic gap reflects the imbalance between the current and the desired positions of the organization strategically (Harrison 1986). In other words, it "is a measure of the imperfect fit between the organization and its external environment" (Harrison 1996). Strategic gap does not exist if the capabilities of an organization are fully committed to exploiting all opportunities and avoiding all threats. (Harrison 1996.)

A gap analysis begins with assessment of the main capabilities of the organization in the principal categories of management, technology, policies, and resources. Another important point about this approach is that it involves the development of capabilities to discover areas of strength and weakness. Leontiades (1982) propose that strategic decisions are "a compromise between offence and defence with the optimum balance dependent on awareness of external conditions and skilful utilization of internal resources". (Harrison 1996.)

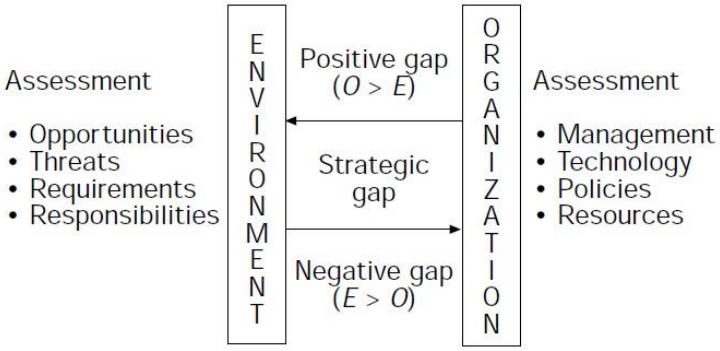

Figure 4. The concept of strategic gap (Harrison 1996).

As shown in Figure 4 there are three variations of strategic gap: positive, negative, and zero strategic gap. According to this if *O>E*, the strategic gap is balanced in favour of the organization thus a positive gap exists. If *E>O*, the organization is unable to exploit available opportunities, deal with threats, fulfill expected responsibilities. In other words, the organization is at a significant disadvantage in comparison with its external environment. (Harrison 1996.)

2.3.2. Strategic decision-making

A vital aspect of the strategist's role, while steering the organization into the future, is decision making (Steptoe-Warren et al. 2011). The two schools of thoughts in decision-making theory are: analytic and experiential (incremental) schools. Both of these

schools follow the same process in decision making: problem definition, alternative identification, evaluation and selection, and implementation. (Sipp & Carayannis 2013.)

Strategic decisions are considered as one of the main means in an organization's management by which limited resources are rationally committed to reach managerial goals for success, although they are complex and involve dynamic variables. The managerial decision-making and strategic gap analysis together form the strategic decision-making. (Harrison 1996.)

Harrison (1996) suggests using the following five criteria for identifying and making a strategic decision:

- The decision is intended to define the relationship between the organization and its environment.
- The decision takes the organization as a whole for the analysis.
- The decision encompasses all the major functions of the organization.
- The decision provides guidance for all the administrative and operational activities.
- The decision is important to the long-term success of the whole organization.

Decision-making process is also vital for developing resources, as it is difficult to determine where the performance heterogeneity exists in the firm and as well as implementing resource-based strategies (Foss 1997; Priem & Butler 2001). According to Amit and Schoemaker (1993) and Teece et al. (1997) for managers seeking to build competitive advantage, resource-based theory is not useful as is limited to explaining the past performance. (Kunc & Morecroft 2010.)

2.4. Operations strategy

Strategy is one of the most frequently-used words in the business world. It is defined as the direction and scope of an organization over the long-term, which gains advantage in a changing environment through its resource configuration with the aim to meeting

stakeholders' expectations (Johnson, Scholes & Whittington 2005). Operations management, and thus operations strategies are mainly concerned with organizational resources. The way that a business interacts with its external environment and the ability to meet its stakeholders' needs both depend on operations function. Therefore, operations management is a fundamental part of an organization's strategy. In an organization, strategy is considered to be at three levels: corporate level, business level, and functional level. Corporate level strategy is the highest level of strategy, often expressed in the form of a corporate mission or vision statement. Business level strategy is mainly concerned with a particular business unit, its strategic aims and objectives. Lastly, functional level strategy is the bottom level of strategy, which is concerned with how individual functions contribute to the actual business strategy. It is about how strategic objectives of each function should be and how they should manage their resources to reach those objectives. (Barnes 2008: 22–23.)

Slack, Chambers and Johnston (2004) suggest that operations strategy is about the pattern of strategic decisions and actions which determine the role, objectives and activities of operations (Barnes 2008:28). According to Davis, Aquilano and Chase (2003:30–32) operations strategy is the development of a plan using the main resources of the firm for a high degree of compatibility between these resources and the firm's corporate strategy in the long run. It also refers to contribution of operations management to a firm's ability to achieve competitive advantage in that marketplace. Therefore, competitive priorities such as low cost, high quality, fast delivery, flexibility and service form the operations strategies which depend on core capabilities of a firm. (Davis et al. 2003:30–32.)

Historically, manufacturing functions has been the focus of many of the operations strategy studies. This is due to the fact that manufacturing functions have been considered as the core of the businesses through which the performance was measured and enhanced to reach pre-set objectives. According to Slack, Chambers and Johnston (2009:63) operations are the resources that create products and services. In addition, over the last decades, there has been an increasing emphasis on service operations and supply chain management as operations strategy is assumed to be a subset of overall supply chain strategy (Boyer, Swink & Rosenzweig 2005). Fine and Hax (1985) defines

manufacturing strategy as a vital component of the firm's corporate and business strategies, comprising a set of well-unified objectives and action programs aimed at securing a long-term, sustainable advantage over the firm's competitors which should also be consistent with the firm's corporate and business strategies, as well as with the other managerial functional strategies.

Figure 5. A process model for manufacturing strategies (Kim & Arnold 1996).

Although there is not a universal agreement on how operations strategy should be described, four perspectives emerge from different views and definitions of the subject:

- Top-down: as a top-down reflection of what the business wants to do.
- Bottom-up: as a bottom-up activity where operations improvements build strategy cumulatively.
- Market requirements: translation of market requirements into operations decisions.
- Operations resource capabilities: exploiting the capabilities of operations resources in chosen markets (Slack et al. 2009:63).

Furthermore, there are several models or topologies have been proposed for strategy subject that also sheds light into the subject of operations strategy. According to Porter's model, as one of the most well-known strategy topology, there are three generic strategies for gaining competitive advantage: overall cost leadership, differentiation (product or service), and focus (segmentation).

Miles, Snow, Meyer and Coleman (1978) discuss how the world of an organization is changeable and complex and thus every form of organizational behaviour cannot be encompassed by a single typology. Their study proposes a formulation for categorizing organizations. According to this typological classification, there are four strategic types of organizations of which pure forms are described below:

Prospector: For the prospector strategy creativity comes before efficiency as more attention is given to market changes than to improving internal efficiency. Innovation, taking risks and searching for new opportunities are the main focus areas of this strategy. In a dynamic and growing environment, prospectors can create change and uncertainty, pushing the competitors to response. Nike, with its outward expansion and inward redesign of operations, 3M, and online companies such as Facebook and Google can be given as examples of prospectors. (Daft 2009:70; Thompson & Martin: 2005:345.)

Analyzer: For the analyser strategy, the aim is to maintain a stable business with a moderate level of innovation. It lies between prospector and the defender and with two aspects to observe: stable and changing. Stable form has formal structures and considers efficiency and keeping customers as a priority, while the changing form monitors competitors and their strategies to follow where growth is possible. Amazon.com, DuPont, IBM and Yahoo! are considered to be in the analyzer group. (Daft 2009:71; Thompson & Martin: 2005:345; Griffin 2013:213.)

Defender: This strategy is considered as the opposite of the prospector, since it is concerned with stability and retrenchment. It neither seeks for growth nor innovates. The primary concern is internal efficiency, present operations and steady customers. Defenders have conservative beliefs with low-risk strategies and limited ability to search

for anything new. Some of the well-known defenders are BIC and eBay. (Daft 2009:7071; Thompson & Martin: 2005:345; Griffin 2013:213.)

Reactor: The main characteristic of reactor is the inability to effectively respond to change pressures. In a reactor strategy, there is no defined long-range plan, a mission or goal for the organization to take actions for. Instead, it drifts with environmental events which might lead to failed companies. Miles et al. (1978) suggests three reasons why organizations become reactors: top management failing the articulation of organization's strategy, failure in shaping the organization's structure, and failure to adapt changes in environmental conditions. Kmart, Chrysler and Dell have shown signs of reactor strategy during the last decade. (Daft 2009:72; Thompson & Martin: 2005:345; Griffin 2013:214.)

Table 1. Miles and Snow's strategy typology (Daft 2010:73; Miles et al. 1978).

	Strategy	**Environment**	**Organizational Characteristics**
Defender	Protect turf; secure current market. Retrench	Stable	Tight control, centralized, production efficiency, low overhead
Prospector	Innovate. Find new market opportunities. Grow. Take risks.	Dynamic & growing	Strong in research. Innovative, flexible, decentralized structure
Analyzer	Maintain current market with moderate innovation	Moderately changing	Tight control and flexibility, efficient production, creativity
Reactor	No clear strategy. React to specific conditions. Drift.	Any condition	No clear organizational approach. Depends on current needs

According to Takala, Hirvelä, Liu and Malindzák (2007) a manufacturing strategy based on a business strategy includes competitive priorities, manufacturing objectives and action plans. Takala et al. (2007) propose that as the first step, competitive priorities are defined to answer what the manufacturing strategy function should achieve regarding to cost, quality, flexibility and delivery. Secondly, manufacturing objectives which

have relative emphasis on performance measures are determined. Finally in the third step, these objectives are used to form an action plan by which possible improvement programs and their expected effects are described. A process model of manufacturing strategy by Kim and Arnold (1996) is shown in Figure 5 above. (Takala et al. 2007.)

2.4.1. Competitive priorities

Operation strategies are established on the competitive priorities. It includes low cost, high quality, fast delivery, and flexibility which enable organizations achieve competitive advantage. According to Fine and Hax (1985) manufacturing strategic performance is measured using four main criteria; cost, delivery, quality and flexibility. These four components are called competitive priorities. According to Ward, McCreery, Ritzman and Sharma (1998) there is a broad agreement that manufacturing competitive priorities can be ex-pressed in terms of these four basic components although there are semantic differences:

Quality: It is measured by considering the return rate, product reliability, cost and rate of field repairs and cost of quality (Fine & Hax 1985). According to Parajogo (2007) quality is a reflection of the competitive strategy of organizations. Furthermore, Garvin (1987) identifies eight dimensions of quality as defined from the customer's viewpoint: performance features, reliability, conformance, durability, serviceability, aesthetics, and percieved quality. Quality is considered as a competitive weapon as it helps the organization create and sustain its competitive advantage. (Awwad, Khattab & Anchor 2013.)

Cost: It includes the evaluation of unit cost, total cost and life cycle cost (Fine & Hax 1985). Zhao et al. (2002) describe this priority as the ability to reduce product cost by reducing overheads, labour, raw material costs and production cycle time (Russell & Millar 2014).

Time (delivery): This priority is examined under percentage of on time shipments, predictability of delivery dates and response time to demand changes (Fine & Hax 1985). It also refers to speed and dependability. Kumar and Kumar (2004) state that

delivery of the required function means that the right product is delivered in the right quantity, at the right time, in the right place, from the right source, with the right service, and, finally, at the right price (Awwad et al. 2013).

Flexibility: It can be measured by product substitutability, product options or variants and response to product or volume changes (Fine & Hax 1985). Scholars agree on the importance of flexibility in coping with uncertainty. Boyer and Lewis (2002) defines it as the ability to change or react with little penalty in time, effort, cost or performance. In other words, it is about coping with changes efficiently and effectively. (Awwad et al. 2013.)

Ward et al. (1998) propose that competitive priorities should guide and constrain the design and operating decisions of manufacturing executives. Furthermore, Hayes and Wheelwright (1984) and Skinner (1969) propose, competitive priorities are useful to both decision makers and researchers, particularly because the variables guide decisions made on process choice, technology, capacity, manufacturing planning and control systems, and quality (Ward et al. 1998). Additionally, operational measures of these priorities have direct managerial utility in auditing the manufacturing strategy and in decision making process of appropriate benchmarking partners among other manufacturers (Ward et al. 1998).

2.4.2. Resource-based view of the firm

Resourced-based view of a firm provides a theoretical foundation for understanding the role operations strategy play in creating and sustaining a competitive advantage (Boyer et al 2005). Resource-based view (RBV) approach is started by Penrose (1959) investigating how management internal process can influence behaviour of the company. According to Penrose's theory a company can make economic value by having special ability in managing its resources (Anwar, Subroto, Alhabsji & Djumahir 2014). It has emerged as a unique model of how firms compete since the mid-1980s (Barney 1991, Peteraf 1993, Akio 2005). The idea that firms are heterogeneous in terms of their resources and internal capabilities has been at the centre of the strategic management

field. It is suggested that RBV model can be practically used by managers who seek to understand, preserve, or extend their competitive advantage. Furthermore, resources are said to be perfectly immobile if they cannot be traded. Other kinds of resources which are tradable and specialized to firm-specific needs are described as imperfectly mobile. (Peteraf 1993.)

According to Barney (1991:101, 2001:625) firms resources include all assets, management skills, capabilities, organizational processes and routines, firm attributes, information, knowledge, etc. These resources can be classified into three categories: physical capital resources, human capital resources, and organizational capital resources. According to this classification, physical capital resources include the physical technology, plant, equipment, geographic location of a firm, and its access to raw materials. Human capital resources include the qualities of individual managers and workers in a firm such as training, experience, judgement, intelligence, relationships, and insight. Lastly, organizational capital resources include formal reporting structure, formal and informal planning, controlling, and coordinating systems of a firm, as well as informal relations within a firm and between the other firms in its environment. (Barney 1991:101.)

Barney (1986) discusses that it is possible for a firm to gain expectational advantages by analysing information on the assets it already possesses. By analysing the resource position, a manager would have a clearer understanding of his situation for a sustainable advantage and thus fewer strategic mistakes would be made. As long as the assets of a firm are imperfectly mobile, that is inimitable, and non-substitutable, other firms will not be able to copy its strategy. (Peteraf 1993.)

RBV approach is mainly about resource and capability. By identifying the strength and weakness of the resource, companies can make priority scale and select resources that can be optimized to produce the productivity and efficiency. Lastly, RBV shows that the implementation of operations strategy is built by strength and weakness of resource operations targeting competitive advantage gain. (Anwar et al. 2014.)

2.5. Sustainable Competitive Advantage

In order to comprehend what SCA (Sustainable Competitive Advantage) really means in today's world, the distinction between competitive advantage and SCA should be drawn carefully.

The theory of competitive advantage was first proposed by Porter in 1985. He concentrated on the firm trying to find a way to conceptualize it that would reveal the building stones of competitive advantage and its sustainability. Porter (1996) proposes that competitive advantage is at the core of a firm's performance and thus the success and failure. According to Fahey (1989) competitive advantage stands for anything that distinguishes a firm from others from the viewpoint of its customers. Kay (1993) defines it as an advantage over a competitor or a group of competitors in a specific market, strategic group or industry. (Foon & Nair 2010:64.) Competitive advantage can also be used to gain profitable market share which will bring the need for protection. In order to make the best use of its limited resources, a firm should target competitors that it sees as biggest treat and about whom it has the most knowledge. Naturally, a firm is expected to have more knowledge about existing competitors that pose bigger threat than potential competitors. (Barney, McWilliams & Turk 1989.) Barney et al. (1989) suggests competitive strategy should focus on insulation of firms from existing competitors since the ability to develop effective competitive strategies for potential competitors with specific unknown capabilities is limited. However, there is a need for maintaining the competitive advantages over time for both existing and potential competitors. Therefore, the objective of the firm should be sustaining the competitive advantage.

Sustainability of a competitive advantage depends upon the possibility of a competitive duplication. Sustainability is achieved only if it continues to exist after efforts to duplicate that advantage have ended (Barney 1991:102). In other words, SCA is an implementation of a unique value creating strategy while other organizations are still unable to realize the benefits of it. After he first postulated the resource-based view of the firm in 1991, Barney (2001) developed the definition of SCA as a resource-based theory. According to his theory, in order to have the potential of sustained competitive ad-

vantage a firm resource must be valuable, rare, imperfectly imitable, and without equivalent substitutes (Barney 1991:105–106). Furthermore, Baumol et al. (1982) and Barney et al. (1989) suggest that the term "sustainable competitive advantage" is used to describe the attributes and resources of a superior performer which cannot be duplicated or imitated by the current or potential competitors in an industry. (Foon & Nair 2010:64.)

The theory of SCA has emerged as one of the most important theoretical frameworks in strategic management field in the recent years. The development of SCA could be categorized into two major concepts as follows: cost and differential advantage concepts, and resource based concept. As the more recent view, the concept of the resource-based view (RBV) (Barney 1991; Conner 1991; Peteraf 1993) has been dominant in studies related to the sources of SCA. Another dominant concept was "intangible resource" (Hall, 1993) which mainly focused on intangibility of resources as source of competitive advantage such as branding, market orientation, organizational learning, innovation, and relationship marketing. Although, in the last two decades, new terminologies such as learning organization, knowledge management, technology and innovation, and globalization have emerged, SCA remained as one of the most important issues in strategic management. Lastly, the sources of SCA and the main focus of firms have become more tacit and intangible in the 21st century. (Foon & Nair 2010:64–75.)

3. SLOVENIA AND SMART SPECIALIZATION STRATEGIES

3.1. The Republic of Slovenia

The Republic of Slovenia is located in Central Europe with the neighbouring countries Italy, Austria, Croatia, and Hungry, and stretching across the Alps, the Dinaric Alps and the Pannonian Plain to the Mediterranean (Vlada n.d.). The capital Ljubljana is located in the centre of the country. Its population is 2,061,085, which is 0.4% of total EU population. Slovenia became a member of EU in 2004. It joined the Eurozone in 2007 and also became a Schengen Area member in late 2007. (Europa 2015.)

Figure 6. County map of the Republic of Slovenia (World Fact Book 2015).

The country covers an area of 20,273 km^2. Despite being geographically small, it has its own characteristics and unique features. Around half the territory of Slovenia is covered by forests (10,124 km^2); it is the third most forested country in Europe, after Finland and Sweden (Slovenian S3 2014). The most important sectors of the country's economy

were industry, wholesale and retail trade, transport, accommodation and food services, and public administration, defence, education, human health and social work activities in 2014. The main export and import partners are Germany, Italy and Austria. (Europa 2015.)

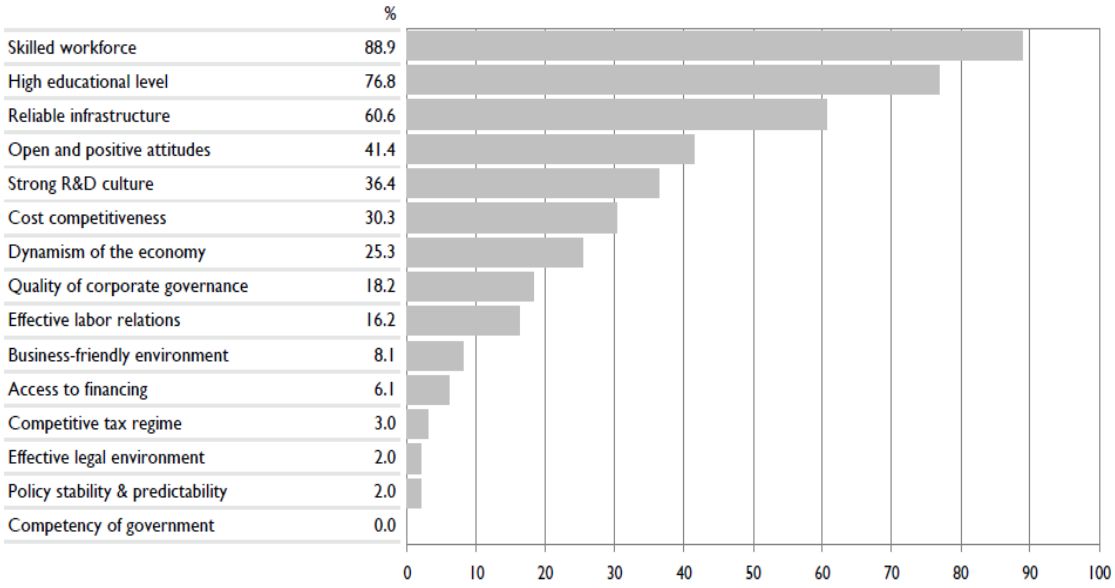

Figure 7. Key attractiveness indicators for Slovenia (WCY 2014).

Despite having suffered the recession in 2008-2009 in the wake of the global financial crisis, Slovenia has one of the highest per capita GDPs in Central Europe with a well-educated labour force (approximately 913,500), and a strategic point between the Balkans and Western Europe. In 2014, with the help of growing export due to the demand in larger European markets, GDP growth raised up to 2.6%, while the high unemployment rate fell to 13%. According to 2014 estimations, GDP of the country was composed by 2.1% agriculture, 28.4% industry, and 69.5% services as by sector of origin. Some of the industries contributing to GDP are: ferrous metallurgy and aluminium products, lead and zinc smelting; electronics, trucks, automobiles, electric power equipment, wood products, textiles, chemicals, machine tools. (World Fact Book 2015.)

3.2. Forests and wood-processing sector in Slovenia

Slovenia is one of the most forested countries in Europe with 1,186,104 ha of forests (in 2010) covering more than a half of its territory (62.3% in 2011 according to World Fact Book). Most of these forests consist of beech, fir-beech and beech-oak sites (70%) with a high production capacity. 76% of Slovenian forests are private property, while the remaining 24% is owned by the state or communes. State-owned forests are larger and undivided, which enable professional management. However, the private forest estates are mostly small and fragmented. Therefore, they are not of economic interest. The number of the private owners in Slovenia is around 313,000 (with co-owners 461,000). The major fragmentation of forests and the high number of forest owners constitute a serious problem in professional management of private forests in the country. Furthermore, it becomes an obstacle to optimal timber production and utilisation of forest potential. (ZGS 2005 & 2010.)

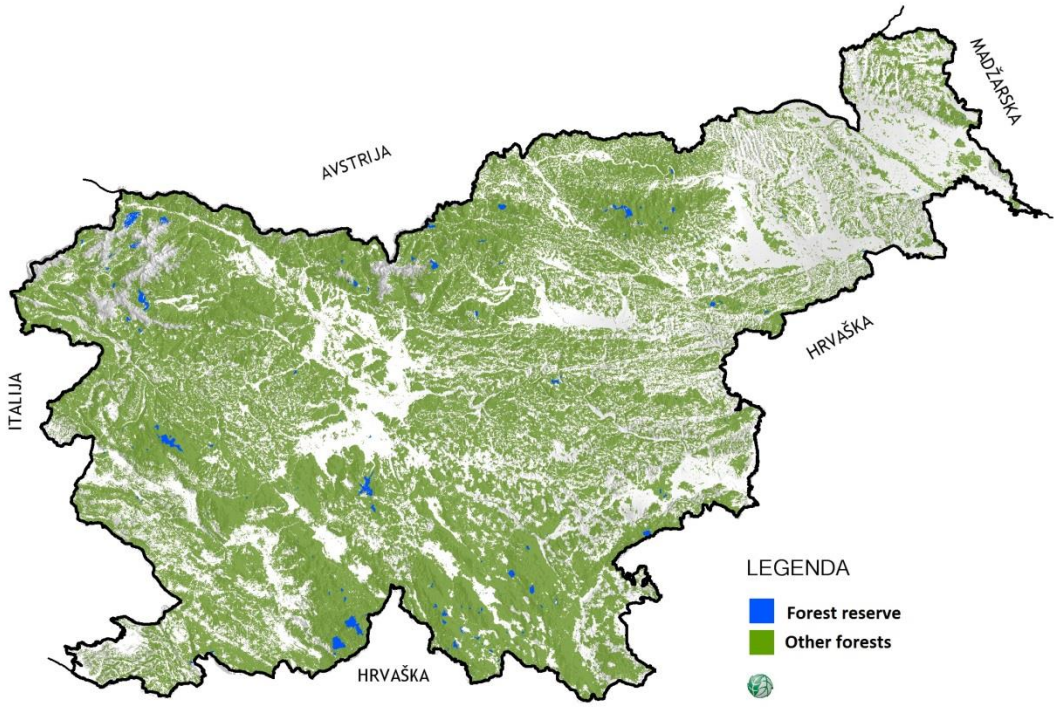

Figure 8. Slovenian forest reserves by 2013 (ZGS 2015).

According to forest management plans reported by Slovenian Forest Service (ZGS – Zavod za Gozdove Slovenije) the growing stock of country's forests totals to 327,500,000 cubic metres or 276 cubic metres per hectare. There is an annual increment of 8,000,000 cubic metres of wood or 6.7 cubic metres per hectare in forests. During the recent years (until 2010) the cut in Slovenian forests has totalled 3 million m^3 of trees per year. However, it was reported that the cut fell behind the possible one according to the forest management plans. Furthermore, Slovenian forests have been endangered by insects in addition to the damage caused by wind, sleet, snow and other extreme weather conditions. Insects, mainly bark beetles are the main reason for sanitary cut which on average amounts to a third of the entire cut, around 30% and between 19% and %45 of the total cut in different years. In addition to making the implementation of planned forest management difficult, it also weakens the bio-ecological stability of forests. (ZGS 2005 & 2010.)

The forest reserves in Slovenia are an important source of wood biomass for energy. The sustainable potential of wood biomass for energy supply amounts to 1.4 million m3 per year. In 2013, over 1 million m3 of fuelwood was produced in the country. As a consequence of increase in tree felling, the quantity of the removed wood which can be used for energy also increases. Also, in the last five years, the share of wood waste used for energy purposes raised by 50% compared to all wood waste. In 2013, in total 190,000 tons of wood waste used for energy purposes. (Gale 2015.)

The use of renewable energy has been increasing in Slovenia. The country aims to reach at least 25% share of renewable sources in gross final consumption within the frame-work of EU objectives for 2020. As the most important renewable source of energy, the use of wood has also been encouraged by the government. The country has been pro-moting and hastening the use of wood for producing electricity and therefore adopted regulations to support this attitude. (Krajnc et al. 2011.)

According to Krajnc et al. (2011) development of production and use of wood biomass in Slovenia is affected by the following:

- Principles of forest management in the country
- Harvesting technology and use of biomass
- Fragmentation and size of private forests
- The market of wood fuels
- Socio-economic status of forest owners
- Lack of knowledge on efficient use of biomass as fuel
- Lack of confidence in the sustained supply of quality fuel.

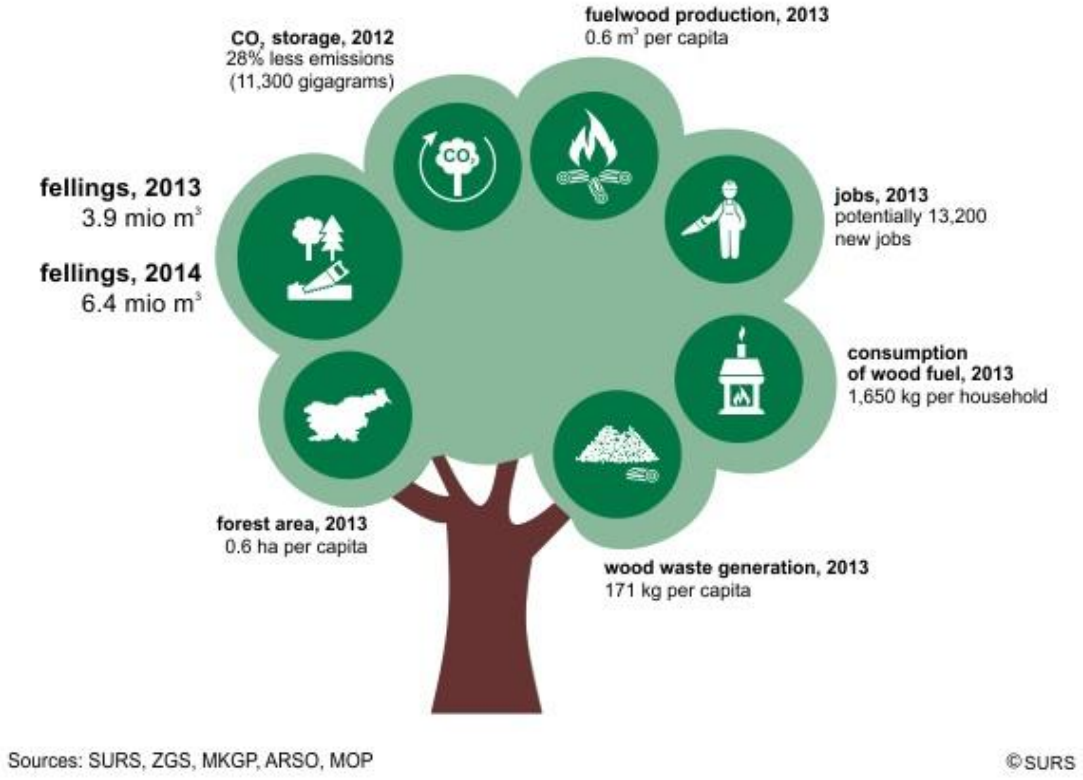

Figure 9. Statistical data for Slovenia (Gale 2015).

Forest-wood product chain is the only economic product chain in Slovenia that has sufficient quantity of raw material, geographically dispersed, with technologically well-equipped manufacturing facilities (Humar et al. 2011). Despite the socio-economic turbulences in the near past, Slovenia has been successful in conserving its forests in a healthy sustainable and predominantly natural state. However, country's forest man-

agement did not result in a successful use of wood or the well-developed wood technology. Wood is the only abundant natural renewable resource in Slovenia, however, is not sufficiently used or sustained. (Humar & Kraigher 2009.)

The Slovenian Forestry Institute (SFI) is the main national forest research institute in the field of basic and applied forest research, landscape, ecosystems, health, forestry, wildlife and hunting in the country. Some of the key on-going international projects carried out with the attendance of the institute are (Simončič 2014.): Euforinno, Biomasstradecentre II, Emonfur, Woodapps, Startree, and Simwood.

EUFORINNO is one of the major on-going (2012-2015) projects in collaboration with ASP Teisendorf, including exchange of knowledge to enhance and promote scientific excellence and visibility of SFI with a budget of 2.91 million Euros. Additionally, the institute adopts sustainability, close-to-nature management, multi-purpose management, and conservation of forest genetic resources (FGR) as fundamental principles. Therefore, it aims sustained preservation of forests and sustained use of wooden goods and non-material functions. (Simončič 2014).

Woodworking industry has always been important for Slovenia. According to 2012 records, there are 887 companies actively operating in wood-processing sector in Slovenia with approximately 11,800 employees generating 951 million Euros. The key export markets are: Algeria, Austria, Bosnia and Herzegovina, Croatia, Italy, Germany, Libya, Saudi Arabia, Tunisia, Serbia, and Switzerland. Together the exports to these countries generate up to 483 million Euros of income. (SPIRIT Slovenia 2014.)

In Slovenian wood-processing sector, there is a full product of both mechanical and chemical processing. The mechanical branch includes milling, manufacturing of plywood and particle board, as well as furniture and timber components for other industries. The chemical branch includes production of pulp and paper, cardboard, packaging materials and surface coatings. In addition, waste and residues from forestry and related industries are used as biomass in the production biofuel. According to Chamber of Commerce and Industry of Slovenia, the companies in woodworking and furniture in-

dustries and the Chamber of Agriculture and Forestry established contact with around 70% of forest owners and other actors in the forest sector in order to strengthen the relation between forest owners, forest managers and the manufacturers. The aim of this is to increase the number of jobs available and higher value added products in the woodworking industry. There are numerous opportunities for woodworking companies to export value added products as well as using biomass to generate the energy needed for production, instead of trading raw timber alone. (SPIRIT Slovenia 2014.)

Additionally, fragmentation in product chain, problems with skilled employees, the relationship between knowledge institutions and companies, as well as the inadequate positioning of the sector in the state in the past have been considered as the issues in Slovenian wood industry (Humar et al. 2011). Furthermore, Slovenian furniture and furnishing industry has been facing problems due to low value-added products and decreasing export competitiveness. The annual increment in the country is over 9 million cubic meters of renewable raw material. The key is the wood-processing industry as the latest competitiveness policy support activities focusing on promotion of R&D, promotion of forest-wood chains, use of wood and wood products, efficient and innovative marketing, new jobs and the growth of added value per employee in forestry and the wood-processing industry. In an adequately arranged value chain the value of a cubic meter of wood from forest to a sold finished wood product or a building on the market can increase substantially and even more when wood is used in a high-tech product. Therefore, wood undoubtedly is a natural asset of Slovenia that should be utilised efficiently. (SPS 2014.)

3.3. Sleet disaster and its effects in Slovenia

According to the Slovenian national forest health inventory carried out in 2013, the assessment encompassed 1056 trees, 396 coniferous and 660 broadleaved trees with a mean defoliation of 25.9% for all tree species. The share of damaged trees later reached 30.9%. The mean defoliation of all tree species has been slightly increasing since 1991. (Michel & Seidling 2014:117.)

In February 2014, an ice storm hit Slovenia leaving severe damages behind. In addition to damage on forests, thousands of households were left without electricity due to the damage on the electrical infrastructure. The sleet (ice storm) affected 11 out of 13 regions and 160 out of 212 municipalities. The damage caused in forests is extremely high. According to the estimations 51% of Slovenian forests (7 million m^3) were damaged. Combined with the damage on road and railway infrastructure the estimated cost of the disaster is over 430 million Euros. (Hudohmet 2015.)

As a consequence of the ice storm, Slovenia has an enormous quantity of wood waiting to be utilized. Otherwise, the bark beetle outbreak will ruin an additional part of the country's forests (Strovs 2014). Having started straight after the disaster, revitalisation activities are expected to continue until 2018. It includes natural process and planting of seedlings as well as repairing of electricity lines, railways and roads which have already been mostly done by the end of 2014. The bright side of this natural disaster is the increasing trend in the use of wood waste and biomass which local companies have been ready with the collaboration of Slovenian Forestry Service. (SPIRIT Slovenia 2014.)

The disaster caused a movement of wood prices on the market as a consequence of increased supply. In addition to the decrease in purchase price of wood, price of fuel wood also decreased. The felling was 65% of potential in 2013. If the removal was up to 100%, there would have been opportunities for 13,200 new jobs in positions related to forest resources. (Gale 2015.)

3.4. Smart specialisation strategy of Slovenia

The Smart Specialisation Strategy brings a different approach for the Member States of the EU in determining policies in research, development, and innovation. The main idea and benefit of this is promotion of efficient and effective fund investment in areas where the highest value added and contribution most to objectives of sustainable growth and development. Also, specialisation of the states and regions in their clearly defined areas enables achieving critical mass as well as promoting better performing economies at the

regional and state levels individually. In the areas where Slovenia has the critical mass of knowledge, capacities and competences as well as the innovation potential for development recovery, there is a need for establishing consensus to direct investments where appropriate. Therefore, smart specialisation is the process to ensure balanced and development priority-oriented functioning of policies. However, it requires an in-depth analysis of strengths and weaknesses of the state or region with good governance and a shared vision of stakeholders. (SPS 2014.)

S3, as a broad range of development policies related to innovation, means particularly promotion of research and innovation, industrial policy, entrepreneurship, education system, rural development and international relations. Smart specialisation strategies are structured in two pillars. The first pillar refers to entrepreneurial and innovation ecosystem. The second pillar refers to value chains and networks where niche products and services are being identified for connecting competences and potentials. (SPS 2014.)

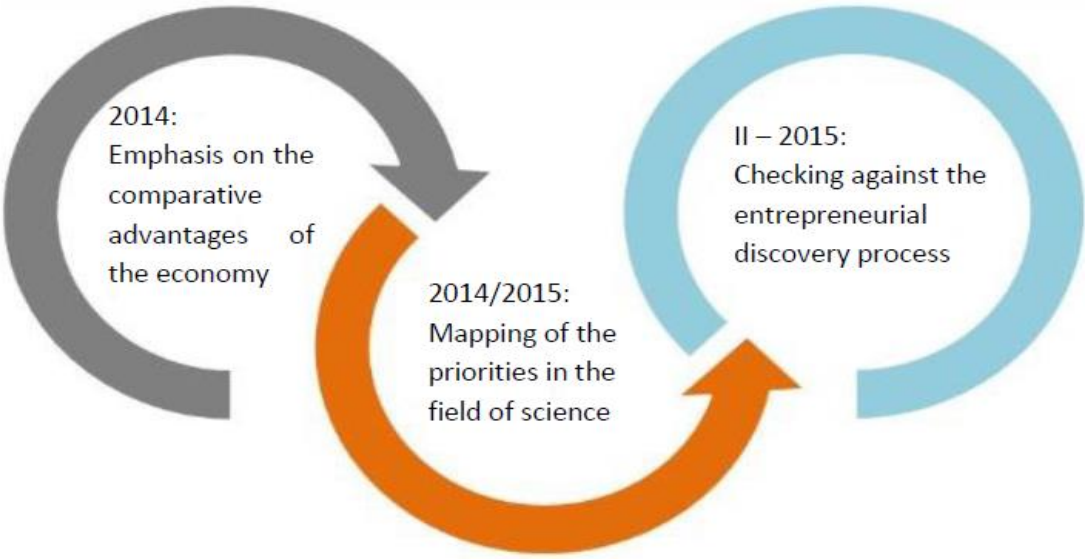

Figure 10. Initial smart specialization plan for Slovenia (SVRK 2015).

According to the report "Smart Specialization Strategies of the Republic of Slovenia" (SPS 2014) Slovenian smart specialisation strategies, mainly, target building on its natural assets, focus on its particular qualities, and support achieved broader public consen-

sus for the vision of the "green Slovenia". The strategic objectives of the Slovenian S3, with innovation being ranked at the top of political priorities, are as follows:

I. Developing and positioning the country as an attractive innovative ecology, with a focus on development of medium and high-tech and comprehensive solutions for niche areas where Slovenia has key capacities and know-how to compete in the global market.

II. Establishing dynamic, strategically-guided, responsive, highly advanced, globally up-to-date and connected research, innovative and entrepreneurial ecosystem.

The overview of key strengths, weaknesses, opportunities, and threats (SWOT analysis) reveals that the achievement of the above mentioned S3 objectives requires the following to be considered as priority areas: knowledge transfer and application, entrepreneurship, creativity and talent, and internationalization. Slovenian has to ensure connection of best players in or out the country in order to establish itself in international value chains and networks. International requires a well-established support mechanism provided by industrial policy, entrepreneurship, generating conditions for networks of knowledge creation, transfer and application. S3 in Slovenia is not a concept for only cities and related areas. Instead, it is an innovation strategy for the whole country, including for all the regions and rural areas. In line with the international dimension of S3, successful specialisation requires related activities to be conducted in cooperation with neighbouring regions and both macro-regional and inter-regional level. (SPS 2014.)

> *Development and specialisation of agriculture, food-processing industry, fisheries and forestry, and the challenges faced by micro, small and medium-sized enterprises in rural areas, require an adequate level of competence in the technological, economic environment and many other areas as well as enhanced ability to obtain and exchange knowledge and information, including the spread of best production practices in agriculture and forestry.*
>
> SPS 2014

Slovenia is preparing the key national strategic documents for the period 2014-2020, particularly including partnership agreements, S3s, and operational programmes (OPs) corresponding to these strategies by which the EU funds are expected to support the restructuring of the country's economy and increase the efficiency of the national innovation system (Stanovnik 2014).

According to the 2015 report published by Innovation Union Scoreboard (IUS), Slovenia's innovation performance has been increasing during the last eight years. The country has been listed in "innovation followers" group with innovation performance above or close to that of the EU average, with Austria, Belgium, France, Ireland, Luxembourg, Netherlands, and the UK. Despite being the weakest performing country in its group, Slovenia has been the fastest growing innovation follower with an average annual growth rate of 2.6%. According to 2015 data (as updated on May 2015), during the last year the country has shown a slight increase in innovation performance just above EU average and managed to remain within innovation followers (strong innovators) group. Furthermore, Slovenia has been among the best performers following Finland, Estonia, Sweden, and Denmark for firm investments with its companies investing much more in science-based R&D and in advanced equipment and machinery. During the last eight-year period, performance of Slovenia in intellectual assets has increased rapidly. (Hollanders, Es-Sadki & Kanerva 2015.)

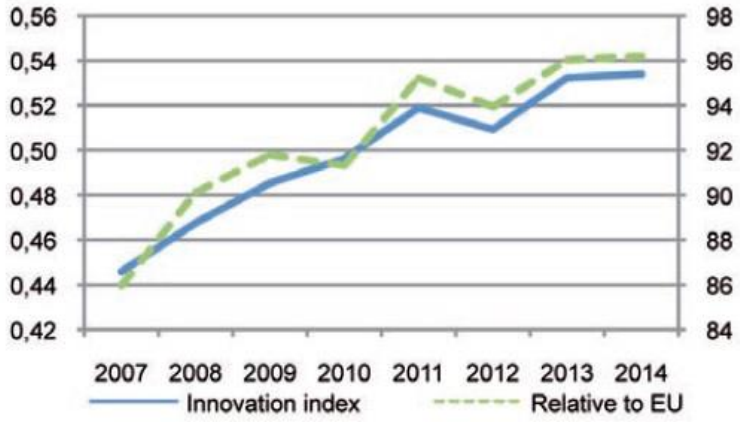

Figure 11. Slovenia innovation index compared to EU (IUS 2015).

According to Innovation Union Scoreboard (2015), R&D expenditure in the business sector is close to 2% of GDP in Slovenia, after Denmark, Germany, Sweden and Finland. However, the country's performance for R&D expenditure in the public sector as percentage of GDP falls below the EU average. Similarly, non-R&D innovation expenditure as percentage of total turnover and SMEs innovating in-house as percentage of all SMEs are the two other areas Slovenia falls below the EU average. Moreover, the degree to which SMEs are involved in innovation co-operation with others is fairly high. In other words, the flow of knowledge between public research institutions and private firms and between firms and other firms is efficient and stable. Furthermore, it is possible to observe good figures for public-private research linkages and active collaboration activities between business sector researchers and public sector researchers resulting in academic publications in the country. (Hollanders et al. 2015.)

One of the major problems Slovenian SMEs face is the process of development, and especially management problems during the transition from a family or local company to medium-sized or bigger companies with higher growth and development potential. The reason for such problems usually is poor entrepreneurial climate (internally), poor process design and organization of operations, inadequate R&D processes, unawareness of the global growth potential, insufficient financial resources, and unstable short-term opportunities in the area. As a part of sub-programme "Design Slovenia", the activities of "Creative Slovenia program are expected to encourage organizations, young researchers, students, academics, laboratories, companies, and various groups of users to adopt open innovation as a constant process. This, as a result, will make the companies get to better high-tech products rapidly with a higher level of integration. Furthermore, it will accelerate the emergence of new industries, as well as creating new ones, in Slovenia as a solution to problems the traditional industrial branches suffer from and result high potentials of enabling technologies with the support of educational and research institutions. (SPS 2014.)

According to a study (Burger & Kotnik 2014) conducted for identifying the needs of the S3 preparation, key economic industries in Slovenia are: chemical industry, pharmacy and medical equipment, basic and fabricated metal products, electronic and electrical

industry, ICT, mechanical engineering, automotive and nautical industry. Burger and Kotnik (2014) further suggest dynamic parts of some of the less visible sectors are: textiles, wood and wood-processing industry, recycling, creative industries, logistics, construction and construction of houses.

4. METHODOLOGY

In this chapter, the methods applied to empirical data as a part of S&R analysis are presented. Also, the questionnaire used to obtain the empirical data is introduced with data collection process. Lastly, validity and reliability of the study are discussed in the last section of the chapter.

4.1. Research methods

4.1.1. Sense and Respond methodology

Sense and Respond (S&R) first appeared in Haeckel's Management Review article as a business concept in 1992. Bradley and Nolan were the developers of the S&R thinking which was further analysed by Markides as dynamic business strategies. (Liu, Qian, Zhao & Takala 2011.)

According to Takala and Uusitalo (2012) S&R is the philosophy of executing the best practices in a constantly changing environment by detection of changes (sensing) and reacting to these changes properly (responding) (Takala & Uusitalo 2012).

The S&R model is used to help organizations in dynamic decision-making to describe, evaluate, benchmark and optimize lower level resource allocations in order to meet the performance requirements of all the interest groups inside and outside the organizations and thus to improve higher level strategies (Liu 2010). Therefore, Liu et al. (2011) propose that the ability to quickly adjust processes will be a decisive factor in the concurrent economy.

In order to make the right decisions, management of an organization need to have a profound overview of both the current situation and future development possibilities. Therefore, Critical Factor Index (CFI) has been developed to offer different supporting decision-making model which is also a fast and reliable method for management pur-

poses (Nadler & Takala 2010). CFI methodology and the questionnaire used as the tool for application of these methods are further presented in the following sections.

4.1.2. Critical Factor Index Methods

CFI was first introduced by Ranta and Takala (2010) as a tool that measures the experiences (past) and expectations (future). It has been developed as a method which enables finding the critical factors of the process by utilizing the experts' views (Liu, Takala, Siltamäki, Wu, Heikkilä & Gauriloff 2011). A new formula called BCFI (Balanced Critical Factor Index) was developed by Nadler and Takala (2010). It aims at detection of the attributes affecting organization's business performance by providing the organization with the possibility for its adjustment and development. (Nadler & Takala 2010.)

Liu et al. (2011) introduced a new formula SCFI (Scaled Critical Factor Index) which further analyses the direction of development for the attributes. Finally, based on the former models, Liu proposed a further improvement with a new one called NSCFI (Normalized Scale Critical Factor Index) which adds the trend research to the method. It is also discussed that the NSCFI give higher-accuracy managerial implications compared to former ones. (Vuoti, Takala, Mäntylä, Liu, Yang, Malek, Kronman, Kreuzer & Zafar 2014.)

The S&R model proposed by Ranta and Takala (2007) is used for the empirical analyses in this study. According to this model, gap index, direction of development index, importance index, standard deviation of experience and expectations are calculated for the CFI, BCFI, SCFI and NSCFI calculations (Liu 2010). The raw data for the empirical analyses are obtained by questionnaires which will be further discussed in the following sections.

Gap index is calculated to understand the gap between experience and expectations of a specific attribute. The development index provides the information about the direction of the organization's development. The importance level of an attribute is calculated by actual expectations for that attribute, whereas performance index represents the actual performance of an attribute based on the experience indicated by respondents in the

S&R questionnaires (see Table 2). Furthermore, standard deviation of experience and expectation calculations reflects whether there is a similar or contradictory evaluation for the attributes. (Takala, Shylina & Tilabi 2014.)

The final equations for these indexes are as follows:

$$Gap\ index = \frac{Average\ of\ expectation - Average\ of\ experience}{10} - 1 \quad (1)$$

$$Development\ index = \left|\left(\frac{Better\% - Worse\%}{100}\right) - 1\right| \quad (2)$$

$$Importance\ index = \frac{Avarage\ of\ expectation}{10} \quad (3)$$

$$Performance\ index = \frac{Average\ of\ experience}{10} \quad (4)$$

$$SD\ experience\ index = \frac{Std\{experience\}}{10} + 1 \quad (5)$$

$$SD\ expextation\ index = \frac{Std\{expextation\}}{10} + 1 \quad (6)$$

$$BCFI = \frac{SD\ expectation\ index \cdot SD\ experience\ index \cdot Performance\ index}{Importance\ index \cdot Gap\ index \cdot Development\ index} \quad (7)$$

$$SCFI = \frac{\sqrt{\frac{1}{n}\sum_1^n [experience(i) - 1]^2} \cdot \sqrt{\frac{1}{n}\sum_1^n [expectation(i) - 10]^2} \cdot Performance\ index}{Importance\ index \cdot Gap\ index \cdot Development\ index} \quad (8)$$

$$NSCFI = \frac{\sqrt{\frac{1}{n}\sum_1^n [experience(i)]^2} \cdot \sqrt{\frac{1}{n}\sum_1^n [expectation(i) - 11]^2} \cdot Performance\ index}{Importance\ index \cdot Gap\ index \cdot Development\ index} \quad (9)$$

The equations also present the development of CFI models over time. In this thesis, NSCFI is used for the calculations since it is accepted as a more accurate and up-to-date model. In addition to this traditional method, a new of version (CFI′) is also used for the analysis. It has been developed by Takala and Kamdee (2015) in order to reduce the complexity of the equation and to scale down a distortion of the independent variable and thus to preserve the natural form of variables. As shown below, in the new model CFI′ is obtained by firstly calculating balance index (I_{Bal}) and gap index (I_{Gap}) with mean of expectations and experiences (x_{Ep}, x_{Er}). After finding the development index (I_D) based on direction of development (grows, remains the same, lowers), finally the new normalized critical factor index (CFI′) can be calculated.

$$I_{Bal} = \frac{\bar{x}_{Er}}{\bar{x}_{Ep}} \tag{10}$$

$$I_{Gap} = 2^{\frac{\bar{x}_{Ep} - \bar{x}_{Er}}{10}} \tag{11}$$

$$I_D = 2^{\left(\frac{Lowers}{Grows + Remains\ the\ same + Lowers}\right) - \left(\frac{Grows}{Grows + Remains\ the\ same + Lowers}\right)} \tag{12}$$

$$I_D = 2^{D_W - D_B} \tag{13}$$

$$CFI = \frac{\left|\bar{x}_{Ep} - 11\right| \times \bar{x}_{Er} \times I_{Bal}}{I_{Gap} \times I_D} \tag{14}$$

$$CFI' = \frac{CFI}{\sum CFI} \tag{15}$$

For increased practicality and better interpretation, CFI results are grouped in three categories based on the traffic light colours. According to this, red represents criticalness

of under-resourced attributes. If the CFI value of an attribute is over-resourced, it is also accepted as critical but marked with yellow. The attributes which are non-critical are marked with green representing the safe area where all the attributes should be. In order to identify which color an attribute will be marked with, the level of criticalness is calculated for each relation and thus for each version of S&R questionnaire. The total value of resources is considered as 100% in each questionnaire. Dividing this total value by the numbers of attributes the average resource level can be determined. If the value of an attribute falls between the range of 1/3 and 2/3 of the average level, it is then considered as balanced or non-critical and marked with green. If the value of an attribute is found to be lower than 1/3 of the average level, it is then defined as an under-resourced critical attribute. Lastly, any attribute which has a value higher than 2/3 of the average level is considered to be over-resourced.

4.1.3. Manufacturing Strategy Index

Miles and Snow (1978) proposed that the analytical models for manufacturing strategy are used to calculate the operational competitiveness indexes of companies in different competitive groups which are named prospector, analyzer, defender, and reactors as mentioned in the previous sections (Liu 2010). The responsiveness, agility and leanness (RAL) holistic model, according to Takala, supports the theory of analytical models using four main criteria (Liu 2010). These are quality, cost, time and flexibility as mentioned under competitive priorities.

The manufacturing strategy index (MSI) is modelled based on the multi-criteria priority weights of quality (Q), cost (C), time or delivery (T), and flexibility (F), as function MSI= f_{MSI}(Q,C,T,F). Below the equations for calculation of normalized weights of competitive priorities are presented:

$$Q' = \frac{Q}{Q + C + T} \tag{16}$$

$$C' = \frac{C}{Q + C + T} \tag{17}$$

$$T' = \frac{T}{Q + C + T} \tag{18}$$

$$F' = \frac{F}{Q + C + T + F} \tag{19}$$

The analytical models for calculating the manufacturing strategy indexes of operational competitiveness in each group are shown below (Liu 2010). The MSI model for prospector, analyzer, defender groups respectively are as follows:

$$MSI_P = 1 - \left(1 - Q'^{1/3}\right) \cdot (1 - 0.9 \cdot T') \cdot (1 - 0.9 \cdot C') \cdot F'^{1/3} \tag{20}$$

$$MSI_A = 1 - (1 - F') \cdot |(0{,}95 \cdot Q' - 0.285) \cdot (0.95 \cdot T' - 0.285) \cdot (0.95 \cdot C' - 0{,}285)|^{\frac{1}{3}} \tag{21}$$

$$MSI_D = 1 - \left(1 - C'^{1/3}\right) \cdot (1 - 0.9 \cdot T') \cdot (1 - 0.9 \cdot Q') \cdot F'^{1/3} \tag{22}$$

$$MSI_R = \frac{(MSI_P + MSI_D)}{2} \tag{23}$$

Manufacturing strategy index for the reactor group (MSI_R) is calculated by finding the middle point of prospector and analyzer strategy values. According to Miles and Snow, reactor group, in contrast to the three other stable groups, does not lead to a consistent and stable organization and thus it is advised that the company changes over to one of the other stable groups (Liu 2010). Therefore, Takala's justified presentation of multi-focused manufacturing strategies covers the three stable groups (Liu 2010). In this study, calculated strategy index values for reactor group are presented for comparison purposes.

4.2. Data collection

In order to gain insights into the theoretical foundations of the case and obtain the appropriate data required for this research and application of methods introduced previously, both primary and secondary data were collected. The secondary data was collected from relevant literature including textbooks, journals, articles and other sources both online and printed. The primary data was collected by S&R questionnaire which was developed by Rautiainen and Takala (2003) for obtaining the required information from the relevant respondents to apply the S&R method. In the questionnaire, respondents are asked to evaluate each attribute based on their experience and expectations in the area by rating the performance in a scale of 1 to 10. Next, direction of development is indicated as worse, same or better for both past and future. The triple helix formed by academy, industry, and government spheres consists of 9 different relations when these are considered as unilateral. In order to get accurate information on how these spheres view each other in their cooperation, 9 different questionnaires which are different in terms of either attributes or competitive priority distribution were prepared for the study. These questionnaires are attached at the end of the thesis as appendix. In Table 2, the format of basic form of the questionnaire used in this study is illustrated.

Table 2. S&R questionnaire framework.

	Experiences	Expectations	Direction of development, experiences (past) X			Direction of development, expectations (future) X		
ATTRIBUTES								
	(1-10)	(1-10)	Worse	Same	Better	Worse	Same	Better
Area of Cooperation								
Cooperation attribute 1								
Cooperation attribute 2								
Cooperation attribute 3								

The questionnaires were sent respectively to respondents from universities, companies, and public organizations which interact actively with forest industry. In addition to responses obtained from municipalities, local bodies and other public organizations in or

around Ljubjana, Slovenj Gradec, and Maribor, public group have responses from Slovenian Forest Institute and Race Kogo. Company group respondents include Gozdno Gospodarstvo (Maribor), Electro Gorenjska, and Port of Koper. Lastly, for the academy sphere of triple helix, responses were obtained from University of Maribor, Faculty of Forestry at University of Ljubljana, and University of Primorska. There are in total 12 respondents who provided 19 responses. The distribution of responses is shown in the table below.

Table 3. Distribution of responses by cooperation group.

Cooperation group		**Number of responses**
Universities – Other universities	(U → U)	1
Universities – Companies	(U → C)	2
Universities – Public organisations	(U → P)	1
Companies – Other companies	(C → C)	5
Companies – Universities	(C → U)	4
Companies – Public organisations	(C → P)	1
Public organisations – Other public organisations	(P → P)	3
Public organisations – Companies	(P → C)	1
Public organisations – Universities	(P → U)	1
	Total	***19***

4.3. Validity and reliability

Triple-helix consists of three main spheres which intersect with each other and constitutes in total 9 bilateral relations. For each of these relations, a separate version of S&R questionnaire was prepared specifically. By the nature of S&R questionnaire, each question, corresponding to an attribute, is assigned to one of the competitive priority group to be used. According to this, these 9 questionnaires used in this research had also different distribution of attributes into priority groups, namely, quality, cost, time, and flexibility. In addition, questions clearly covered all the aspects of forestry and forest

industry related cooperation between the respondents and their partners from the triple-helix. Moreover, the respondents were from different parts of the triple-helix and with different backgrounds and sufficiently qualified for filling the questionnaire. This reduces the possibility of biased results and thus increases validity.

In order to crosscheck the results there were at least one respondent for each relation group. As mentioned earlier, there is a bilateral relation between the two parties involved in cooperation. This provides the opportunity compare results from different sides of relation assessing the cooperation in between. For instance, although evaluated by different versions of questionnaires, responses from university-company and company-university can be used in crosschecking the results for this cooperation. Although the number of responses has been limited for some of the relations (at least one response for each relation and two for each intersection) it does not reduce the reliability of the results. It should be noted that a greater number of responses for this research would increase the accuracy would not affect the reliability. Furthermore, regarding consistency, the S&R model was developed based on analysis of current conditions and future possibilities for companies in order to help them react to the constant changes in the environment. Therefore, by the nature of the model, if these methods are applied over an extended time or at a different time, the results are likely to change. It should be taken into consideration that the Slovenia and its underperforming forestry industry did not fully recover from the sleet disaster in 2014 and many changes and opportunities for the good are expected.

5. EMPIRICAL RESEARCH

5.1. Case introduction

Slovenian forest industry was chosen as the case in this study. As mentioned in the previous chapters, the potential of the Slovenian forest industry, the sleet disaster experienced in 2014, and the S3 projects conducted by the EU all together create an environment which is full of lessons to learn, problems to identify and also opportunities waiting to be discovered. The disconnection or the lack of communication between the three spheres of triple helix in the country might constitute a severe problem on the way to sustainable development, especially while the country and the forest industry are in such condition. Therefore, in order to better understand the environment and make deductions on these issues, this study has been conducted.

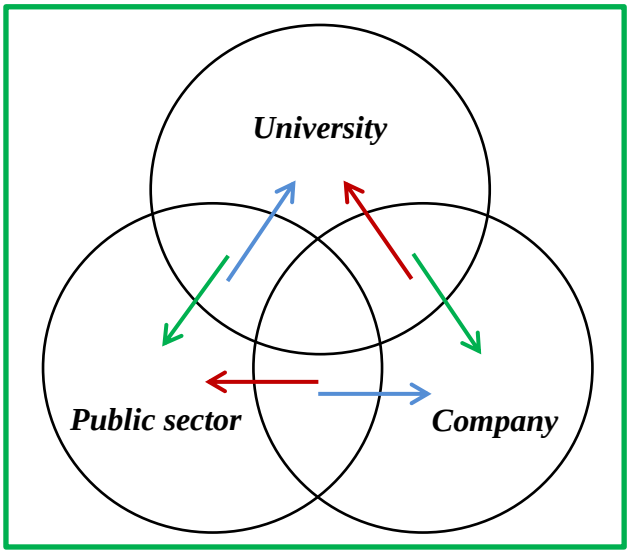

Figure 12. Triple-helix representation of Slovenian forest industry.

The three spheres of the triple helix, namely university, firm, and public, break down to 9 different relation groups. There are in total 12 respondents from these three spheres, with at least 2 responses for each cooperation group where the three spheres intersect.

After receiving the raw data, Sense and Respond method was applied and the required calculations were made using the CFI equations introduced earlier. The values of attributes were later used to find the competitive priority weights (in percentage) for each relation group. Next, these weights are used for MSI calculation and thus to determine the strategic position for each cooperation type in the triple-helix. In addition, trend analysis and results comparison of the new method are included in the study.

There are in total 9 different questionnaire versions used for 9 cooperation relations between the three spheres. These can be found at the end of the thesis as appendix. The data collected from the conducted questionnaires are analysed and discussed in the following subchapters.

5.2. Analysis and results

The analysis of the data obtained from questionnaire responses are presented and discussed below with the results. NSCFI and CFI′ were used for the evaluation of responses. The reason why these two methods were chosen was, as discussed earlier, that they are the most developed and up-to-date CFI models. As the starting point, all cooperation relations were considered to have balanced resource allocation and balanced competitive priorities. This means quality, cost, time and flexibility competitive priorities are all weighted 25%. In terms of MSI, this points the analyzer strategy (by 0.98) which is reasonable in our case. Also, being positioned as analyzer provides a balanced setting for comparisons based on the received data.

It should be noted that upper and lower limits for each relation are different below since it depends on the number of the attributes of each questionnaire as mentioned earlier. The bars in the figured coloured red, green, and yellow represent under-resourced, balanced (non-critical), and over-resourced respectively. The relative upper and lower limits of each relation used for determining the criticalness are given where necessary.

5.2.1. University group

The calculated past and future NSCFI values of the University group are presented below as: university-university, university-company, and university-public sector respectively.

For the University-university relation there are 41 attributes in the questionnaire. Based on the average resource level 2.44 (100÷41) critical levels are determined as 1.63 and 3.25 (2.44±2.44×0.33). As illustrated in Figure 13, there are 10 under-resourced or critical and 1 over-resourced attribute for the responses given by the informants based on their experience (past). According to this, quality attributes regarding familiarity with partner researchers for cooperation in research and in marketing development and R&D methods combination cooperation for process and technological development in the region where university is located are under-resourced in the past. Familiarity with partner researchers for cooperation concerning education systems, familiarity of the partner university with the work procedures of home university in marketing development, information gathering on the complex questions of innovation from the partner for regional development, within the region university is located in are the flexibility attributes were reported as under-resourced in the past. Frequency of cooperation for regional research and marketing development was under-resourced time attributes of the university-university relation. Lastly, the only over-resourced attribute is frequency of cooperation in process development in the region which is also a time attribute.

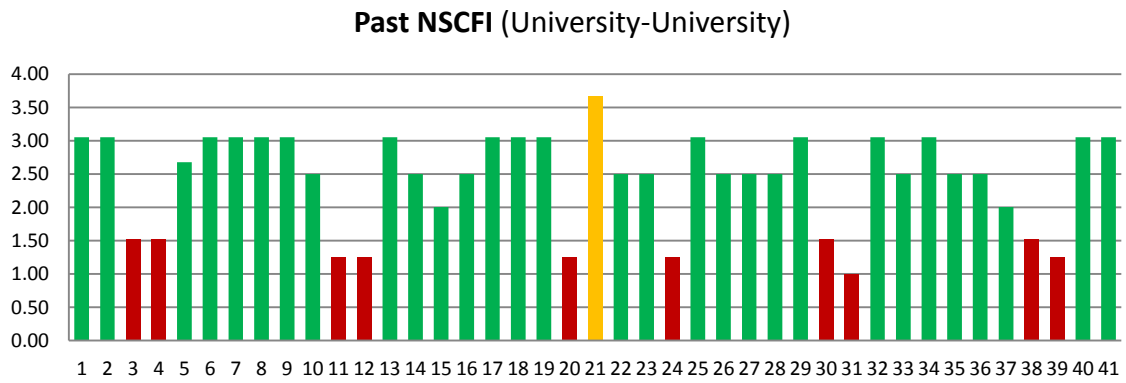

Figure 13. Past NSCFI values of attributes university-university cooperation.

The future NSCFI values of university-university relation, as illustrated below, do not include any critical attributes. The under-resourced attributes identified in the past as well as the over-resourced attribute shift to the optimum level which is between the lower and upper limits.

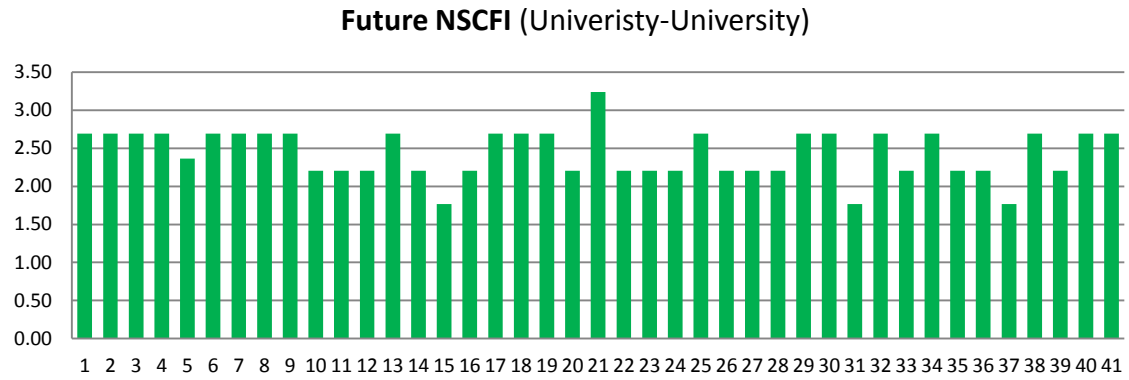

Figure 14. Future NSCFI values of attributes for university-university.

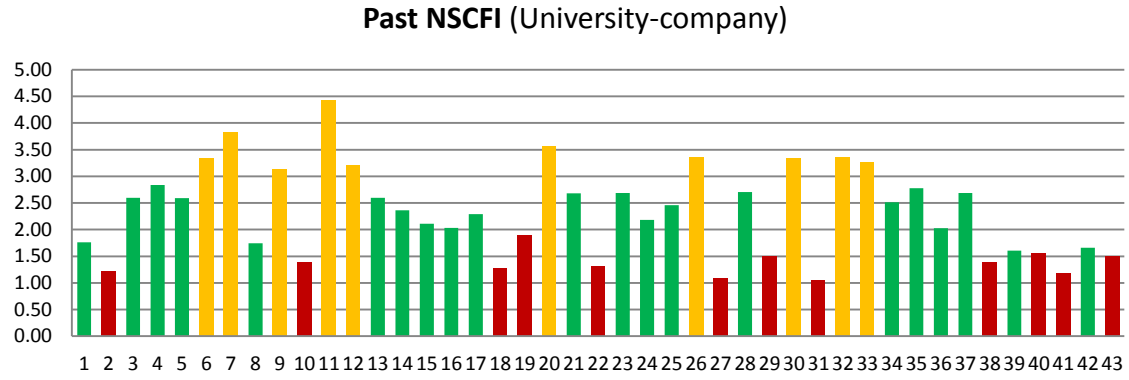

Figure 15. Past NSCFI values of attributes for university-company cooperation.

There are 43 attributes in university-company questionnaire. Based on the average level of resource 2.33 (100÷43) lower and upper-limits are determined as 1.55 and 3.10 (2.33±2.33×0.33) respectively. In the university-company relation the calculations for past NSCFI values show there are 12 under-resourced and 10 over-resourced attributes.

Firms' familiarity of the standards and concepts being currently used at the universities concerning educational systems, agreeing on R&D methods in marketing development, regarding region and patenting activities, the importance of patents for the global partnering companies of universities were the reported under-resourced quality attributes for the university-company relation. Cost related attributes: support provided by universities in order to meet parent companies' needs concerning educational system and marketing development cooperation were also under-resourced in the past. The amount of research concerning process information partners have and the amount of research done with the national partnering company are the time attributes which were under-resourced. Lastly, regarding flexibility, familiarity of universities in complex questions of innovation partner companies have concerning educational systems and technological development, familiarity of companies in working procedures of the universities concerning marketing development and technological development, and the amount of research cooperation in organisational information were reported as under-resourced attributes.

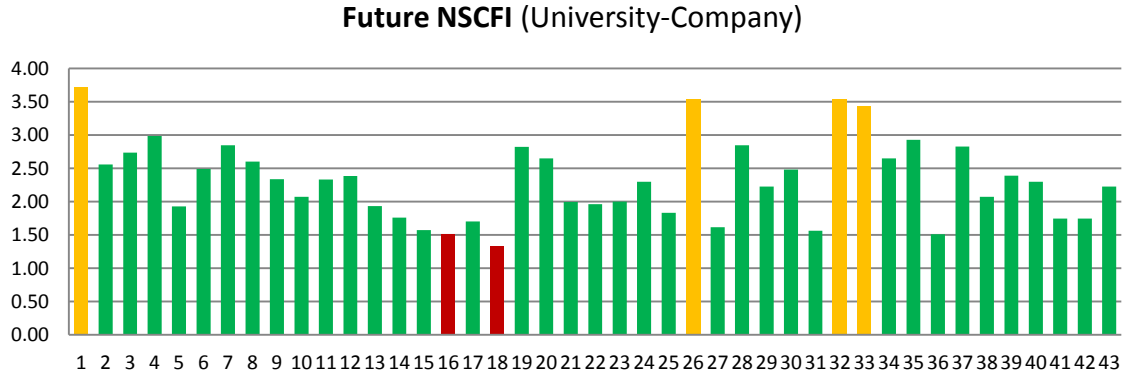

Figure 16. Future NSCFI values of attributes for university-company cooperation.

Based on the expectations, future NSCFI values for university-company relation show the under-resourced attributes are adjusted and move above the lower-level. As shown in Figure 16, although most under- and over-resourced attributes are taken care of in the future, quality attributes regarding cooperation in regional research and patenting activi-

ties with the regional and global partnering companies are expected to be under-resourced in the future.

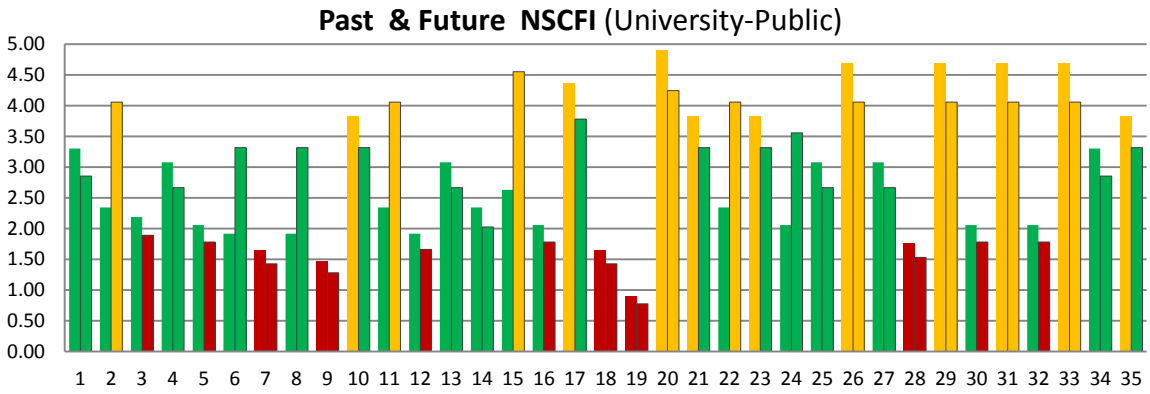

Figure 17. Past and Future NSCFI values for university-public cooperation.

For the university-public relation, there are 35 attributes in the questionnaire. According to this, average level of resource is 2.86 (100÷35) and critical levels are 1.90 and 3.81 (2.86±2.86×0.33) respectively. Both past and future NSCFI values of the last relation in the university group university-public sector are shown in Figure 17. Based on the experience, the past NSCFI values of university-public relation have only 5 under-resourced and 10 over-resourced attributes in the past. The expected performance of university-public relation, however, shows a poor image as compared to the experience with 11 under-resourced and 9 over-resourced attributes. According to this, quality attributes regarding cooperation in educational system, process development, organizational development, regional development and labour market agency cooperation between universities and their partners from the public sector are expected to be under-resourced. Also, cost attributes related to cooperation in research, organizational development, and regional development fall below the lower-limit. Lastly, flexibility related attributes for organizational development and labour market agency cooperation remain under-resourced in the future.

After identifying the critical attributes for past and future values of NSCFI as indicated by experience and expectations of the respondents, for each relation priority weights can

be calculated by taking the sum of pre-defined attributes of each competitive priority: quality, cost, time, and flexibility respectively. It should be noted that the total weight is calculated by taking the sum of all the critical and non-critical attributes in its respective competitive priority group. As presented in Table 4, for the university-university and university-company cooperation quality was reported as more prioritized than others for both past and future. Although there is a 5% decrease in university-company quality prioritization, it remains still remains dominant. Based on these values, for the cooperation of universities with each other and companies there exists a prospector strategy. Conversely, for the cooperation between universities and public actors, flexibility is more prioritized for both past and future. Also, unlike the other two, the strategy of cooperation between universities and public actors is analyzer for both past and future, although the corresponding value decreases in the future slightly.

Table 4. Competitive priority and operations strategy results for university group.

Cooperation		**Priority weights (%)**				**Operations strategy**			
		Q	C	T	F	Prospector	Analyzer	Defender	Reactor
University-university	Past	**42**	3	25	30	**0.93**	0.89	0.86	0.90
	Future	**42**	3	24	31	**0.93**	0.90	0.86	0.90
University-company	Past	**45**	16	12	26	**0.93**	0.90	0.90	0.92
	Future	**40**	16	13	31	**0.93**	0.91	0.90	0.91
University-public	Past	33	17	6	**44**	0.92	**0.96**	0.89	0.91
	Future	36	17	7	**40**	0.92	**0.94**	0.90	0.91

5.2.2. Company group

The calculated past and future NSCFI values of the company group are presented below as: company-company, company-university, and company-public sector respectively.

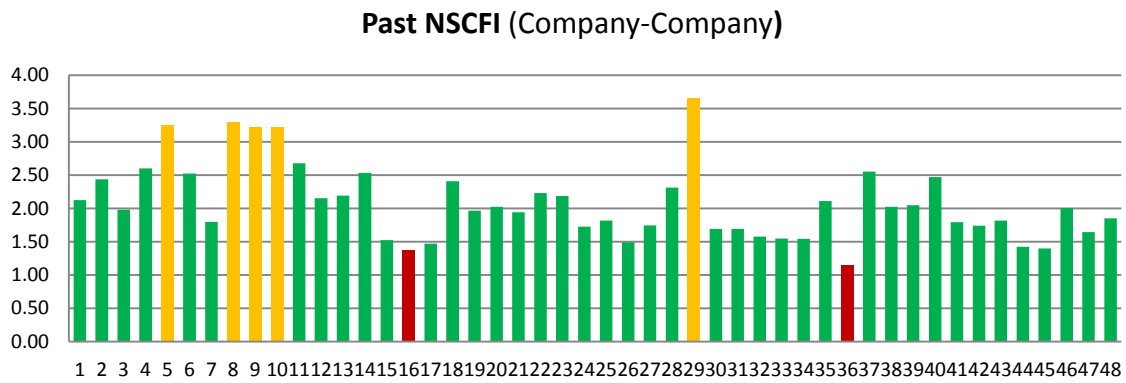

Figure 18. Past NSCFI values of attributes for company-company cooperation.

For the company-company relation the lower- and upper-level limits are determined as 1.39 and 2.78 based on the average resource level 2.08. According to past NSCFI values, there are only 2 under-resourced and 5 over-resourced attributes for the company-company relation as shown in Figure 18. Based on experience, the quality attribute of cooperation in innovation standards and concepts in projects, and time attribute of the amount of research done with the global partnering companies for region and patenting activities were under-resourced in the past. Figure 19 shows the expected NSCFI values for company-company relation. According to future NSCFI values, there are no attributes to be critical in the future. There are only 1 quality and 1 cost attribute which are expected to be slightly over-resourced in the future.

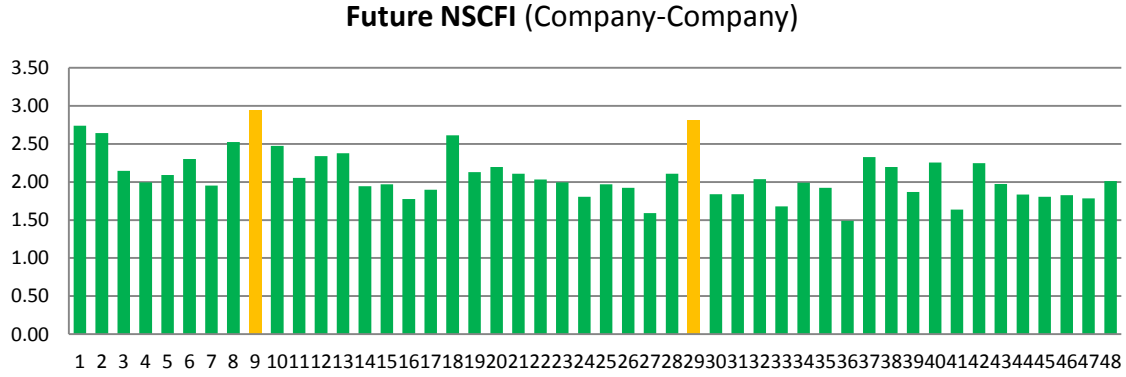

Figure 19. Future NSCFI values of attributes for company-company cooperation.

There are 43 attributes in the questionnaire used for evaluation the cooperation of companies with universities. The lower- and upper-level limits are calculated as 1.55 and 3.10 based on the average resource level 2.33. For the company-university relation, respondents reported 19 under-resourced and 1 over-resourced attributes based on their experience. These are shown in Figure 20. There are 10 quality, 3 cost, 1 time and 4 flexibility attributes among the under-resourced ones. According to these past values, in terms of quality, cooperation of companies with partner universities did not perform well in organizational development, marketing development, technological development, research in management, production information, and patenting activities. Cost and flexibility attributes concerning cooperation between companies and universities in educational systems, organizational development, and marketing development also underperformed in the past. Lastly, in terms of time, the only under-resourced attribute is related to regional research and patenting activities.

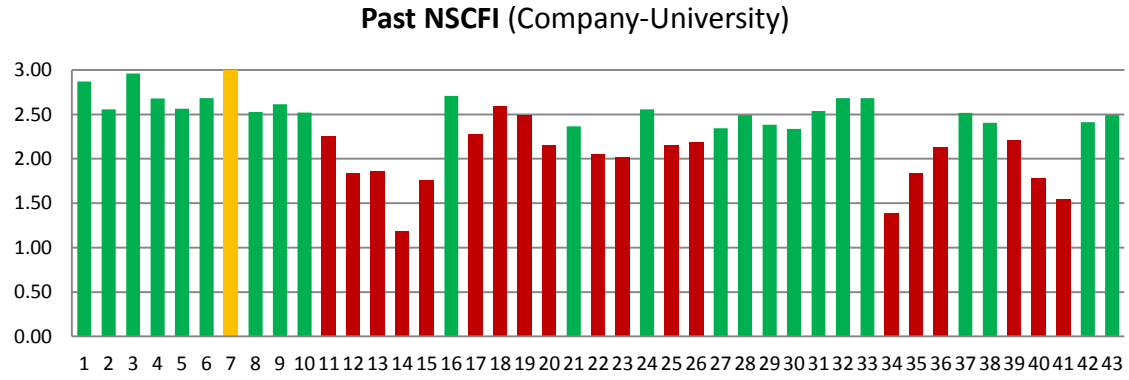

Figure 20. Past NSCFI values of attributes for company-university cooperation.

Future NSCFI values of company-university relation show an image similar to the one experienced. Based on the expectations of the respondents from the companies for the cooperation between companies and universities, there are 18 under-resourced attributes. Although some under-performing attributes shift towards the optimum level, there is no significant improvement in cooperation performance.

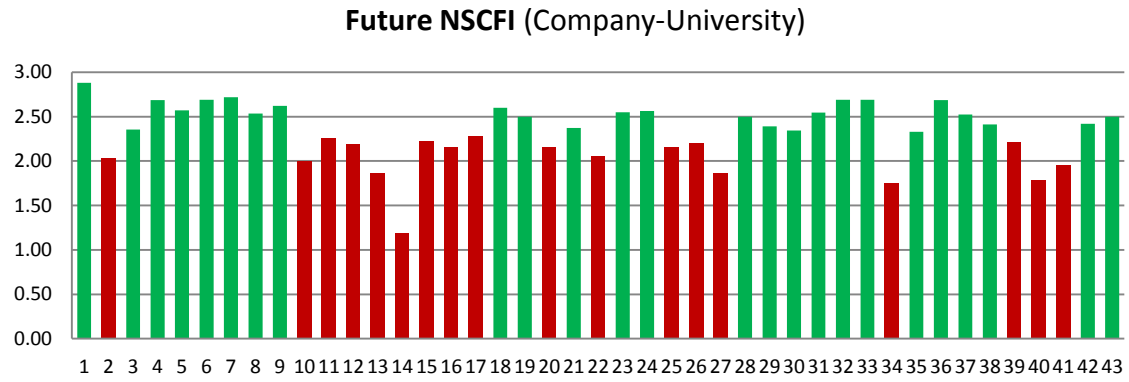

Figure 21. Future NSCFI values of attributes for company-university cooperation.

The results of the last relation in company group, company-public is presented with past and future NSCFI values in the same figure (see Figure 22). The number of attributes in the respective questionnaire is 25. According to this, the average resource level is 4.00 and the critical levels are 2.67 and 5.33. There are 4 under-resourced attributes according to the responses from the companies based on their experience of company-public cooperation. In terms of quality, familiarity of partners of the companies from public sector in spatial planning and environmental planning were under-resourced in the past. The other 2 are cost attributes which indicate poor performance of partners from the public sector being unaware of the logistical needs of the companies and poor performance of distant public actors being unaware of the environmental planning challenges that companies face.

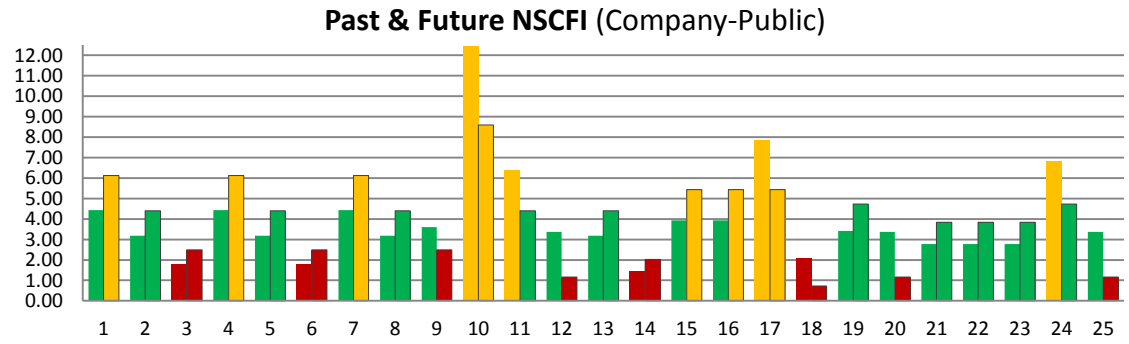

Figure 22. Past and Future NSCFI values for company-public cooperation.

According to the expectations for company-public cooperation performance, future NSCFI results show that there 7 under-resourced attributes. In addition to the attributes indicated as critical for the past above, there are 3 more under-resourced attributes which fall below the lower-limit in the future. These values show that public sector partners of the companies do not perform well in labour market agencies cooperation. Furthermore, the cooperation is not expected to be at a good level in environmental regulation and planning outside the region, in terms of time and flexibility.

Table 5. Competitive priority and operations strategy results for company group.

Cooperation		**Priority weights (%)**				**Operations strategy**			
		Q	C	T	F	Prospector	Analyzer	Defender	Reactor
Company-company	Past	**62**	7	8	23	**0.96**	0.80	0.92	0.94
	Future	**60**	6	10	24	**0.96**	0.81	0.91	0.94
Company-university	Past	**53**	16	12	19	**0.95**	0.86	0.91	0.93
	Future	**50**	16	12	20	**0.94**	0.87	0.91	0.93
Company-public	Past	**55**	19	7	19	**0.95**	0.87	0.92	0.94
	Future	**58**	19	6	17	**0.95**	0.85	0.92	0.94

For the company group relations, the calculated weights of each competitive priority are shown in Table 5. The priority weights of quality, cost, time, and flexibility are later used for identifying the strategic position of each relation. As presented in Table 5, for all the combinations of cooperation between companies and other actors either from academic or public organizations, quality is the main priority for both past and future. The quality weight is dominant for each relation with a value at least 50% (minimum for company-university past). Although there are slight changes in the weights the allocation does not change radically. Based on these values, for all the cooperation of companies with each other, partner universities and public actors a prospector strategy is adopted for both past and future. Company-company relation has the strongest level of prospector strategy compared to others followed by defender strategy. Additionally, the other two relations, companies with universities and public actors show a more balanced profile as compared to the first.

5.2.3. Public sector group

The calculated past and future NSCFI values of the public sector group are presented below as: public-public, public-company, and public-university respectively. According to the questionnaire responses of the public actors (public-public) for both past and future, calculated NSCFI values are presented in Figure 23 below. There are 25 attributes in the questionnaire for this relation and thus the average resource level is 4.00. Based on this, the lower- and upper-level limits are 2.67 and 5.33 respectively. For the cooperation between the public actors, based on the experience of respondents, there are 6 attributes which were under-resourced in the past. Under-resourced attributes from the past NSCFI values show public performed poorly in all the attributes related to labour market agencies cooperation. The only difference between experienced and expected performance for public actors is that the under-resourced cost attribute regarding cooperation in infrastructure moves over the lower-limit, while one of the non-critical flexibility attribute regarding cooperation in environmental planning falls below the lower-limit and becomes under-resourced. Furthermore, there are 8 over-resourced attributes according to the past NSCFI values, while this number drops down to 6 in the future.

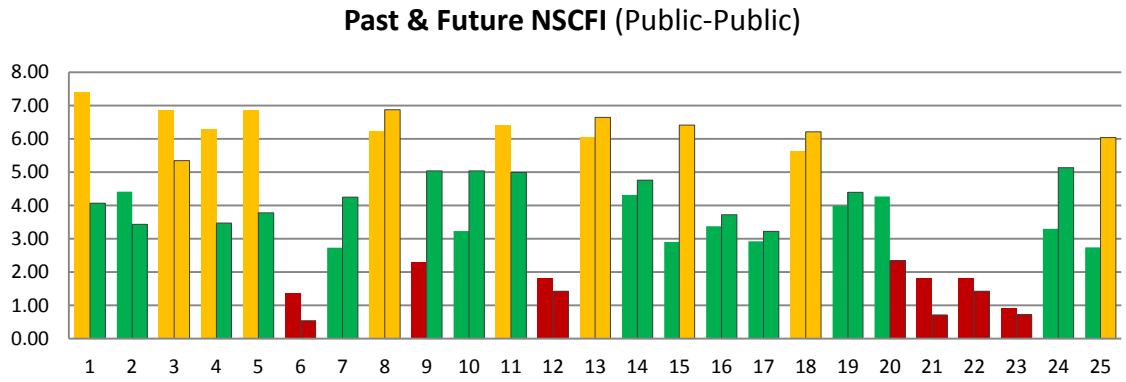

Figure 23. Past and Future NSCFI values of attributes for public-public cooperation.

The questionnaire used for the evaluation of cooperation of public actors with companies from the forest industry consists of 25 attributes. The average level was determined as 4.00 and the critical levels are 2.67 and 5.33 respectively. Past and future NSCFI

values of public-company relation are shown in Figure 24. There are only 2 under-resourced attributes which were quality and time related, while in the future there are 7 attributes expected to be under-resourced. According to this, cooperation between public actors and companies regarding spatial planning and infrastructure did not perform well in the past. Both of these critical attributes are identified and adjusted as the future NSCFI values show. However, although they move over the lower-limit, they become over-resourced in the future. In addition to these changes, half of the flexibility related attributes (5 out of 10) regarding all the areas of cooperation fall below the lower-limit and thus become critical for the future.

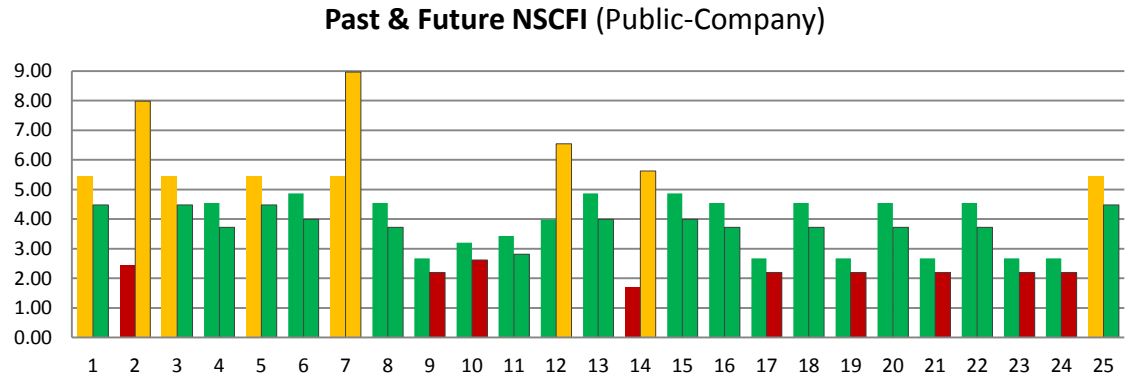

Figure 24. Past and Future NSCFI values of public-company cooperation.

The ninth and the last relation is public-university. The questionnaire of this relation consists of 35 attributes. Accordingly, the average resource level is 2.86 and critical levels are 1.90 and 3.81 respectively. Both past and future values of NSCFI for the relation are presented below in Figure 25. In cooperation of public actors and universities, there were 13 under-resourced attributes in the past. Similarly, the future expectation for the cooperation is expected to have 12 under-resourced attributes as the critical attributes from the past fail to improve and move above the lower-limit. In the past, cooperation between public actors and universities performed poorly in activities related to labour market agencies, environmental regulation and planning. Considering the future NSCFI values, there is not a major improvement expected in the under-performing areas of cooperation.

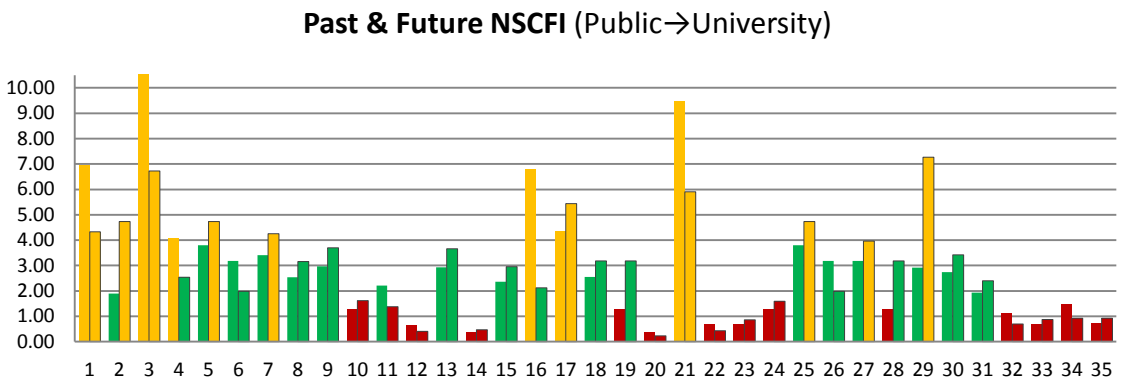

Figure 25. Past and Future NSCFI values of public-university cooperation.

The weights of each competitive priority for the public sector relations are presented in Table 6. According to the allocation of weights, for all the combinations of cooperation between public organization, companies and universities, quality is the main priority for both past and future. The only exception is public-public relation, as flexibility becomes more prioritized in future. The cooperation of public organizations with each other is also different in terms of the strategic positioning. While the cooperation of public actors is strongly positioned as analyzer in the past, it shifts towards prospector strategy in the future. Except this, for all the other relations of public organizations with partner universities and companies, the cooperation is positioned as prospector both in past and future.

Table 6. Competitive priority and operations strategy results for public group.

Cooperation		**Priority weights (%)**				**Operations strategy**			
		Q	C	T	F	Prospector	Analyzer	Defender	Reactor
Public→public	Past	**42**	20	4	34	0.93	**0.96**	0.91	0.92
	Future	32	23	5	**40**	**0.92**	0.91	0.90	0.91
Public→company	Past	**41**	15	66	37	**0.93**	0.91	0.90	0.92
	Future	**44**	16	10	30	**0.93**	0.90	0.90	0.92
Public→university	Past	**47**	18	11	24	**0.94**	0.89	0.90	0.92
	Future	**44**	17	7	32	**0.93**	0.90	0.90	0.92

5.2.4. New CFI′ model results comparison and trend analysis

In the previous sections, results of S&R and MSI analyses were presented. These results clearly show where the cooperation does not perform well as well as the strategic positioning. Although it is possible to follow the behaviour of each attribute for all the 9 different relations from the past to the future, trend analysis can bring a different approach to the case. In addition, the new model CFI′ developed by Takala and Kamdee (2015), was also used in this study as mentioned in Chapter 4. Trend analysis and CFI′ results are given together below, since both of these methods have a single output value for the experience and expectations indicated by respondents. In other words, based on the experience and expectation values indicated in the questionnaires, both methods have a single output rather than two separate results (past and future). This provides an image for observing the general situation. It should be noted that for both NSCFI and CFI′ methods the lower- and upper-level limits used for identifying the critical and non-critical (balanced) attributes are the same.

Table 7. Trend behaviour and CFI′ results by number of attributes.

Cooperation			**Trend behaviour**			**CFI′ results**		
		total	Worse	Better	Neutral	Under-resourced	Non-critical	Over-resourced
University→university	Number of attributes	*41*	-	11	**30**	3	**36**	2
University→company		*43*	5	**19**	**19**	14	**20**	9
University→public		*35*	**15**	12	8	5	**22**	8
Company→company		*48*	-	7	**41**	6	**37**	5
Company→university		*43*	-	4	**39**	6	**30**	7
Company→public		*25*	**10**	7	8	**15**	5	5
Public→public		*25*	**11**	6	8	5	**14**	6
Public→company		*25*	9	6	**10**	6	**15**	4
Public→university		*35*	12	**15**	8	12	**16**	7

According to the trend analysis, university-university, company-company, and company-university relations move towards the better (towards the range between lower- and

upper-limits), since there are no attributes with a worse trend for these three groups. This shows that there is an improvement expected for these attributes and the cooperation area they belong to. University-company, public-company, and public-university relations also show improvement as most of the attributes either move towards the better or remain unchanged. There are, however, a number of attributes which follow a worse trend and thus require adjustment in the relative areas of cooperation. Lastly, according to the trend analysis, university-public, company-public, and public-public cooperation have the least performance in terms of trend behaviour, as the number of attributes with worse trend is higher than the others for these three. Furthermore, based on the new model CFI′, 8 out of 9 relations have non-critical values as the majority. As shown in Table 7, except the company-public relation, all the others have more attributes either classified as non-critical and over-resourced. The cooperation of companies with public organizations is weaker as there are more critical values than non-critical attributes.

A comparison between the average values for each attribute calculated by using the NSFCI and the CFI′ models could be helpful in understanding the differences in these two methods. Based on the values each method produces, Table 8 illustrates how the averages change for resource and relation groups. It should be noted that, in order to avoid any confusion, the arithmetic mean of each attribute was calculated for the NSCFI results by taking the sum of past and future values and dividing them by 2. Below, Table 8 show, when the two methods are compared there are not substantial differences between the results except the company-public, public-company, and university-company relation which is further illustrated in the lower figure. For these three, priority weights of quality, cost, time and flexibility calculated using the new method (CFI′) are clearly different than they are for NSCFI.

Unlike the company and public relation groups discussed below, there are no divergent relations for the university group in terms of priority allocation. Except the slight differences, the traditional model NSCFI and the new model CFI′ results are similar and follow a similar pattern. That being said, according to Table 8, university-university relation differs from others in the way that resource weights are distributed. The number of

the time related attributes for this relation is 10 which is the highest number of time attributes among all the other 8 relations. Therefore, the increase in the weight of time is a natural result.

The traditional method finds quality as the most prioritized group for company-public cooperation, while CFI′ results suggest cost is the most prioritized. However, the number of cost attributes in the company-public relation is 5 (in total 25 attributes in the whole questionnaire) and the percentages of some of the cost attributes are extremely high as compared to the rest. This seems to be the main reason for the difference and for the shift to the cost from other resource groups.

Table 8. Comparison of competitive priority weights for both models.

Cooperation	**model**	**Priority weights (%)**			
		Quality	*Cost*	*Time*	*Flexibility*
University→university	NSCFI	**42**	3	24	31
	CFI′	**43**	3	24	30
University→company	NSCFI	**43**	16	12	29
	CFI′	**44**	13	10	29
University→public	NSCFI	35	17	7	**42**
	CFI′	37	13	7	**43**
Company→company	NSCFI	**61**	7	9	23
	CFI′	**63**	6	9	22
Company→university	NSCFI	**52**	16	12	20
	CFI′	**51**	16	12	21
Company→public	NSCFI	**57**	19	6	18
	CFI′	43	**46**	7	4
Public→public	NSCFI	37	21	5	**37**
	CFI′	31	23	6	**40**
Public→company	NSCFI	**42**	16	8	34
	CFI′	**40**	20	14	26
Public→university	NSCFI	**45**	17	9	28
	CFI′	38	17	6	**39**

For the public group, while public-public and public-university relations have slight changes in percentages, the public-company relation has in total 20 per cent distributed

differently when compared to its NSCFI results. In terms of the major priority, public-university group is the only one that does not match the priority traditional model suggests. According to this, while quality is the most prioritized by 45%, for the public-university flexibility has the major priority by 39%.

Lastly, according to the results calculated using the traditional method NSCFI suggest quality is the most dominant competitive priority as it is more prioritized for 7 out of 9 different relations, followed by flexibility which is more prioritized for 2 out of 9. For the CFI′ method quality was also found to be most prioritized for 5 relation groups, followed by flexibility (3) and cost (1). According to the results of both methods time was not found to be the major competitive priority for any of the relation groups.

The comparison between the past NSCFI, future NSCFI and CFI′ values of each cooperation group are further illustrated below. This time the comparison is based on the arithmetic mean of competitive priorities calculated for each relation separately. The sum for each priority group was first calculated and this value was divided by the number of attributes in that group. A line illustrates the behaviour of models for each of the relations. If the figures are investigated based on the horizontal movement of the lines, it is possible to observe whether the models correlate or not. If they are compared based on the vertical movements, it is possible to identify how the models perform in terms of average competitive priority weights. In addition, a horizontally straight line means the values for each model do not differ from each other.

The average competitive priority weights of university cooperation with companies and public actors are illustrated in Figure 26. According to this, the values for cooperation of universities with other universities are similar since the average values do not differ from each other substantially. Also, the line representing university-university cooperation has the least fluctuations, while the green line representing the university-public cooperation shows inconsistency.

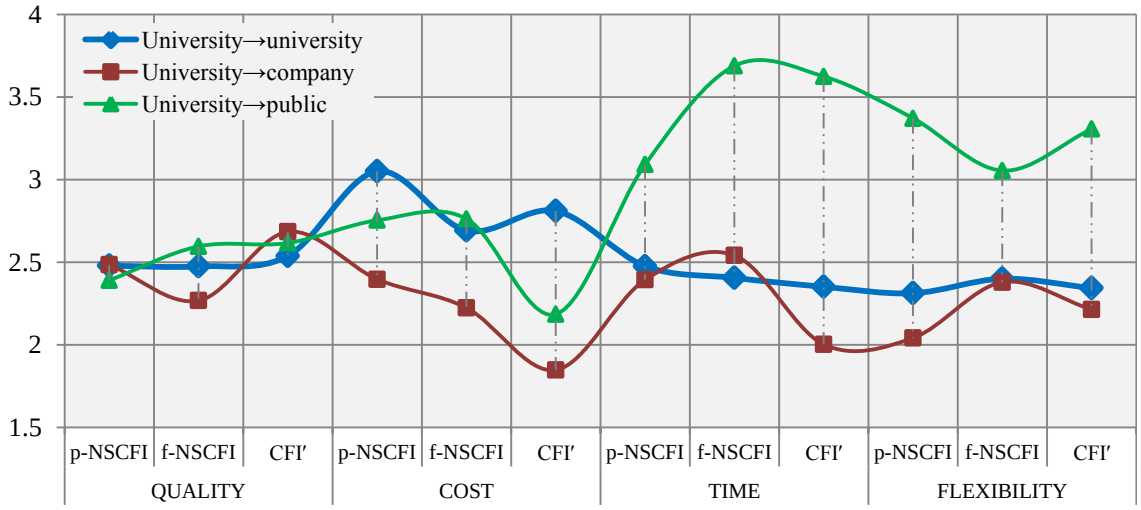

Figure 26. Average attribute value by competitive priorities for university group.

In Figure 27, the company group comparisons are illustrated in the same manner. It is clearly shown that for the cooperation of companies with each other, and with universities, the average competitive weights form lines that are almost horizontally straight. However, for the cooperation between companies and actors from the public sector there are great differences. Especially for the cost and flexibility, the average weights calculated using CFI′ results deviate from the others.

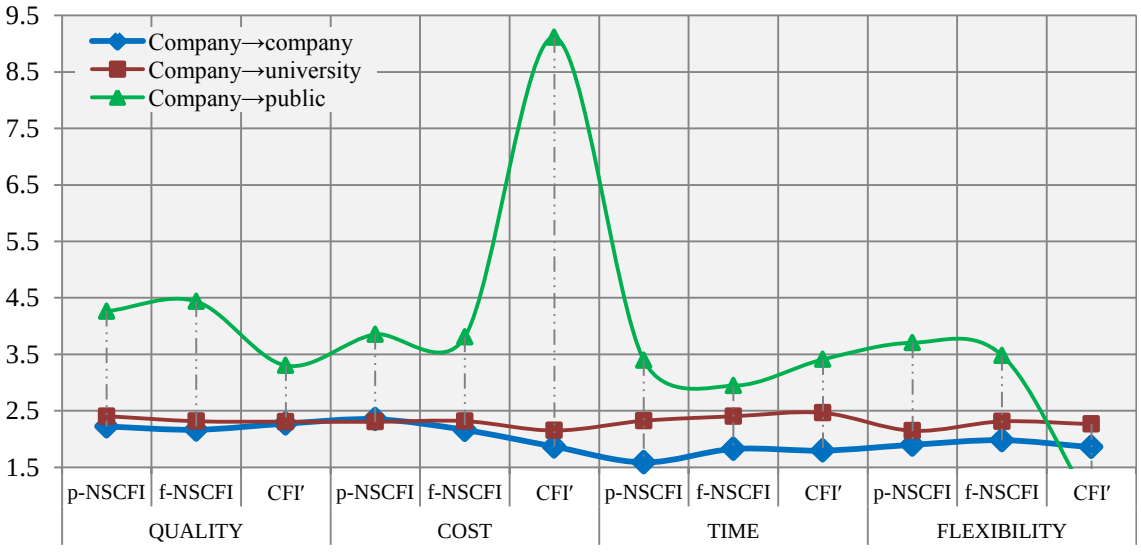

Figure 27. Average attribute value by competitive priorities for company group.

While the average CFI′ value of cost for the company-public relation is extremely high, the average for flexibility is well below the others. Additionally, company-public relation has a better performance based on the average values of attributes for all the models. It is clearly higher than others for in each category except the average flexibility weight calculated with CFI′ model.

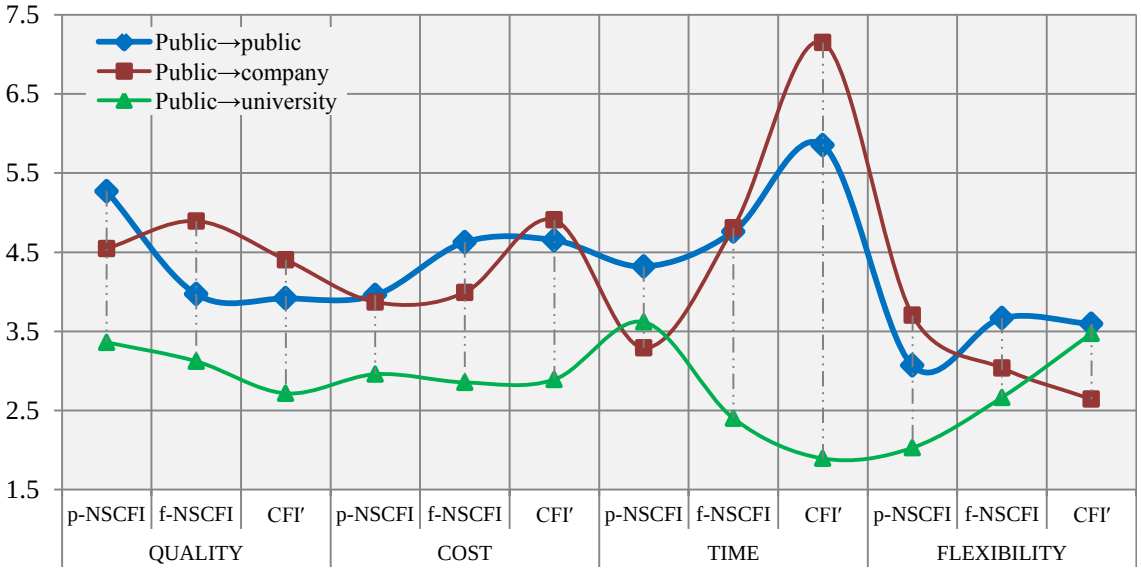

Figure 28. Average attribute value by competitive priorities for public group.

The average priority weights of public group are shown in Figure 28. Despite minor fluctuations, the past and future NSCFI and CFI′ results do not differ from each other in most of the categories. The only exception is where there is a great difference between the CFI′ results of time weights for all the three public cooperation groups. According to this, based on the CFI′ values, while the average time weight is too high for the cooperation of public actors with other public actors and with companies, it is very low for the cooperation between the public actors and universities. Also, in terms of the general performance, based on the averages, public-university cooperation has a lower performance in most of the categories.

The results calculated by using the two models, traditional NSCFI and the new CFI′, were discussed previously. In summary, the comparison and analyses show that there are some differences which should be taken into account. Firstly, although most resource groups presented similar results for the two methods, some of the relations had a divergent behaviour. For instance company-public relation has extremely high values for the cost attributes calculated by the CFI′ model which results in an abnormal increase in the cost weight of the relation in return. The attributes C2, C3 and C4 as well the attribute Q10 alone make up to 50% of the company-public relation's priority weight in total (see Appendix 6).

When we look at the overall picture, the CFI′ model results are mostly negative as it shows a more pessimistic image than the NSCFI results. This can be seen from the total number of critical and under-resourced attributes for each relation or relation group in Table 7. For instance, while NSCFI results suggest company-company, company-university, and company-public relations would have 0, 1, and 10 critical attributes, the CFI′ model suggests it would be 6, 6, and 15 respectively. Although not in the same manner, this negative view applies to other groups as well.

6. DISCUSSION AND CONCLUSION

6.1. Summary of research findings and general implications

This study yielded findings that include general practical and managerial insights regarding the smart specialisation in Slovenian forest industry. The empirical research was conducted using the data obtained from the responses and Sense and Respond method (S&R) using the introduced models as tools. In the previous chapter, the cooperation between the three spheres of triple helix representing the actors of Slovenian forest industry was evaluated. In order to accurately evaluate each of the cooperation between actors, resource allocation and operational strategy were investigated based on competitive priority weights. Based on the literature review and empirical research, the main findings of the study are summarized with the general implications below. Additionally, the managerial implications are given in the next section.

The results show that except for the cooperation between universities and public actors, quality is the main priority for all the remaining 8 relationships. Considering the Slovenian forest industry and its related sectors it is an expected result for quality to be more prioritized. However, considering the 9 different questionnaires and the distribution of the attributes into competitive priorities (Q, C, T, F) this might also be a result of having more quality related attributes than others. The distribution of attributes can be found in appendix.

Based on the number of critical attributes and trend analysis, quality and flexibility have more critical-level attributes although they are more prioritized. This also could be due to having a greater number of quality and flexibility related attributes than others. It is important to evaluate the cooperation performance of the spheres of triple helix considering both NSCFI results and trend analysis, since they might point different directions if they are investigated separately.

The best performing relations according to the analyses, with the least number of critical attributes, are company-university, company-company, university-company, and uni-

versity-university relationships. This shows a consistent result for the analyses as both directions have similar performance. In other words, the respondents from companies in the forest industry and the respondents from universities have consistent judgments for the mutual relation in between. On the other hand, based on the responses of universities and companies, cooperation with public actors has the highest number of critically valued attributes and thus it has worse performance compared to others. Therefore, another implication might be that public sphere of the triple-helix tend to have less performance, and thus public sector relations need more focus both for the cooperation of public actors with each other and with others. In addition to this, there are no drastic changes between past and future values of priorities based on NSCFI results. This is also a well-grounded outcome consistent with reality since Slovenian forest industry is known with its high quality.

Considering the ice-storm and its effects in 2014, we could expect drastic changes in the weights of competitive priorities from past to future. The results suggest, except the public sector, company and university sectors remain in prospector group for future. The only notable change is that these tend to have a more balanced strategy for the future.

When the two models compared, the CFI′ results are mostly negative as it shows a more pessimistic image than the NSCFI results. An important difference between , some of the attributes which are found to have values falling between the lower and upper-limits (valid area) and said to be performing well by the NSCFI are considered as under-performing and under-resourced by the CFI′ model. Lastly, since the CFI′ model suggests moderately different results than the NSCFI model thus each result group for each relation should be studied separately and carefully.

6.2. Managerial implications

The aim for analyser type of operation strategy is to maintain a stable business with a moderate level of innovation, in between prospector and the defender and with two as-

pects to observe: stable and changing (Daft 2009:71; Thompson & Martin: 2005:345; Griffin 2013:213). According to reports published by Food and Agriculture Organization of the United Nations and also Slovenian Forestry Institute, during recent years the actors of Forest Industry had production and resource efficiency focus and aimed at sustainable forest management. This presents enough evidence for considering the actors of the Slovenian forest industry in analyzer group for the base of our analyses.

The results suggest university and company spheres are mainly positioned as prospector in terms of operational strategy. On the other hand, although public sector S&R results point analyzer group for this relation, future values suggest public sphere groups move to the prospector category as well. Based on the smart specialization strategies being adopted in the country and expectations for economic and industrial recovery from the sleet disaster, positioning as prospector in the forest industry becomes a better option. However, as explained in Chapter 2 and 3 this should be a channelled strategy. In other words, the endeavours should focus on particular qualities in the relative areas.

The distribution of repeat critical attributes suggest that under-performance of cooperation and worse trend or under-resourcing of attributes occur due to poor information flow between the actors of the three main groups, university, company, and public sector. The quality and amount of the information being circulated between the actors within the triple-helix cause unfamiliarity and disconnection between partners. Therefore, all parties but mostly public actors should be willing to share more and be more open for cooperation.

According to Ministry of Agriculture, Slovenia has decided to use all available sources on a national level as well as actions within the new Rural Development Programme for damage restoration. In addition to these, after a disaster damaging over 40% of the forest in Slovenia, all the actors should take recovery plans into consideration. However, more than 60% of the Slovenian forest is owned by private entities. This is also another issue in the sector since private ownership does not let development or maintaining sustainable forest management country wide as well as bringing limitations of access. In order to recover from the damages of the disaster and maintain a better sustainable for-

est management, first of all a better collaboration is needed. More importantly, since it is the least performing corner of the triple-helix, the government, thus the public actors should take more initiative and also encourage private forest owners.

As highlighted repeatedly, wood biomass is a very important source of energy in Slovenia. According to Krajnc (2011) majority of the private forest owners use wood only to cover their own need and they have no interest in entering the market. Considering the fact that most of the forests in Slovenia are private and most of these are small estates, the production and market for wood biomass is limited to state forests (minority). This suggests there is a great potential for solutions regarding renewable energy as well as opportunities for new jobs which would be realized once a broader mobilization is achieved.

The analyses show that there are problems in relations with distant partners, in addition to disconnection and unfamiliarity with regional actors. The on-going and future projects within EU and also conducted by EU are promising. However, in order to attend these, the domestic actors should first have a well-arranged and maintained network.

Lastly, considering the resource allocation for both past and future and also the situation in Slovenia after the disaster in 2014, although it is a fundamental change, the quality priority could be shifted towards cost and time during this transition period providing a faster recovery. This would also mean a more balanced strategy for all the actors which is consistent with the common forest policy in Slovenia.

6.3. Limitations of the study and recommendations for further research

As with any research, there are several limitations inherent in this study that should be highlighted. Firstly, the number of respondents which generated the data used in this research by answering the S&R questionnaire has been limited. Although this does not affect the validity of results, a greater number of responses would generate more precise outcomes. It was mentioned that in order to ensure the validity at least two responses

were analysed for each intersection of triple helix. However, in order to minimize the risk, this number could be increased.

Another limitation of the study is the time constraint. The SCA analysis and S&R method require continuous evaluation of the conditions by nature. After the sleet disaster in 2014, although recovery process started immediately the environment has been rather turbulent in Slovenia. Considering the fact that the responses were obtained by early 2015, it is possible that interpretation of the actors of the forest industry were prejudiced by the temporary conditions. In addition, having conducted this research in 2015, the sources of secondary data such as annual and industrial reports which would be useful in the analysis have been limited. A possible comparison of the situation in Slovenian forest industry before and after the sleet disaster could also yield valuable insights.

There are a number of future directions which would be valuable to investigate with further research. Firstly, in order to enhance the accuracy of findings, an extensive study can be conducted with more responses from the industry. Also, while allocating each attribute to the competitive priority groups in the questionnaires, respondents can be consulted.

In this study, analyses were made using the traditional NSCFI model. Also, the results obtained using the new model CFI′ have been discussed and compared with others. The differences and similarities between these models can be also further investigated. In terms of operational strategy, past and future comparisons can be improved by simply obtaining the estimations of priority weights from the respondents for past and future to be used for MSI analysis and in comparison with these two models. This would also be helpful in identifying a possible strategic gap and influence authorities' decision making accordingly. Lastly, another important direction for future studies would be investigation of reactor type of operation strategy. This type of operations strategy has not been paid enough attention in the recent studies of this field. However, in turbulent environments, such as the case in this study, where rapid response to constant changes is required, positioning as a reactor might be a crucial strategic decision.

6.4. Conclusion

This study aimed to identify the cooperation level of the Slovenian forest industry actors with a triple helix framework by answering the research questions introduced in the first chapter. In order to better understand the conditions of triple helix environment in Slovenian forest industry, Sustainable Competitive Advantage (SCA) analysis were made using the Sense and Respond (S&R) method. Also, a literature review was carried out to gain insights in theoretical background of main terms engaged in this study. Furthermore, a qualitative investigation of Slovenia was conducted, in terms of country overview, smart specialisation strategies, forest industry and reserves.

In terms of smart specialization, both in general and particularly for the forest industry, Slovenia has still a long way to go. However, the latest endeavours for achieving sustainable development with smart specialization strategies and projects backed by European Union prove that the country is on the right track. The key to success lies in allocating resources efficiently and focusing on priority areas with the right strategies. There are already a great number of studies, projects, and other kinds of work for achieving long term goals of the country. In addition, it looks possible to recover from the damage caused by the disaster in 2014 with the involvement of companies, universities, and public actors building a strong network both regionally and nationally.

The results of analysis suggest there is a level of cooperation between the three spheres of triple helix representing the Slovenian forest industry, namely company, university and public sector. Based on the findings, there is a greater potential for development in cooperation of public actors with other parties. Apart from that, in order to survive the severe conditions of the market and the environment, such as the sleet disaster, and to achieve sustainable development based on higher value creation, the strategic positioning of cooperation between the parties and the strategic positioning of each party involved in triple helix should be done accurately. Especially at the times when cooperation and mobilization are needed nationwide, for permanent prosperity, temporary sacrifices should be made.

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APPENDICES

APPENDIX 1. Questionnaire for university-university cooperation

Attributes by cooperation area	Priority
Co-operation concerning educational systems in Ostrobothnia	
How well do you think that the educational system supports your main partners needs?	C1
How well do you know the educational needs of your main partner?	Q1
How often you are co-operating with your main partner?	T1
How much do you get information on the complex questions of innovation from your main partner?	F1
How well do you know your main partners researchers?	Q2
Co-operation in research in Ostrobothnia (can be asked for each development branch)	
How frequently do you co-operate with your main partner?	T2
How well does your R/D methods combine with your main partners methods?	Q3
How well do your main partner know the procedures of your work?	F2
How much do you get information on the complex questions of innovation from your main partner?	F3
How well do you know your main partners researchers?	Q4
Co-operation in process development in Ostrobothnia	
How frequently do you co-operate with your main partner?	T3
How well does your R/D methods combine with your main partners methods?	Q5
How well do your main partner know the procedures of your work?	F4
How much do you get information on the complex questions of innovation from your main partner?	F5
How well do you know your main partners researchers?	Q6
Co-operation in organisational development in Ostrobothnia	
How frequently do you co-operate with your main partner?	T4
How well does your R/D methods combine with your main partners methods?	Q7
How well do your main partner know the procedures of your work?	F6
How much do you get information on the complex questions of innovation from your main partner?	F7
How well do you know your main partners researchers?	Q8
Co-operation in regional development in Ostrobothnia	
How frequently do you co-operate with your main partner?	T5
How well does your R/D methods combine with your main partners methods?	Q9
How well do your main partner know the procedures of your work?	F8
How much do you get information on the complex questions of innovation from your main partner?	F9
How well do you know your main partners researchers?	Q10
Co-operation in marketing development in Ostrobothnia	
How frequently do you co-operate with your main partner?	T6
How well does your R/D methods combine with your main partners methods?	Q11
How well do your main partner know the procedures of your work?	F10
How much do you get information on the complex questions of innovation from your main partner?	F11
How well do you know your main partners researchers?	Q12
Co-operation in technological development in Ostrobothnia	
How frequently do you co-operate with your main partner?	T7
How well does your R/D methods combine with your main partners methods?	Q13
How well do your main partner know the procedures of your work?	F12
How much do you get information on the complex questions of innovation from your main partner?	F13
How well do you know your main partners researchers?	Q14
Research region and patenting activities	
How much of your research is done with regional partner?	T8
How important patents and patenting are with your regional partner?	Q15
How much of your research is done with national partner?	T9
How important patents and patenting are with your national partner?	Q16
How much of your research is done with global partner?	T10
How important patents and patenting are with your global partner?	Q17

APPENDIX 2. Questionnaire for university-company cooperation

Attributes by cooperation area	Priority
Co-operation concerning educational systems	
How well do you think that the educational system supports your main partner's needs?	C1
How well does your main partner know your work?	Q1
How well does your main partner know the standards and concepts that are currently used?	Q2
How much do you get information on the complex questions of innovation from your main partner?	F1
How well do you know your main partners staff?	Q3
Co-operation in research (can be asked for each development branch)	
How frequently do you contact your main partners for research?	T1
How well do you know the R/D methods used or favoured by your main partner?	Q4
How well do you know your main partners work?	F2
How much do you get information on the complex questions of innovation from your main partner?	F3
How well do you know your main partners staff?	Q5
Co-operation in process development	
How well do you think that the process development fulfils your main partner's needs?	C2
How well do you know the R/D methods used or favoured by your main partner?	Q6
How well does your main partner know the procedures of your work?	F4
How much do you get information on the complex questions of innovation from your main partner?	F5
How well do you know your main partners staff?	Q7
Co-operation in organisational development	
How well do you think that the organisational development fulfils your main partner's needs?	C3
How well do you know the R/D methods used or favoured by your main partner?	Q8
How well does your main partner know the procedures of your work?	F6
How much do you get information on the complex questions of innovation from your main partner?	F7
How well do you know your main partners staff?	Q9
Co-operation in marketing development	
How well do you think that the marketing development fulfils your main partner's needs?	C4
How well do you know the R/D methods used or favoured by your main partner?	Q10
How well does your main partner know the procedures of your work?	F8
How much do you get information on the complex questions of innovation from your main partner?	F9
How well do you know your main partners staff?	Q11
Co-operation in technological development	
How well do you think that the technological development fulfils your main partner's needs?	C5
How well do you know the R/D methods used or favoured by your main partner?	Q12
How well does your main partner know the procedures of your work?	F10
How much do you get information on the complex questions of innovation from your main partner?	F11
How well do you know your main partners staff?	Q13
Research subject	
How much research do you have with your partner firm concerning information systems?	F12
How much research do you have with your partner firm concerning technical information?	C6
How much research do you have with your partner firm concerning production information?	Q14
How much research do you have with your partner firm concerning process information?	T2
How much research do you have with your partner firm concerning organisational information?	F13
How much research do you have with your partner firm concerning management information?	Q15
How much research do you have with your partner firm concerning marketing information?	C7
Research region and patenting activities	
How much of your research is done with regional partner firm?	T3
How important patents and patenting are with your regional partner?	Q16
How much of your research is done with national partner firm?	T4
How important patents and patenting are with your national partner?	Q17
How much of your research is done with global partner firm?	T5
How important patents and patenting are with your global partner?	Q18

APPENDIX 3. Questionnaire for university-public cooperation

Attributes by cooperation area	Priority
Co-operation concerning educational systems	
How good do you think that the educational system supports your main partner?	C1
How well does your main partner know your educational services?	Q1
How well do you know the standards and concepts that are used by your main partner?	Q2
How much do you get information on the complex questions of innovation from your main partner?	F1
How well do you know your main partners personnel?	Q3
Co-operation in research (can be asked for each development branch)	
How frequently does your main partner contact you for research?	T1
How well do you know the R/D methods used or favoured by your main partner?	C2
How well does your main partner know the procedures of your work?	F2
How much do you get information on the complex questions of innovation from your main partner?	F3
How well do you know your main partners personnel?	Q4
Co-operation in process development	
How well do you think that the process development fulfils your main partner's needs?	C3
How well do you know the R/D methods used or favoured by your main partner?	Q5
How well does your main partner know the procedures of your work?	F4
How much do you get information on the complex questions of innovation from your main partner?	F5
How well do you know your main partners personnel?	Q6
Co-operation in organisational development	
How well do you think that the organisational development fulfils your main partner's needs?	C4
How well do you know the R/D methods used or favoured by your main partner?	Q7
How well does your main partner know the procedures of your work?	F6
How much do you get information on the complex questions of innovation from your main partner?	F7
How well do you know your main partners personnel?	Q8
Co-operation in regional development	
How well do you think that the regional development fulfils your main partner's needs?	C5
How well do you know the R/D methods used or favoured by your main partner?	Q9
How well does your main partner know the procedures of your work?	F8
How much do you get information on the complex questions of innovation from your main partner?	F9
How well do you know your main partners personnel?	Q10
Labour market agencies co-operations	
How often do you co-operate with your main partner?	T2
How well does your partner know your work?	Q11
How well does your main partner know the procedures of your work?	F10
How much do you get information on the complex questions of innovation from your main partner?	F11
How well do you know your main partners personnel?	Q12
Co-operation with actors in environmental regulation and planning (outside your region)	
How well do you think that the environmental planning works outside the region (nationally)?	C6
How well do the distant public actors know environmental planning challenges of the region?	Q13
How well do you know the distant public actors procedures of work?	F12
How much do you get information on the complex questions of innovation from the distant public actors?	F13
How well does your main partner know the officials outside the region?	Q14

APPENDIX 4. Questionnaire for company-company cooperation

	Attributes by cooperation area	Priority
Co-operation with suppliers	How important your main supplier is for your firm's success?	Q1
	How well does your main supplier know the needs of your firm?	Q2
	How well does your main supplier know the standards and concepts used on your firm?	Q3
	How much information on the complex questions of innovation do you get from your main supplier?	F1
	How well does your main supplier know the business life and it´s actors, which relate to your firm?	Q4
Co-operation with customers	How important is your main customer's part on your firm's success?	Q5
	How well do your firm's main customers know the products/service of your firm?	Q6
	How well do your main customers know the standards and concepts used on your firm?	Q7
	How much information on the complex questions of innovation do you get from your main customer?	F2
	How well does your main customer know the business life and it´s actors, which relate to your firm?	Q8
Competitors	How large threat do you consider your main competitor to be?	C1
	How well does your firm's main competitor know the products/service of your firm?	Q9
	How well does your main competitor know the standards and concepts used on your firm?	Q10
	How much information for innovations do you acquire from your main competitor?	F3
	How well does your main competitor know the business life and its actors, which relate to your firm?	Q11
Knowledge sharing regional/national/global	How much knowledge do you usually share with your main partners during innovation process?	F4
	How well your firm's products/services are known regionally/nationally/globally?	Q12
	How well your firms standards and concepts are known regionally/nationally/globally?	Q13
	How much information on the complex questions of innovation do you give outside your firm?	F5
	How well do you know the business life and it´s actors, which relate to your firm?	Q14
Innovation projects	How important different innovation projects are for your firm's success?	Q15
	How often your firm is asked to join mutual innovation projects?	T1
	How well your innovation standards and concepts is known?	Q16
	How much information on the complex questions of innovation do you get from outside your firm?	F6
	How well do your firm know the possible innovation actors, which relate to your firm?	Q17
Spesific Resources (human, technical, etc.)	How important specific resources are for your firm?	Q18
	How well your firms specific resource needs are known?	Q19
	How well the standards and concepts concerning your specific resource is known?	Q20
	How much information on the complex questions of innovation is related to your main resource?	F7
	How well do the resource providers know the business life and it´s actors, which relate to your firm?	Q21
Department co-operation	How much of your firm's innovations are created internally?	F8
	How much of your innovation needs is covered by internal co-operation within the firm?	F9
	How well are your firm's standards and concepts known within the firm?	Q22
	How much information on the complex questions of innovation do you get from inside your firm?	F10
	How well do your firm know the latest developments on your field?	Q23
Area of co-operation	How much co-operation do you have concerning information systems?	F11
	How much co-operation do you have concerning technical information?	C2
	How much co-operation do you have concerning production information?	Q24
	How much co-operation do you have concerning process information?	T2
	How much co-operation do you have concerning organisational information?	F12
	How much co-operation do you have concerning management information?	Q25
	How much co-operation do you have concerning marketing information?	C3
Research region and patenting activities	How much of your research is done with regional partner?	T3
	How important patents and patenting are with your regional partner?	Q26
	How much of your research is done with national partner?	T4
	How important patents and patenting are with your national partner?	Q27
	How much of your research is done with global partner?	T5
	How important patents and patenting are with your global partner?	Q28

APPENDIX 5. Questionnaire for company-university cooperation

Attributes by cooperation area	Priority
Co-operation concerning educational systems	
How well do you think that the educational system supports your firm's needs?	C1
How well does your main partner know the needs of your firm concerning education?	Q1
How well does your main partner know the standards and concepts that are used on your firm?	Q2
How much information on the complex questions of innovation you get from your main partner?	F1
How well do you know the researchers from your main partner?	Q3
Co-operation in research (can be asked for each development branch)	
How frequently do you contact your main partner for research?	T1
How well do you know the R/D methods that are used by your main partner?	Q4
How well do you know the procedures of your main partner?	F2
How much information on the complex questions of innovation you get from your main partner?	F3
How well do you know the researchers from your main partner?	Q5
Co-operation in process development	
How well do you think that your main partner's process development fulfils your firm's needs?	C2
How well do you know the R/D methods that are used by your main partner?	Q6
How well does your main partner know your work?	Q7
How much information on the complex questions of innovation you get from your main partner?	F4
How well do you know the researchers from your main partner?	Q8
Co-operation in organisational development	
How well do you think that your main partner's organisational development fulfils your firm's needs?	C3
How well do you know the R/D methods that are used by your main partner?	Q9
How well does your main partner know your work?	Q10
How much information on the complex questions of innovation you get from your main partner?	F5
How well do you know the researchers from your main partner?	Q11
Co-operation in marketing development	
How well do you think that your main partners marketing development fulfils your firm's needs?	C4
How well do you know the R/D methods that are used by your main partner?	Q12
How well does your main partner know your work?	Q13
How much information on the complex questions of innovation you get from your main partner?	F6
How well do you know the researchers from your main partner?	Q14
Co-operation in technological development	
How well do you think that your main partner's technological development fulfils your firm's needs?	C5
How well do you know the R/D methods that are used by your main partner?	Q15
How well does your main partner know your work?	Q16
How much information on the complex questions of innovation you get from your main partner?	F7
How well do you know the researchers from your main partner?	Q17
Research subject	
How much research do you have with your partner university concerning information systems?	F8
How much research do you have with your partner university concerning technical information?	C6
How much research do you have with your partner university concerning production information?	Q18
How much research do you have with your partner university concerning process information?	T2
How much research do you have with your partner university concerning organisational information?	F9
How much research do you have with your partner university concerning management information?	Q19
How much research do you have with your partner university concerning marketing information?	C7
Research region and patenting activities	
How much of your research is done by regional partner university?	T3
How important patents and patenting are with your regional partner?	Q20
How much of your research is done by national partner university?	T4
How important patents and patenting are with your national partner?	Q21
How much of your research is done by global partner university?	T5
How important patents and patenting are with your global partner?	Q22

APPENDIX 6. Questionnaire for company-public sector cooperation

Attributes by cooperation area	Priority
Co-operation in infrastructure	
How frequently does your main partner contact you concerning infrastructure?	T1
How well does your main partner know the logistical needs of your firm?	C1
How well does your main partner know your work?	Q1
How much do you get information on the complex questions of innovation from your main partner?	F1
How well does your main partner know your personnel?	Q2
Co-operation in spatial planning	
How well do you think that the spatial planning fulfils your firm's needs?	C2
How well does your main partner know the spatial planning needs of your firm?	Q3
How well does your main partner know your work?	Q4
How much do you get information on the complex questions of innovation from your main partner?	F2
How well does your main partner know your personnel?	Q5
Co-operation in environmental planning	
How well do you think that the environmental planning fulfils your firm's needs?	C3
How well does your main partner know the environmental planning need your firm?	Q6
How well does your main partner know your work?	Q7
How much do you get information on the complex questions of innovation from your main partner?	F3
How well does your main partner know your personnel?	Q8
Labour market agencies co-operations	
How well do you think that the labour market actors fulfil your firm's needs in?	C4
How well does your main partner know the needs of your firm?	Q9
How well does the main partner know the standards and concepts that are used on your firm?	Q10
How much do you get information on the complex questions of innovation from your main partner?	F4
How well does your main partner know your personnel?	Q11
Co-operation with actors in environmental regulation and planning (outside the region)	
How well do you think that the environmental planning works outside the region (nationally)?	Q12
How well do the distant public actors know environmental planning challenges concerning your firm?	C5
How well do you know the distant public actors procedures of work?	T2
How much do you get information on the complex questions of innovation from distant public actors?	F5
How well does your main partner know your personnel?	Q13

APPENDIX 7. Questionnaire for public sector-public sector cooperation

Attributes by cooperation area	Priority
Co-operation in infrastructure	
How frequently does your main partner contact you concerning infrastructure?	T1
How well does your main partner know the logistical challenges concerning his firm?	T2
How well does your main partner know the procedures of your work?	F1
How much do you get information on the complex questions of innovation from your main partner?	F2
How well does your main partner know your personnel?	Q1
Co-operation in spatial planning	
How well do you think that the spatial planning fulfils your main partner's needs?	C1
How well does your main partner know the spatial planning's challenges concerning his firm?	Q2
How well does your main partner know the procedures of your work?	F3
How much do you get information on the complex questions of innovation from your main partner?	F4
How well does your main partner know your personnel?	Q3
Co-operation in environmental planning	
How well do you think that the environmental planning fulfils your main partner's needs?	C2
How well does your main partner know the environmental planning challenges concerning it?	Q4
How well does your main partner know the procedures of your work?	F5
How much do you get information on the complex questions of innovation from your main partner?	F6
How well does your main partner know your personnel?	Q5
Labour market agencies co-operations	
How well do you think that the labour market actors fulfil your main partner's needs?	C3
How well does your main partner know your organisations agendas?	Q6
How well does your main partner know your work?	F7
How much do you get information on the complex questions of innovation from your main partner?	F8
How well does your main partner know your personnel?	Q7
Co-operation with actors in environmental regulation and planning (outside your region)	
How well do you think that the environmental planning works outside the region (nationally)?	C4
How well do the distant public actors know environmental planning challenges of the region?	Q8
How well do you know the distant public actors procedures of work?	F9
How much do you get information on complex questions of innovation from distant public actors?	F10
How well does your main partner know the officials outside the region?	Q9

APPENDIX 8. Questionnaire for public sector-university cooperation

Attributes by cooperation area	Priority
Co-operation concerning educational systems	
How good do you think that the educational system supports your organisation's needs?	C1
How well does your main partner know the educational needs of your organisation?	C2
How well do you know the standards and concepts that are used by your main partner?	Q1
How much do you get information on the complex questions of innovation from your main partner?	F1
How well do you know your main partners researchers?	Q2
Co-operation in research (can be asked for each development branch)	
How frequently does your main partner contact you for research?	T1
How well do you know the R/D methods used or favoured by your main partner?	Q3
How well does your main partner know the procedures of your work?	F2
How much do you get information on the complex questions of innovation from your main partner?	F3
How well do you know your main partners researchers?	Q4
Co-operation in process development	
How well do you think that the process development fulfils your needs?	C3
How well do you know the R/D methods used or favoured by your main partner?	Q5
How well does your main partner know the procedures of your work?	F4
How much do you get information on the complex questions of innovation from your main partner?	F5
How well do you know your main partners researchers?	Q6
Co-operation in organisational development	
How well do you think that the process development fulfils your needs?	C4
How well do you know the R/D methods used or favoured by your main partner?	Q7
How well does your main partner know the procedures of your work?	F6
How much do you get information on the complex questions of innovation from your main partner?	F7
How well do you know your main partners researchers?	Q8
Co-operation in regional development	
How well do you think that the process development fulfils your needs?	C5
How well do you know the R/D methods used or favoured by your main partner?	Q9
How well does your main partner know the procedures of your work?	F8
How much do you get information on the complex questions of innovation from your main partner?	F9
How well do you know your main partners researchers?	Q10
Labour market agencies co-operations	
How often do you co-operate with your main partner?	T2
How well do you know the R/D methods used or favoured by your main partner?	Q11
How well does your main partner know the procedures of your work?	F10
How much do you get information on the complex questions of innovation from your main partner?	F11
How well do you know your main partners researchers?	Q12
Co-operation with actors in environmental regulation and planning (outside your region)	
How well do you think that the environmental planning works outside the region (nationally)?	Q13
How well do the distant public actors know environmental planning challenges of the region?	C6
How well do you know the distant public actors procedures of work?	T3
How much do you get information on the complex questions of innovation from distant public actors?	F12
How well does your main partner know the officials outside the region?	Q14

APPENDIX 9. Questionnaire for public sector-company cooperation

Attributes by cooperation area	Priority
Co-operation in infrastructure	
How frequently does your main partner contact you concerning infrastructure?	T1
How well does your main partner know the logistical challenges concerning his firm?	T2
How well does your main partner know the procedures of your work?	F1
How much do you get information on the complex questions of innovation from your main partner?	F2
How well does your main partner know your personnel?	Q1
Co-operation in spatial planning	
How well do you think that the spatial planning fulfils your main partner's needs?	C1
How well does your main partner know the spatial planning challenges concerning his firm?	Q2
How well does your main partner know the procedures of your work?	F3
How much do you get information on the complex questions of innovation from your main partner?	F4
How well does your main partner know your personnel?	Q3
Co-operation in environmental planning	
How well do you think that the environmental planning fulfils your main partner's needs?	C2
How well does your main partner know the environmental planning challenges concerning his firm?	Q4
How well does your main partner know the procedures of your work?	F5
How much do you get information on the complex questions of innovation from your main partner?	F6
How well does your main partner know your personnel?	Q5
Labour market agencies co-operations	
How well do you think that the labour market actors fulfil your main partner's needs?	C3
How well does your main partner know your organisations agendas?	Q6
How well does your main partner know your work?	F7
How much do you get information on the complex questions of innovation from your main partner?	F8
How well does your main partner know your personnel?	Q7
Co-operation with actors in environmental regulation and planning (outside your region)	
How well do you think that the environmental planning works outside the region (nationally)?	C4
How well do the distant public actors know environmental planning challenges of the region?	Q8
How well do you know the distant public actors procedures of work?	F9
How much do you get information on the complex questions of innovation from distant public actors?	F10
How well does your main partner know the officials outside the region?	Q9