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CREATING SUPPORTING DATA FOR DECISION MAKING BY USING A SENSE AND RESPOND METHOD

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ABSTRACT

For several years the South East region of Finland, where the city of Kouvola is located, has been one of the world's largest forest industry concentrated areas. In recent years, the forest industry companies have restructured their outsourcing strategies which have affected local engineer offices and metal industry companies. Kouvola Innovation Oy is affected by this since one of their main objectives is to develop the business operating environment in the area. Kouvola Innovation Oy sees that one potential new business for the area is renewable energy, especially bioenergy.

In this thesis I will introduce the role of technology foresight in creating competitive advantage using sense and respond methods and use the Critical Factor Index tool in creating supporting decision making data for Kouvola Innovation Oy for developing existing strategies and new ones.

The results suggest that the companies see bioenergy as an interesting and potential new business for the area. The results also indicate that there is improvement needed in product and service development. To be able to create new businesses to the area, networks and value chains are formed to gain competitive advantage to the area.

Keywords: Technology foresight, competitive advantage, sense and respond method

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TIIVISTELMÄ

Usean vuoden ajan Kaakkois-Suomen alue, jonka pohjoisosassa Kouvola sijaitsee, on ollut yksi maailman suurimpia metsäteollisuuden keskittymiä. Viime vuosien aikana metsäteollisuus yritykset ovat joutuneet uudelleen järjestelemään toimintojaan mikä on vaikuttanut paikallisesti toimivien yritysten toimintaan. Kouvola Innovation Oy:n eräs päätehtävistä on kehittää Kouvolan seudun elinkeinoliiketoimintaa ja tämän takia metsäteollisuuden muutokset ovat vaikuttaneet myös heidän toimintaansa.

Tämän Pro Gradu – työn tarkoituksena on tuottaa päätöksentekoa tukevaa tietoa käyttäen sense and respond – metodia teknologia johtamisen näkökulmasta. Työkaluna työssä on käytetty kriittiset menestystekijät – työkalua jonka avulla on ollut mahdollista selvittää kohde yritysten tämän hetkinen tilanne ja mihin Kouvola Innovation Oy:n kannattaa kohdistaa resurssinsa tässä vaiheessa.

Tuloksista selviää että yritykset kokevat bioenergian mielenkiintoisena vaihtoehtona uusia liiketoimintamahdollisuuksia kehittäessä. Tuloksista selviää myös että yritysten pitää kehittää tuote- ja palvelukehitystään kuten myös että uusien kilpailukykyisten liiketoimintojen kehittäminen alueelle on mahdollista mutta se vaati verkostoitumista ja arvoketjujen luontia yritysten välille.

Avainsanat: Teknologia johtaminen, kilpailukyky, sense and respond

1. BACKGROUND

For several years the South East region of Finland has been one of the worlds largest forest industry concentrated areas. Due to the global and rapidly changing business environment, the forest industry companies have been forced to carry out structural changes in their operations in order to remain profitable and being able to continue to offer added value for their interest groups. These companies struggle with increased energy, raw material and labor costs in Finland and this has meant reductions in production capacity and also production limitations. This in turn has lead to lay-offs and reduced outsourcing and subcontracting. In a four year span starting from April 2004 and ending to April 2008, the amount of persons working in the forest industry in South East Finland has dropped approximately 35 % and currently the industry employs little less than 6000 persons and the trend is downward (Kymenlaakson kauppakamari 2009).

The region of Kymenlaakso is located in the South Eastern part of Finland and it has been the home of engineer and metal industry companies that have received a major portion of their turnover from contracts originating from the forest industry. And now that the industry is facing challenging times it has also meant challenging times for these small and medium sized enterprises (Later on referred as SME).

Kouvola Innovation Oy is a company that was formed in the beginning of the year 2009 and one of its purposes is to support and develop the business

environment in the region of the city of Kouvola which is located in the northern part of Kymenlaakso. This thesis has been derived from the company's need to develop and support new business opportunities for local companies that are facing challenging times due to the worldwide economical situation which has played a part in the previously mentioned constructive changes in the forest industry. Kouvola Innovation Oy sees that there are potential new business opportunities in the fields' bioenergy and wood based building. The main focus of this thesis is to determine the current state of the engineer offices and metal industry companies regarding the previously mentioned areas of interest to give Kouvola Innovation Oy supporting data for their decision making processes. With the method used in this thesis, I will determine the most important attributes that are considered to be strong and vice versa the ones that are needed to be stressed the most at this time.

Even though the forest industry is facing challenging times in Finland and their need for raw wood has declined, the wood that still exists and will exist in the forests, offers opportunities to develop new businesses. Bioenergy is a field that offers potentially new business opportunities since it is something that is becoming increasingly important. Reason for this is that in 2007 the EU has stipulated new regulations for energy consumption that have to be reached by the year 2020. These regulations are aimed to increase the use of renewable energy sources up to 20 % of the end consumption which equals to trebling the amount that was used in 2005. For Finland this has meant that the country has to increase their usage of renewable energy sources from 28, 5 % to 38 %. In Finland, wood and other wood based raw material possesses the greatest unused potential in terms of biomass (Finbio 2009). One other thing that makes

bioenergy and related businesses an attractive option is that in year 2000 the refining value of wood in paper industry was 8, 8 times greater than it was in the energy industry that used wood as raw material. Last year it was only 1, 6 times greater (Jurvelin 2009).

The structure of this thesis is quite straight forward – In the next chapters will be covered the theoretical background of how technological foresight can offer competitive advantage for companies that incorporate it to their strategies. After this will be discussed how companies can use sense and respond methods to support technology foresight. In the latter part of the theoretical section will be introduced how the Critical Factor Index tool in a sense and respond method is derived. The empirical part of this thesis will cover the data collection process and analysis of it. This thesis will be rounded off by conclusions and discussions of the results.

The research method used in this thesis is based on the method introduced by Rautiainen and Takala (2003), which is a tool to measure the quality of service. Later on it has also been used as a basis for methods used in other studies like Latva-Rasku and Takala (2009) and Ranta and Takala (2007). Derived from these methods, the method used in this thesis measures companies expectations and experiences and together with the deviation of the answers, determines the so called Critical Factor Index (later on referred as CFI) for each measured aspect. Based on the CFI, the attributes can be put in order of importance and determine which of them need to stressed first at this stage. To give further

validation to the conclusions, the results will be put through a weak market test which is a part of constructive research.

2. TECHNOLOGY FORESIGHT

2.1. The role of technology foresight

For years the forest industry has provided business opportunities for different kinds of service and manufacturing companies in Finland. These companies have been able to plan their own operations based on the fact that they have known that a certain amount and types of work will be coming their way from the forest industry. This in turn has created a stalemate where these service and manufacturing companies have not had to invest and focus on product and service development. Also they have not been forced to compete in the market for new business opportunities due to these static orders from the forest industry which in turn have kept the business attractive.

As the forest industry is going through structural changes and reorganization of their operations, the service and manufacturing companies that have relied on businesses from it, should have also restructured their operations and focused on developing new business opportunities in order to maintain a profitable business. Campbell and Helleloid (2002) stated that no matter if you are a new industry or a mature industry company, keeping track of new technological breakthroughs is crucial. The same time as new technologies can offer companies new business opportunities, the same time it can also introduce new kinds of threats to existing business. The current economical situation is already in itself challenging and to avoid being squeezed even more in to a

corner, keeping up with new technological and business opportunities is a must.

As a part of a natural progress and elimination, the strongest will survive healthy and strong through the current economical slump. Technology foresight offers means for a company to be up to date with technological trends and therefore also to be part of the first wave in exploiting new business opportunities. Braun (1998) emphasized that including technology foresight to the overall corporate strategic planning of the company will benefit them in the long run. By doing this the company commits itself to an on-going process of technology foresight and as a result being able to take advantage of the cumulative knowhow that is gathered year in, year out.

Kanter (1997) also stressed in her book the role of technology foresight. There are four different things that are the basis of true sustainable competitive advantage:

1. Core Competence
2. Time Compression
3. Continuous Improvement
4. Relationships

All the above four elements are one way or another tight up to technology foresight. To be truly competitive as a small and medium sized company, you have to possess some kind of distinct service or product that no one else offers in the market or you have to able to deliver the service or product you are offering with more added value than your competitors. This determines your core competence and differentiates the company from rivals competing in the same market.

Time compression has become more and more important in the past decade or so. Customers expect to have their products or services delivered to them as soon as possible from the point of order placement, i.e. reduced lead times without having to expect any lower quality or service. Cutting back on production and delivery times is a must and one way of doing this is being aware of new technological possibilities that are available. Of course companies can improve their current processes but this can only be done to a certain extent. Continuous improvement also requires technological awareness since to maintain a position in the market or even improve the company's status, the company must not be satisfied at any point in its current service or product range since there is always someone in the market who will try to overtake the customers by offering the same product/service at a lower price or faster delivery times or a combination of these, i.e. the competitors try to offer more added value to the customers.

The fourth one in Kanter's (1997) list is relationships, which is also known as networking. As companies more and more focus on their core competences,

having an efficient social network is something that can offer competitive advantage over your competitors. By forming networks and value chains companies are able to gain synenergy benefits by each company in the network bringing their own core competence to the table and thus creating a network of services and products that are together more than the sum of its parts.

Tuominen, Rinta-Knuuttila, Takala & Kekäle (2003) also stressed the influence of networks in technology development in their paper. They introduced three main forces affecting technology development: Companies, universities and other institutes (Figure 1).

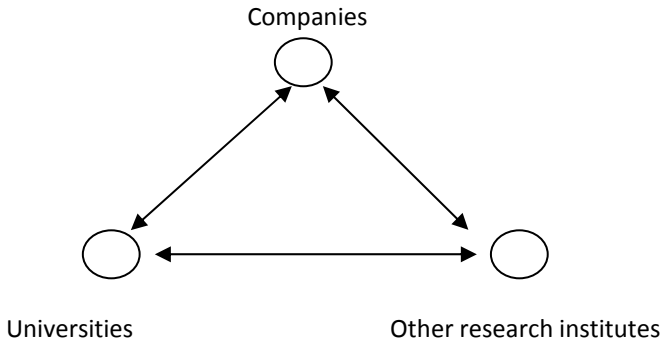

Figure 1. The main contributors of technology (Tuominen et al 2003: 2).

They stressed that each of the above three parties have a role to play in the development of new technologies. Companies focus on product development, universities focus on basic and applied research, and other research institutes –

for example government's research institutes – focuses on implementation research and technology watch (Tuominen et al 2003).

2.2.1. Types of technologies

Depending on at which stage a technology is in its life cycle, different types of technologies can be identified that is typical for each stage. Tuominen et al (2003) indentified three different types of technologies in their research that can be seen from the following picture. The figure also illustrates the linkage to the technology life cycle (Figure 2):

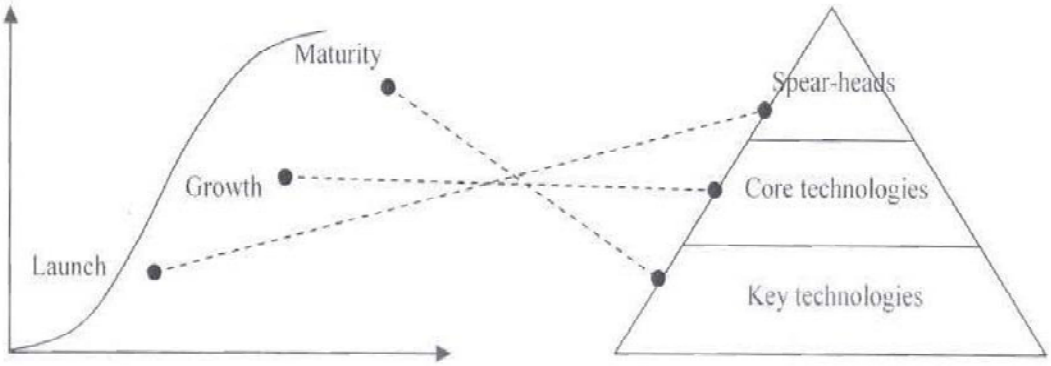

Figure 2. The linkage between technology life cycle and technology pyramid (Tuominen et al 2003: 5).

Spear-head technologies represent technologies that are seen as ones that hold the most potential and can offer successful business opportunities down the road regarding that they are exploited accordingly and efficiently. *Core* technologies include technologies that offer a competitive edge to competitors and enable the company to grow. At the bottom of the pyramid can be found key technologies, which represent technologies that the most critical ones for the business. The products and services are based on these technologies and therefore are the foundation of the business. These are kept inside the company to prevent the business of leaking to competitors. The pyramid can also contain an additional fourth level called additional technologies which represents the functions that are outsourced (Tuominen et al 2003).

3. SENSE AND RESPOND

In the previous chapter the role and importance of technology foresight was described. How can then companies start to implement these ideas in their own processes? And more importantly where do small and medium sized companies get the ideas for product and service development? Many of them do not possess the necessary resources to run their own research and development departments so they need to find other means to stimulate product and service development.

In this chapter the theory of sense and respond will be covered in order to illustrate how companies can carry out technology foresight principles. An efficient way to do this is to have a close relationship with their customers in order to have an image what the customers are currently expecting and more importantly what might they be expecting in the future. And if carried out efficiently, a company may derive from the information gathered completely new products or services that the customers had not even though about.

3.1 Make and sell versus sense and respond

In order to be able to sense the needs of interest groups and to plan the company's current and future operations accordingly, methods have to be developed. Forecasting has been used in the past to gather relevant information but by using it, room for errors increases as it is always more or less guessing what the future will bring. Modern technology has enabled companies to use ´sense and respond´ strategies to assist in forming a picture of what phenomenon might take place in the future. Companies are able to use methods that enable them to collect and analyze real time data and this in turn improves their awareness in terms of what kind of trends and events are taking place in their operating environment. By using sense and respond methods, companies are not only able to collect data regarding expectations and experiences but also able to understand how the target group see themselves compared to competitors plus how they see the development of a certain attribute at a given time frame (Strauss and Neuhauss 1997; Bradley and Nolan 1998; Ranta and Takala 2007).

Companies are moving from their traditional "make and sell" strategies toward "sense and respond" strategies that are faster and offer more real time information (Nolan and Bradley 1998). This has meant that the traditional concept of planning production cycles based on the manufacturers own needs has been replaced by the concept of anticipating the needs of customers in real time. By doing this companies are able to meet the needs and expectations of customers more efficiently and this in turn offers them the possibility to offer more added value compared to the traditional "make and sell" strategies. The

key differences between “make and sell” strategies compared to “sense and respond” strategies are (Bradley and Nolan 1998: 6):

"Make and Sell"	vs.	"Sense and Respond"
Annual budget resource allocation is the "heartbeat"		Dynamic, real time resource allocation is the "heartbeat"
Glacial change		Real-time change
Design, build, sell		Sell, build, design
Plan		Act
Market share		Mind share
Build to inventory		Build to customer
Build reliable, complex products and services		Create unimaginably complex products and services

By incorporating “sense and respond” strategies, companies are better equipped to understand the needs of customers since these strategies integrate customers into the companies own product development processes by continuously collecting data from customers. Nolan and Bradley (1998: 5) identified five key points of the benefits that this yields:

- Reducing cycle-time for developing extremely complex products
- Efficiently delivering value to customers
- Yielding high levels of innovation

- Providing highly challenging work for knowledge workers
- Achieving high levels of financial results

3.2 Technological development enables new opportunities

So far we have mentioned that the technological development has enabled companies to use these "sense and respond" strategies, but what does this mean in practice? Since the early 1960's the computer world has develop from massive and expensive mainframes to a completely different world where everybody is able to stay in contact with one another regardless of time and place. The technological infrastructure has developed to a stage where companies, groups and individuals are able to constantly stay in contact with each other through computers, mobile phones and other IT-equipment. This has been enabled by the rapid development of broadband technology that has offered different ways to share data between different interest groups (Nolan and Bradley 1998: 9).

With the aid of technological development companies are equip to monitor their customers on a constant basis which in turn offers them the possibility to be able to react, or even anticipate, to the changing needs at a accelerated pace compared to past times (Noland and Bradley 1998: 9).

As important as the technological breakthroughs are for sensing the needs of the customers it also offers the companies themselves possibilities to reorganize their old traditional company structure. As information flows faster and it is possible to distribute it more widely throughout the organization, companies are able to restructure themselves more efficiently. Different departments are able to interact with another and stay up to speed what everyone else is doing and at what stage they are in a specific process at any given time. This in turn offers the companies shorter and more efficient processes like production, product development and delivery. These improved processes enable the company to plan the distribution of their resources more efficiently which ultimately results in being able to offer added value to the customer.

3.3. How to sense the customer?

So far we have mentioned that in "sense and respond" strategies companies are able to plan their processes efficiently based on the information gathered from the customers via technology. But how is this executed in real life?

The main challenge in implementing "sense and respond" strategies is how to be able to sense the needs of the customers. One popular method has been to gather customer satisfaction data, enabling companies to have better understanding how the customers see the companies are performing at a certain point time. Also it helps companies to identify matters that are not

meeting the customers' expectations and re-plan processes accordingly if possible. The data gathered this way is always old data and circumstances might have changed since the customer satisfactions survey was carried out but still this way the companies are able have at least some kind of understanding about the market (Nolan and Bradley 1998).

Real time data gathering is extremely difficult like Nolan and Bradley, 1998, points out. They mention in their book couple of different ways how this can be carried out and all of those have one thing in common: All the companies mentioned in their examples have incorporated customers in their product development by allowing them to use an almost ready version of the final products and at the same time gather feedback from the users how they see the product and especially how would they, the potential buyers and end users, improve the products. Of course this is limited to certain types of industries but it can be considered as a starting point when planning "sense and respond" strategies and aiming to gather real time data from customers and other interest groups.

3.3.1. Virtual value chain

Nolan and Bradley (1998: 17) introduced in their book a term "virtual value chain". This "virtual value chain" can be seen from the following picture (Figure 3):

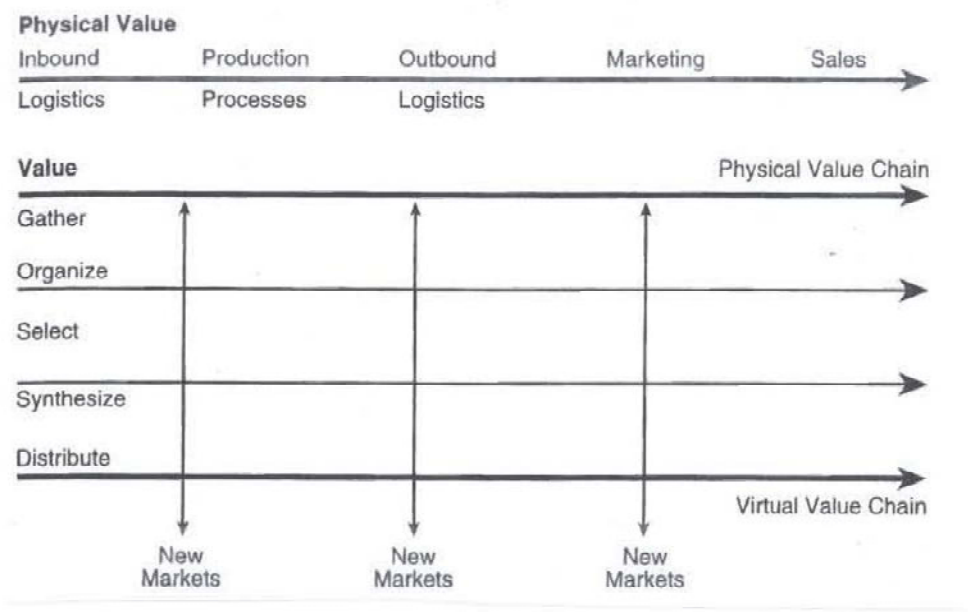

Figure 3. The virtual value chain (Nolan & Bradley 2003: 17).

The idea of the "virtual value chain" is to illustrate how much information flows inside different processes that support the physical value chain. In the picture can be seen that at each stage information is gathered, organized, selected, synthesized and distributed. Each bit of information at any point of the physical value chain might offer completely new information that can be the basis for new business opportunities. The new information can also be the starting point for research and development processes for new technological features and/or services. This is something that needs to be clear to different organizational members as they need to be aware of the different kind of information that flows through their own department. Otherwise golden chances might be lost.

To be able to take full advantage of the benefits that "sense and respond" strategies offer, many times companies need to restructure their organizations. Otherwise the information gathered and the implementation of it will remain at an inefficient level and even though a company might claim that they are a "sense and respond" organization, in fact without the restructuring of operations and the organizations most of the times, they are not. The organization structure needs to support the "sense and respond" strategies (Nolan and Bradley 1998).

3.4. Transforming organizations

It is challenging for companies, both larger and smaller ones, to carry out organizational restructuring throughout the whole company. Companies have been used to operate in a certain ways for years and in some cases tens of years and suddenly to turn everything upside down and reshape things is challenging. One could show theories and research papers to company executives that this new direction is the correct direction that your company needs to take in order remain competitive and profitable also in the future. Most of the times it requires more effort to motivate a company to start the process of revamping their current operations, since it is a challenging road that they might embark on and if it is not done accordingly, it could have disastrous altercations.

How can are organizations then motivated to restructure their operations if we exclude that they are forced to do so due of external factors, e.g. economical circumstances like a worldwide slump or mergers? Even though you could illustrate clear goals to a company executive what kind of improvements organizational restructuring can offer to the company, most of the times it would still be challenging to actually carry out the changes. They might recognize the need for a change which can be described as survival anxiety. And the same time as survival anxiety starts to surface, the same time learning anxiety starts to build up (Schein 2004: 329).

Survival anxiety can be described as the recognition of the need to change and discard their old ways of doing things but once the previous has been accepted, learning anxiety steps in (Schein 2004: 331). Schein (2004) described learning anxiety as a combination of different fears: Fear of temporary incompetence, fear of punishment for incompetence, the fear of loss of personal identity and the fear of loss of group membership. Fear of incompetence comes from having to step out of one's own comfort zone, i.e. while at the same time letting go of old habits and simultaneously trying to learn new ways of doing things and not yet to fully understanding and mastering these new habits. This is something that executives are really careful about since in case the new ways of doing things would not turn out to be as good they originally were intended to be, it would cripple the executive's authority. The second fear of punishment for incompetence is more or less related to the previous fear. The third of the fears described by Schein, 2004, relates to having to do something that they see is uncharacteristic for them. Executives especially have usually long careers behind them and they have built their own identity by doing things in a certain

manner. Now by learning to do something completely differently may be in conflict with one's own identity and thus creating a mental obstacle to carry out the required changes. The last fear is related to previous since by doing things in a certain way, executives have build a circle of trust from other managers and workers around them. The fear of losing the trust of that circle by altering ways of doing things might also prove to be a challenging obstacle to overcome.

It is virtually impossible to measure the level of learning anxiety but there are tools that help to determine vaguely at what level the anxiety is. So far we have determined that learning anxiety comes from the recognition that one realizes in order to perform more efficiently and therefore better than before, one would need to absorb and implement information that was previously unknown. Coghlan (1996) illustrated three stages of responses why a person could not engage in any learning process:

1. Denial where one would convince themselves that the information is not valid and therefore there is no need to further try to comprehend or implemented the information at hand.
2. Dodging, where one states that there is no need for a change before some else does it first.
3. Maneuvering, one seeks some kind of compensation for their efforts in order to implement the changes.

To overcome the previously mentioned obstacles that might stand in the way of transformative change, Schein (2004: 332-333) introduced two principles that apply:

1. "Survival anxiety or guilt must be greater than learning anxiety"
2. "Learning anxiety must be reduced rather than increasing survival anxiety"

The above principles relate to psychological aspects of the human mind that create psychological safety. Psychological safety can be achieved by supporting the members of the organization that are going through the transformational learning. This support can appear in several different ways, including training, mentoring, forming of support groups and lastly the most important thing, being able to create a positive image to the members that by doing the transformational change they will eventually enable the firm to perform better. This last point is helped by the fact that trying to avoid terms like "cultural change" or "transformational change" at the beginning of the process and stating clear targets that are need to be reached and the way they can be reached. Before the participants even realize it they are knee deep in a transformational learning process if they are pursuing the set targets using the agreed tools.

4. BUILDING THE METHOD

4.1. Service process analysis

Like previously mentioned in order for a company to maintain their competitive edge in their business environment, they need to incorporate technology foresight as an on-going process to their strategy. This in itself is not enough but a company has to be able to deliver the technological breakthroughs to the market via the correct channel.

Service Process Analysis (later on referred to as SPA) offers a normative framework where the capabilities of the services are analyzed in a matrix. The matrix is illustrated in Figure 3:

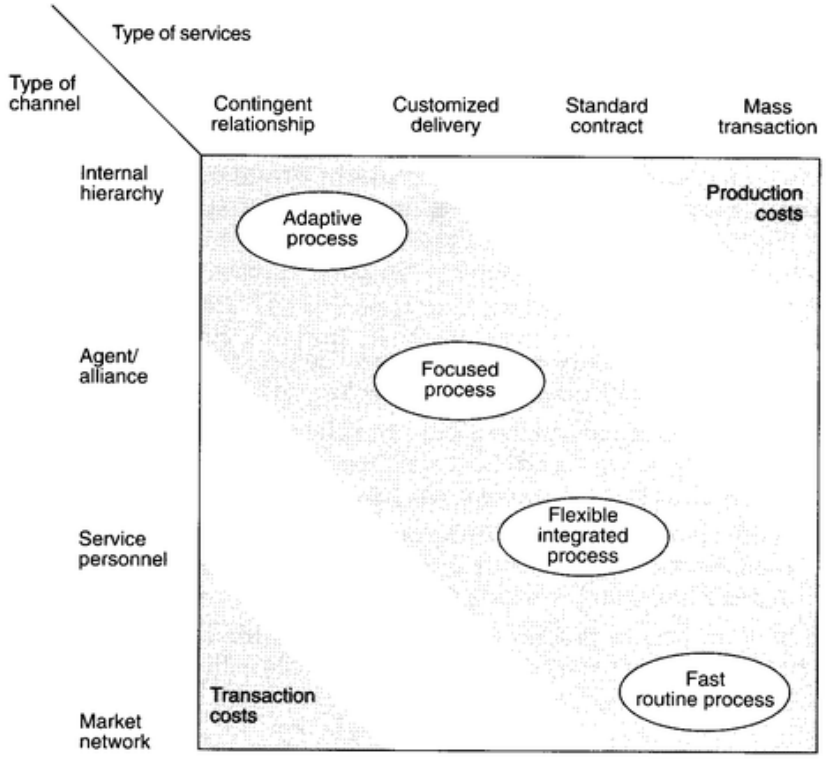

Figure 4. Service process analysis matrix (Ranta & Takala 2007: 2).

The axes consist of types of services and channels. SPA matrix has a core function of analyzing the efficiency of a certain type of service combined to a specific delivery channel (Jahnukainen and Vepsalainen 1992; Tinnilä and Vepsäläinen 1995; Ranta and Takala 2007).

A delivery channel where the actual service process is carried has several parties involved. How efficiently and accordingly a certain channel operates depends on how these different parties interact with one another. Each party must have a comprehensive understanding of their own role and what is required of them to have a dynamic and efficient channel. It is important to

realize that the customer buying and receiving the service is included and not considered as a separate part. Jahnukainen and Vepsäläinen (1992) and Tinnilä and Vepsäläinen (1995) determined four types of services:

- Mass transactions
- Standard contracts
- Customized delivery
- Contingent relationship

First three are clear but the last one, contingent relationship needs more clarification. It consists of complex problems and random acts that need continuous interaction from involved parties in order to tackle them accordingly and efficiently (Ranta and Takala 2009).

Jahnukainen and Vepsäläinen (1992) and Tinnilä and Vepsäläinen (1995) illustrated in the matrix four efficient services processes that are located in points where types and channel cross:

- Fast routine processes
- Flexible integrated processes
- Focused processes

- Adaptive processes

For companies the key in offering added value to its customers and as a result strengthening their own position in the market is to be able to choose correctly both the service and the channel (Ranta and Takala 2009). Sun, Ju and Su (2006) offered a three step questionnaire to help make the right choice. They said that the key is to have a clear vision and understanding where the company is situated currently in the market compared to its competitors, where they see the company is going and how are they planning to meet these objectives?

Rautiainen and Takala (2003) pointed out that when measuring and evaluating customer satisfaction in service processes, the first thing to be carried out is to study the company's current service processes. Idea is to establish the connection between process operations and the attributes of services since attributes arise in operations. This enables the improvement of customer satisfaction based on customer feedback. Figure 4 illustrates the flow of information.

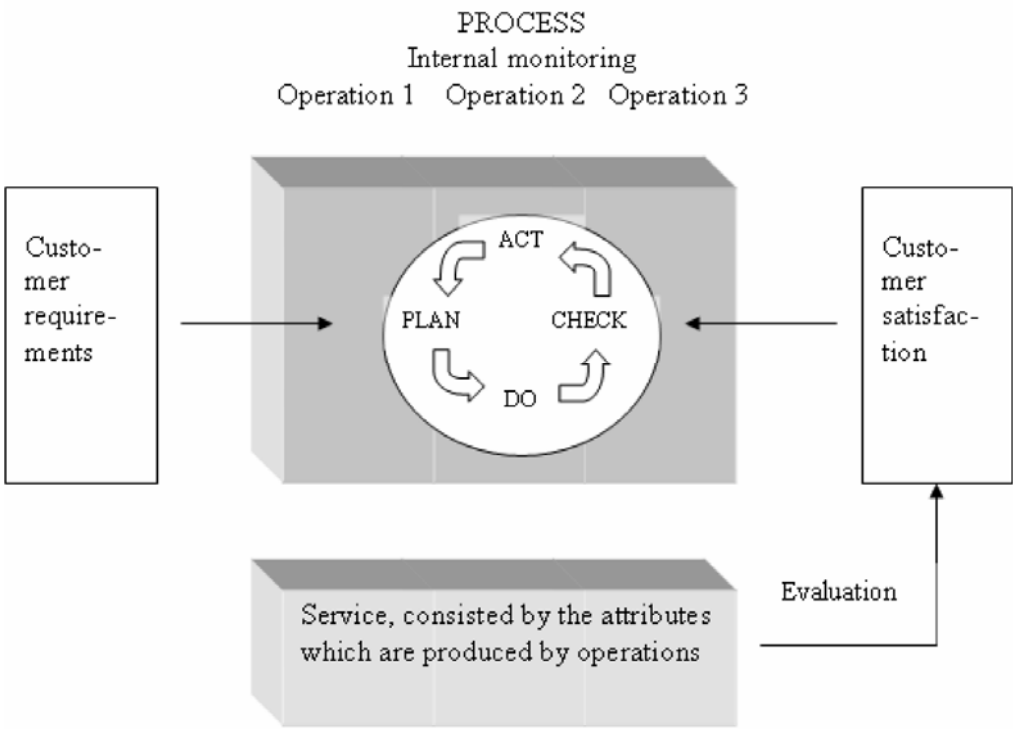

Figure 5. Continuos improvement of customer satisfaction linked to process operations (Ranta & Takala 2007: 2).

The same idea can be applied when determining critical factors influencing the operating environment of companies. First thing to be done is to determine basic characteristics of the business in which a certain company is operating.

4.2. Data collection

Rautiainen and Takala (2003) used in their study a questionnaire to gather data from customers. The questionnaire included attributes that took into account

customer's expectations and experiences, how they saw themselves position against competitors in the market regarding an attribute and how they saw an attribute developing in the future in a given time frame.

When planning the format of the questionnaire, one has to bear in mind that in order to collect answers using it and not just any answers, but reliable and valid ones, the structure must be planned so that is attractive to answer. This means that it has to be short, clear and easy to answer which will result in a positive and enjoyable experience. One of the core things of this method is to find out differences between attributes. This can be done by using a wide enough numerical estimation scale like Ranta and Takala (2007) used which can be seen in Figure 6.

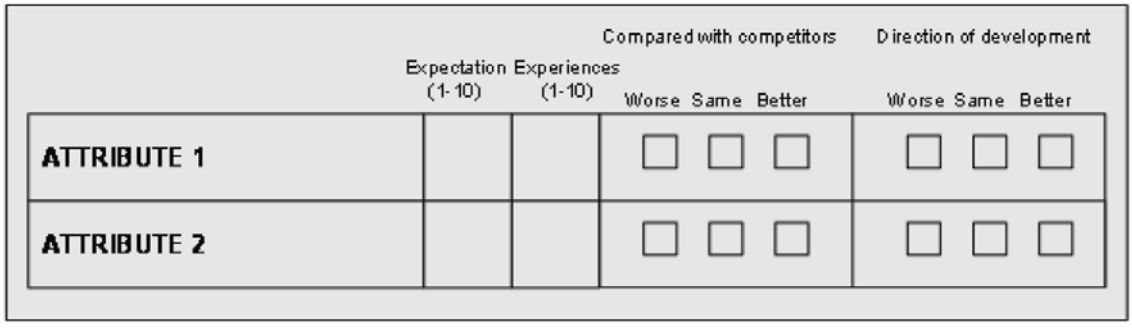

Figure 6. Model of questionnaire (Ranta & Takala 2007: 316).

4.3. Analyzing the data

The analyzing of the data is a process that requires several steps to get valid and useful conclusion. Rautiainen and Takala (2003) began their analysis by calculating standard deviation (later on referred as SD), averages and distributions about the development of the attributes. These distributions were formed by calculating the percentage of how many answers of the total amount of answers fell into to a specific alternative (Ranta and Takala, 2007). Table 1 illustrates an example of the previous.

	Average of the expectation	*SD of the expectation*	*Average of the experience*	*SD of the experience*		*Compared with competitors*			*Direction of development*	
					Worse %	*Same %*	*Better %*	*Worse %*	*Same %*	*Better %*
ATTRIBUTE 1	8.43	1.36	8.75	0.9	3.1	59.4	37.5	6.5	77.4	16.1
ATTRIBUTE 2	8.55	1.15	8.63	1.4	16.1	58.1	25.8	10	73.3	16.7

Table 1. Preliminary analysis (Ranta & Takala, 2007: 317).

In their study Rautiainen and Takala (2003) used three different tools to analyze the data gathered from the above table. One the tools were a gap analysis where the differences of expectations and experiences could be compared. By using the gap analysis can be determined the attributes where the gap between expectations and experiences is big. This in turn points out the attributes that can be taken as the development targets.

Implementation Index (later on referred to as IMPL) measures the importance and pressure to improve (Ranta and Takala, 2007). IMPL has been derived from SD by dividing the SD by the value of the corresponding competitive priority (importance) in order to improve the possibility to compare different attributes with each other and increase the sensitivity of the results. The results can be then interpret so that the smaller the number is, the larger is the possibility to the develop it.

As mentioned above the questionnaire developed for this method includes questions how the answerer sees the development of specific attributes within a given time frame. Together with the estimations of the answerers of how well competitors are performing and handling themselves regarding the same attributed can be developed a so called competitor index and development index. The emphasized IMPL was calculated from the direction of development and answers which applied the competitors. Based on this emphasized IMPL tool, Rautiainen and Takala, 2003, developed a tool called the critical factor index (later on referred to as CFI). This CFI tool points out the attributes that are considered to be critical. The CFI method is more comprehensive and useable method compared to the emphasized IMPL because it takes into account also the SD of the expectations. The equations to illustrate the analyzing method further can be seen from figure 7 (Rautiainen and Takala 2003).

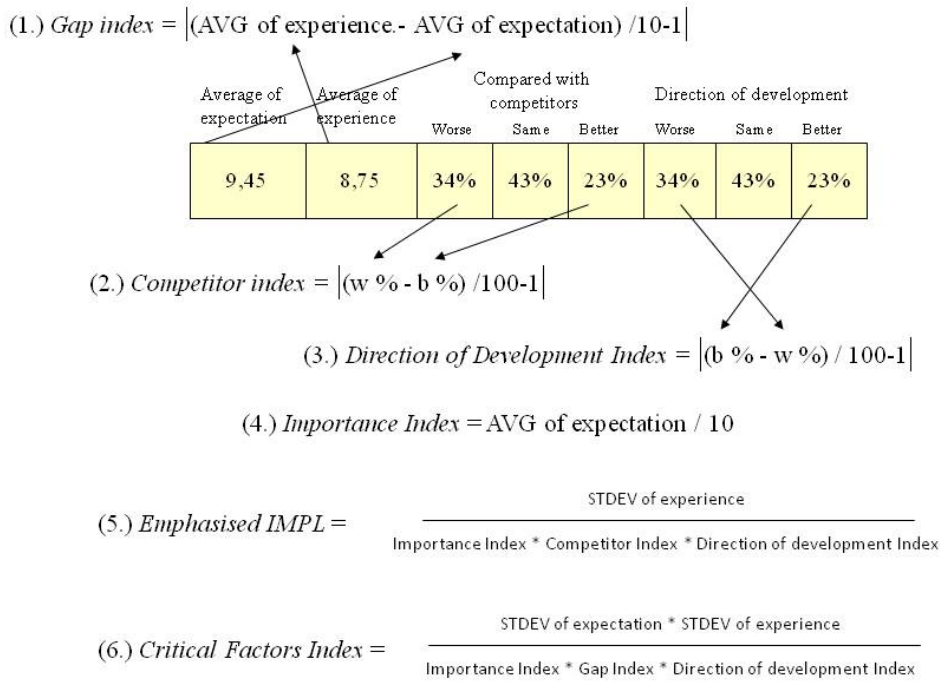

Figure 7. Equations (Rautiainen & Takala, 2003).

After the above equations have been calculated and the CFIs have been determined the next step will be the interpretations of the results. The analysis of the CFIs will be the basis of the recommended actions for Kouvola Innovation Oy. Like mentioned in the beginning of this thesis, in order to get further validation for the recommended actions, the scenario will be put through a weak market test which is a type of constructive modeling that is used in business administration. Constructive modeling will be covered in the following subchapter.

4.4. Weak market test

In this next part of the method building I will take a closer look and introduce a technique that gives even further validation to the research findings and also supports the ideas what to do next. This technique is called a "weak market test".

The "weak market test" is based on constructive research which in general means problem solving with help of constructing a model, diagram, plan, organization, machine or etc (Kasanen, Lukka and Siitonen 1991). Constructive modeling can be found from all areas of science but in this thesis we will look at it from a business administration point of view.

Kasanen et al (1991) described the constructive modeling as a combination of three different types of problem solving techniques: 1. Analytical modeling, where the solution for a problem is stressed but the applicability of it in real life problems remain vague 2. Scientific problem solving where a solution to a problem is produced based on theoretical data but it is a one off solution, i.e. it could not be applied to other problems except the one for which it was specifically developed 3. Consulting which could lead to a problem solution that could work in practice but would lack the theoretical background and the justification of it.

Constructive modeling is a process that has certain characteristics. It is a process that consists of different steps that are to be taken one step at a time in a specific order and these steps need to be transparent so that an anyone having enough theoretical and real life competence is able to see what has been done in each step and how the modeling has moved on to the following step. Lastly the most important thing is that each model must have a specific goal, i.e. a problem that could be resolved by constructing an applicable model. There are five different parts to constructive modeling in business administration. These are displayed in the following picture (Figure 8):

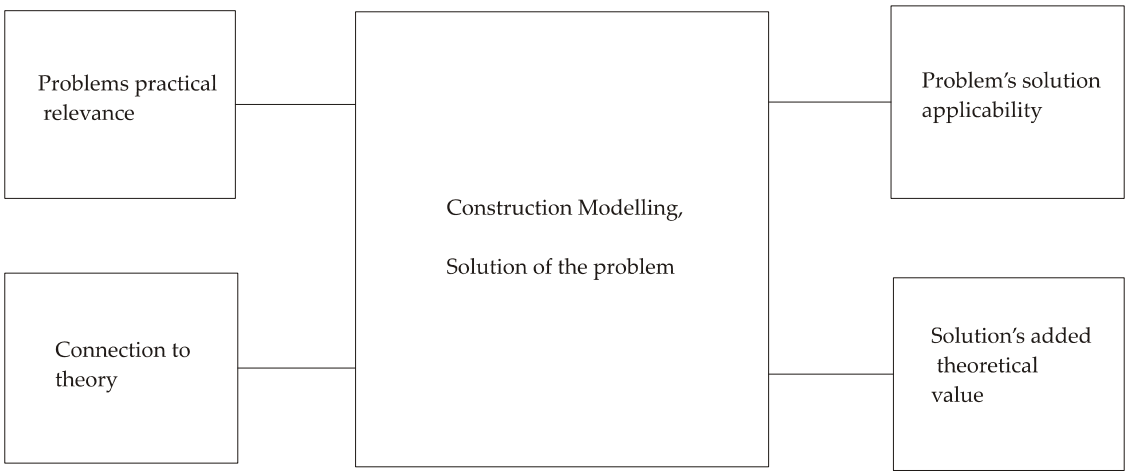

Figure 8. Components of constructive research (Kasanen et all 1991: 306).

The process starts from a real life problem that e.g. a company is facing and they need to resolve it. This problem needs to be tied up in theoretical concepts in order to get deeper understanding of the actual problem and of the issues and circumstances affecting it.

By combining these two aspects, the researcher, company, etc. is able to construct a potential model that can be used to solve the problem at hand. After the problem solving model is constructed, there needs to be methods available how the model can be tested if it really has the potential of solving the relevant problem. Otherwise if this would not be done, the solution for solving the problem would only be the subjective point of view of the person(s) who constructed the model and this would lead to more questions in regard if there are many different models for the same problem which one of them is the most suitable if any since none of them have been tested in real life?

Kasanen (1986) introduced in his doctoral thesis a method for this called marked based validation that is to be used business administration. The method is a two phase process that consists of a weak market test and from a strong market test. In this thesis I will only use the first part of this process, i.e. the weak market test since the latter one would require a longer period of data collection and further analysis and so due to the time frame of this thesis it will not be covered but it will only be shortly introduced. Kasanen (1986) noted that that first step, i.e. the weak market test is itself a tight test that only scarce amount of models ever pass.

The "weak market test" basically means that once a potential model for a relevant problem has been constructed, the model itself and the necessary data that was interpret in constructing the model are shown to a third party. The third party would preferably be a person that is in charge of a related business

and therefore would have the competence to give valid feedback in order to do the "weak market test". In the actual test the person of choice would go through the data and see if he/she would come to the same conclusions and more importantly would he/she be willing to use the constructed model in his own business. By doing this the researcher who constructed the original model is able to gather feedback and validation for the model. After this and assuming the model had past the weak market test, the next step would be the strong market test. In this next step basically the applicability of the model to real life problems would be observed and the data analyzed in order to see if it would have had the desired outcomes.

Kasanen et all (1991) also addressed in their article the issue whether or not this constructive modeling in business administration is relevant science since scientific theories need to be theories that can be applied generally or is it just a form of consulting put into different words. They argued that constructive modeling is a type of scientific research on the basis that it reveals links between phenomenon that are common features to them despite the circumstances rather than revealing connections that are considered one off types of phenomenon that only exits in that certain environment. They based on the previous that to be able to construct an applicable model it requires deep and comprehensive understanding of the phenomenon and therefore if it works in one firm, there is no reason to believe that it could not work also in another firm.

They also argued that constructive modeling, if correctly done and carried out, fulfills at least the scientific characteristics: objectivity, criticalness, autonomous and progression (Kasanen et al 1991). It also fulfills the characteristics, relevancy, simplicity and adaptability, of applicable science since the in constructive modeling there always is problem from real life situation and proof that the model can be applied to it in real life.

5. DATA COLLECTION

The research was conducted so that a questionnaire of 27 attributes was compiled that measured companies expectations, experiences, situation compared to other companies and how they saw an attribute to develop in a five year span. The attributes were chosen so that they would give general information about the company as well as their thoughts about bioenergy and construction. The attributes were divided into smaller segments and after each segment there was a possibility to explain the answers in more depth. At the end of the questionnaire there were also 4 open questions that gave the respondents the chance to bring their own ideas and thoughts to light. The idea behind these open questions as well as the explanation boxes after each segment was to get even more information from the companies and to let the respondents clarify their answers if they saw it necessary. By doing this the information gathered and used in the analysis gain more depth and relevance. All the attributes are listed in appendix 1.

The data collection process itself was carried so that each and every one of the 40 companies that were chosen into the target group, were phoned. The background of this research was introduced and asked if it was possible to come over and discuss more about it. Each company was interviewed for certain amount of time (the interviews lasted between 30 minutes to 1 hour and a half) and the companies had the chance to tell in their own words their current situation and how do they see the coming months and years developing. During these interviews, it was explained in more detail what the

idea behind this research was, to get the companies more interested in it and to explain that this way they were able to get their own voice heard.

The actual questionnaire was done using a web based program called Webropol which enabled the companies to answer the questionnaire in an electronic form. Reason why this approach was chosen was that in order to get as high as possible answer rate, the questionnaire and the process of answering it, were designed so that it would take as short amount of time and effort as possible. During the interviews some of the questions were explained in more detail plus a short introduction of some of the attributes were compiled that were given to the respondents during the interviews. The reason why this was done was to limit any interpretation errors for the attributes. This way the respondent knew what was meant by a certain attribute and vice versa person analyzing the answers, knew what each respondent had meant. A list of what attributes where explained and how they were explained can be found from appendix 2.

Like mentioned in the beginning, the target group consisted of engineer offices and metal industry companies. Also there were couple of architecture firms included to the survey since it was felt that they could offer something to bioenergy and construction related projects.

The criteria by which the companies were chosen were that they should have more than 5 employees and they should have had some kind of connection with the forest industry. Experts inside Kouvola Innovation Oy provided a list of

potential candidates from which a shortlist was made that included 40 companies. Only the architecture companies were chosen with a different criterion, i.e. three of the leading companies in the area were chosen despite they might not had 5 employees or any connection to the forest industry.

The general response to the research was good. Out of the 40 companies interviewed, 29 companies answered the online questionnaire so the total answer rate was 72.5 %. Out the 29 answers 26 were included to this analysis since the three answers discarded, came in late and the decision was made not to include them since they would not made a relevant change to the trends and indexes. So the response rate for companies that answered in time and were included to the analysis was 65 %.

The answers were analyzed so that first all the answers were analyzed together and the engineer companies and metal industry companies also separately. The architecture companies were excluded from the separate analysis since only one of the three chosen companies answered in time (One architecture company was one the three companies whose answer were discarded due to the late response) and therefore it was not relevant to analyze only one answer separately.

5.1. Preliminary analysis

5.1.1. All the answers

In the following table can be seen the results of the preliminary results for all the 26 companies:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.19	2.56	6.19	1.81	7.70	19.20	73.10
Attribute 2	7.46	1.73	**7.08**	1.23	26.90	57.70	15.40
Attribute 3	6.03	2.96	5.65	2.42	42.30	53.80	3.80
Attribute 4	6.44	3.06	5.62	2.66	42.30	42.30	15.40
Attribute 5	5.12	2.85	4.89	2.34	0.00	57.70	42.30
Attribute 6	**7.56**	1.45	**7.08**	1.44	4.00	60.00	36.00
Attribute 7	**9.46**	0.58	**8.27**	1.25	7.70	46.20	46.20
Attribute 8	**4.42**	2.40	**3.04**	2.09	7.70	76.90	15.40
Attribute 9	6.15	1.87	5.08	2.26	0.00	65.40	34.60
Attribute 10	5.39	2.23	4.42	2.02	3.80	76.90	19.20
Attribute 11	7.19	1.50	5.69	2.06	0.00	46.20	53.80
Attribute 12	5.54	3.02	5.08	2.74	3.80	80.80	15.40
Attribute 13	7.27	2.11	6.54	2.00	0.00	50.00	50.00
Attribute 14	6.08	3.05	4.85	2.99	7.70	26.90	65.40
Attribute 15	5.85	2.87	4.81	2.56	7.70	34.60	57.70
Attribute 16	6.42	2.97	5.69	2.77	3.80	26.90	69.20
Attribute 17	**7.65**	1.98	6.08	2.86	0.00	30.80	69.20
Attribute 18	6.08	3.02	5.19	3.10	23.10	61.50	15.40
Attribute 19	7.46	2.90	6.53	2.67	7.70	57.70	34.60
Attribute 20	**4.19**	3.00	**3.96**	2.76	42.30	46.20	11.50
Attribute 21	4.96	3.38	4.58	2.89	23.10	57.70	19.20
Attribute 22	**3.96**	2.60	**3.46**	2.56	30.80	53.80	16.40
Attribute 23	6.65	2.90	6.15	2.74	3.80	57.70	38.50
Attribute 24	6.50	3.05	5.35	3.10	3.80	61.50	34.60
Attribute 25	7.00	2.03	6.32	2.20	0.00	68.00	32.00
Attribute 26	6.46	2.18	5.40	2.27	0.00	53.80	46.20
Attribute 27	6.19	2.51	4.96	2.11	4.00	60.00	36.00

Table 2. Preliminary results for all the answers.

Preliminary analysis indicates the companies hold in high regard attributes 6, 7 and 17 which are being part of a value chain, skillful workforce and interest towards developing bioenergy related businesses. Two of these previous attributes also have high values in how the companies see that the attribute is being carried out in their companies. These attributes are numbers 6 and 7 which are being part of a value chain and the size of customer contracts.

The lowest importance for companies hold attributes 8, 20 and 22 which are the support from the city of Kouvola, building houses and architecture. These also have the lowest values in how attributes are being fulfilled in the companies.

It is also worth pointing out that the standard deviations for the answers are high for almost every single attribute in both how important the companies see each attribute for them and how well those attributes are being carried out in the companies. One exception is skillful workforce which holds lowest standard deviation in both categories.

All the attributes also show a same characteristic feature: All of them score higher in importance than they do in how well those attributes are done in companies (The only exception to this being attribute 1 which is the number of customers which scored the same both in importance and performance). This suggest that all the attributes should be developed but keeping in mind that there are a total of 27 different attributes and companies have their main focus

areas and limited resources as do Kouvola Innovation Oy, the critical areas that are to be taken under revision urgently will be determined later on in this thesis using the CFI tool.

Interesting point from the preliminary analysis that stands out is that all the respondents see that the bioenergy attribute and related attributes will grow their importance in the next five years but at the same time innovation development and productization of new products will not increase their importance strongly which can be seen from attributes 26 and 27. Also when you look at attribute number 10 which is research and development resources can be seen that almost four out of five respondents see them remaining at the current level which are alarming. All the companies see thought, that continues education is important for them (attribute 11) even though it is not currently done as well as companies would like it to be done. Not too many conclusions are to be drawn based this since the engineer offices and metal industry companies are of different nature but this will be looked more closely when the answers are divided between the two target groups.

Next the development indexes and gap indexes for the all the answer will be analyzed. These indexes can be found from the following table (Table 3):

	Direction of development index	*Gap Index*
Attribute 1	0.35	1.00
Attribute 2	1.12	1.04
Attribute 3	1.39	1.04
Attribute 4	1.27	1.08
Attribute 5	0.58	1.02
Attribute 6	0.68	1.05
Attribute 7	0.62	1.12
Attribute 8	0.92	1.14
Attribute 9	0.65	1.11
Attribute 10	0.85	1.10
Attribute 11	0.46	1.15
Attribute 12	0.88	1.05
Attribute 13	0.50	1.07
Attribute 14	0.42	1.12
Attribute 15	0.50	1.10
Attribute 16	0.35	1.07
Attribute 17	0.31	1.16
Attribute 18	1.08	1.09
Attribute 19	0.73	1.09
Attribute 20	1.31	1.02
Attribute 21	1.04	1.04
Attribute 22	1.14	1.05
Attribute 23	0.65	1.05
Attribute 24	0.69	1.12
Attribute 25	0.68	1.07
Attribute 26	0.54	1.11
Attribute 27	0.68	1.12

Table 3. Development and gap indexes for all the answers.

Based on the answers it can be seen that the companies see that most of the attributes will grow or at least have the same significance to the company in the next five year span as they have now. Attributes 2, 3, 4, 18, 20 and 22 will decline in importance for the companies. These attributes corresponds to the size of customer contracts, the importance of the forest industry, the effects of the constructional changes taking place in the forest industry, construction, building houses and architecture. These declining trends related to the forest industry are to be seen as positive signs since engineer and metal industry

companies have been relying on work generated by the forest industry for several decades and companies have realized that their turnovers have to be generated from other businesses in order to stay alive.

Since one of the interest areas of Kouvola Innovation Oy is to be part in developing bioenergy related business opportunities to the region of Kouvola, it is positive to see that the companies see bioenergy (and also environmental friendliness) as a positive thing and as s business that will grow its importance in the next five years. There is a strong desire to develop that area of business in the region and companies are aware that bioenergy related businesses will grow in the future not only in Kouvola but also in other parts of the world.

One part of the questionnaire was related to how the company sees themselves compared to others in terms of each attribute. These results can be seen from the following table (table 4):

	Worse	Same	Better
Attribute 1	26.90	69.20	3.80
Attribute 2	7.70	61.50	30.80
Attribute 3	26.90	57.70	15.40
Attribute 4	23.10	53.80	23.10
Attribute 5	48.00	44.00	8.00
Attribute 6	4.00	88.00	8.00
Attribute 7	3.80	53.80	42.30
Attribute 8	57.70	38.50	3.80
Attribute 9	34.60	53.80	11.50
Attribute 10	38.50	50.00	11.50
Attribute 11	19.20	69.20	11.50
Attribute 12	19.20	69.20	11.50
Attribute 13	0.00	84.60	15.40
Attribute 14	28.00	52.00	20.00
Attribute 15	32.00	56.00	12.00
Attribute 16	20.00	60.00	20.00
Attribute 17	4.00	76.00	20.00
Attribute 18	50.00	42.30	7.70
Attribute 19	19.20	61.50	19.20
Attribute 20	61.50	34.60	3.80
Attribute 21	38.50	46.20	15.40
Attribute 22	52.00	44.00	4.00
Attribute 23	19.20	53.80	26.90
Attribute 24	34.60	57.70	7.70
Attribute 25	4.00	88.00	8.00
Attribute 26	26.90	57.70	15.40
Attribute 27	32.00	64.00	4.00

Table 4. How companies see themselves compared to other companies.

At first glance it seems that most of them see themselves situated more or less the same way as do their competitors but there are few interesting attributes that point out. Firstly, attribute 7 which is skillful workforce, stands out since nearly have of the respondents see themselves stronger in this than their competitors. Of course it is nearly impossible to determine does a company have absolute better workforce than its competitors, but this on the other hand

suggests that companies hold in high regard their own workforce which in turn indicates that they appreciate their work.

Secondly, the support of the city, i.e. attribute 8, stands out since almost 60 % of the respondents see themselves in a worse situation compared to their competitors. This is something that would need to be studied further and determine the actual reason behind this. Is the result based on wrong assumptions or are there facts behind the answers? Are answers somehow related to the merger of the 6 counties in the beginning of this year? Etc.

In the next parts the answers will be divided into two separate units, one unit consisting of answer from the engineer offices and the other one from the metal industry companies. By doing this it is possible to compare answers between the units plus compare the answers of the units to all the answers and determine if there are any discrepancies in the answers and if so what might the reasons be behind those discrepancies.

5.1.2. Engineer offices

The preliminary answers of the engineer offices can be seen from table 5:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.07	2.52	5.73	1.71	13.33	20.00	66.67
Attribute 2	7	1.77	6.67	1.35	13.33	73.34	13.33
Attribute 3	5.8	2.70	5.20	1.93	33.33	60.00	6.67
Attribute 4	6.07	3.26	6.00	2.54	46.67	40.00	13.33
Attribute 5	6.07	2.84	5.07	2.15	0.00	40.00	60.00
Attribute 6	7.33	1.63	**6.80**	1.47	0.00	60.00	40.00
Attribute 7	**9.20**	0.56	**8.33**	0.82	6.67	40.00	53.33
Attribute 8	**4.73**	2.31	**3.00**	1.96	6.67	80.00	13.33
Attribute 9	6.13	1.92	4.87	2.42	0.00	66.67	33.33
Attribute 10	5.27	2.43	4.40	2.13	0.00	80.00	20.00
Attribute 11	7.53	1.19	6.27	2.05	0.00	46.67	53.33
Attribute 12	4.87	2.72	4.47	2.53	6.67	80.00	13.33
Attribute 13	7.20	2.27	6.53	2.29	0.00	46.67	53.33
Attribute 14	7.07	2.34	5.53	2.39	6.67	20.00	73.33
Attribute 15	6.67	2.47	5.40	2.26	13.33	26.67	60.00
Attribute 16	**7.60**	2.23	6.53	1.88	6.67	20.00	73.33
Attribute 17	**8.00**	1.65	**7.13**	1.77	0.00	20.00	80.00
Attribute 18	6.13	2.83	5.33	2.97	20.00	60.00	20.00
Attribute 19	7.53	2.72	6.60	2.67	6.67	53.33	40.00
Attribute 20	**4.73**	3.06	**4.20**	2.68	40.00	46.67	13.33
Attribute 21	5.67	3.42	5.33	3.18	20.00	53.33	26.67
Attribute 22	**4.60**	2.41	**3.87**	2.45	33.33	46.67	20.00
Attribute 23	6.93	2.84	6.67	2.44	0.00	53.33	46.67
Attribute 24	6.67	2.89	5.60	3.00	0.00	66.67	33.33
Attribute 25	6.80	2.76	6.27	2.55	0.00	73.33	26.67
Attribute 26	7.00	1.93	5.67	2.19	0.00	40.00	60.00
Attribute 27	6.53	2.64	5.20	2.24	0.00	60.00	40.00

Table 5. Preliminary results for answers collected from the engineer offices

The response rate for the engineer offices was 83.3 %. Looking at the answers collected only from the engineer offices, one can notice that they more or less follow the same trend as did the answers from all the companies. Engineer offices see that attributes 7, 16 and 17 have high importance to them. These attributes are skillful workforce, bioenergy related device knowhow and bioenergy related project knowhow.

Two out of the three attributes are also being fulfilled at a good level according to the firms. Only bioenergy related device knowhow is somewhat lagging behind more than the other two which indicates that there is much research and development needed still in that area. This is not that surprising when one considers how rapidly changing and developing area bioenergy is. Technology develops at an accelerated pace and news ideas and innovations are introduced all the time. As soon as the technologies are more known and reach a more static stage, companies are able to invest more on device development when the dominant technologies are evident.

The lowest importance to the companies have attributes 22, 8 and 20 which are architecture, support of the city and building houses. All of these three attributes also are seen as the ones that are left with smaller focus than others inside the companies.

When looking at the development indexes for the attributes how the engineers companies see the importance of each attribute develop in the next five years it can be seen that they follow the same trend as where the indexes calculated for all the answers (Indexes can be seen from table 6). According to the answers, the engineer offices see that the importance of the forest industry, the contractual changes taking place in the forest industry, construction, building houses and architecture will decline in importance for them (attributes 3,4,18, 20 and 22). Also from these answers it can be seen that the companies feel that attributes related to bioenergy will grow their importance in the next five years. This can be seen from the low index values for attributes 14 -17. Engineer companies seem to understand the role of innovation development and productization of them (attributes 26 & 27) since none of the respondents indicated that those two attributes will their significance in the next five years.

	Direction of development index	*Gap Index*
Attribute 1	0.47	1.03
Attribute 2	1.00	1.03
Attribute 3	1.27	1.06
Attribute 4	1.33	1.01
Attribute 5	0.40	1.10
Attribute 6	0.60	1.05
Attribute 7	0.53	1.09
Attribute 8	0.93	1.17
Attribute 9	0.67	1.13
Attribute 10	0.80	1.09
Attribute 11	0.47	1.13
Attribute 12	0.93	1.04
Attribute 13	0.47	1.07
Attribute 14	0.33	1.15
Attribute 15	0.53	1.13
Attribute 16	0.33	1.11
Attribute 17	0.20	1.09
Attribute 18	1.00	1.08
Attribute 19	0.67	1.09
Attribute 20	1.27	1.05
Attribute 21	0.93	1.03
Attribute 22	1.13	1.07
Attribute 23	0.53	1.03
Attribute 24	0.67	1.11
Attribute 25	0.73	1.05
Attribute 26	0.40	1.13
Attribute 27	0.60	1.13

Table 6. Development and gap indexes for answers collected from the engineer offices.

The comparison of how the engineer companies see themselves positioning against one another has to be interpret carefully. Reason for this is that in the respondents there are different types of engineer offices that are focused in a certain area of expertise and this is why it comes naturally that in some of the attributes they see themselves stronger than others that might have lesser interest to that matter. All the answers can be seen from the table 7.

	Worse	Same	Better
Attribute 1	26.67	73.33	0.00
Attribute 2	13.33	60.00	26.67
Attribute 3	33.33	60.00	6.67
Attribute 4	26.67	40.00	33.33
Attribute 5	40.00	53.33	6.67
Attribute 6	6.67	86.66	6.67
Attribute 7	6.67	40.03	53.3
Attribute 8	46.67	46.66	6.67
Attribute 9	33.33	53.34	13.33
Attribute 10	40.00	46.67	13.33
Attribute 11	13.33	66.67	20.00
Attribute 12	26.67	66.66	6.67
Attribute 13	0.00	73.33	26.67
Attribute 14	26.67	53.33	20.00
Attribute 15	33.33	53.34	13.33
Attribute 16	13.33	66.67	20.00
Attribute 17	6.67	80.00	13.33
Attribute 18	40.00	46.67	13.33
Attribute 19	13.33	60.00	26.67
Attribute 20	60.00	33.33	6.67
Attribute 21	33.33	40.00	26.67
Attribute 22	46.67	46.66	6.67
Attribute 23	13.33	40.00	46.67
Attribute 24	33.33	60.00	6.67
Attribute 25	6.67	80.00	13.33
Attribute 26	33.33	46.67	20.00
Attribute 27	33.33	60.00	6.67

Table 7. How engineer offices see themselves compared to other engineer offices.

It is still worth noticing that a third of the respondents see themselves lagging behind their competitors in both innovation development and innovation productization (attributes 26 and 27). Before making any further conclusions from these figures, the answers should be taken into closer evaluation since some of the engineer companies might operate in a business that has little

emphasis for innovations and therefore also for innovation productization. Also it stands out that the companies see that they are significantly better off than their competitors in attributes 7 and 23 which are skillful workforce and construction related project know how.

5.1.3. Metal industry companies

The preliminary analysis of the results can be seen from the following table:

	Average of the expectation	*SD of the expectation*	*Average of the experiences*	*SD of the experiences*	*Direction of development*		
					Worse %	*Same %*	*Better %*
Attribute 1	6.20	2.82	6.80	1.93	0.00	20.00	80.00
Attribute 2	**7.90**	1.45	**7.60**	0.84	50.00	30.00	20.00
Attribute 3	6.80	3.22	6.70	2.71	60.00	40.00	0.00
Attribute 4	6.80	3.22	5.40	2.80	40.00	40.00	20.00
Attribute 5	4.10	2.33	5.00	2.49	0.00	80.00	20.00
Attribute 6	6.90	2.56	6.70	2.71	10.00	60.00	30.00
Attribute 7	**9.80**	0.42	**8.10**	1.79	10.00	60.00	30.00
Attribute 8	3.70	2.50	**2.80**	2.25	10.00	70.00	20.00
Attribute 9	5.90	1.73	5.10	2.02	0.00	60.00	40.00
Attribute 10	5.40	2.07	4.30	2.00	10.00	70.00	20.00
Attribute 11	6.80	1.87	5.10	1.85	0.00	50.00	50.00
Attribute 12	6.80	3.26	6.30	2.75	0.00	80.00	20.00
Attribute 13	**7.80**	1.40	**6.90**	1.20	0.00	60.00	40.00
Attribute 14	5.10	3.41	4.20	3.61	10.00	30.00	60.00
Attribute 15	5.10	3.00	4.30	2.79	0.00	40.00	60.00
Attribute 16	5.20	3.08	4.90	3.38	0.00	30.00	70.00
Attribute 17	7.20	2.49	5.00	3.43	0.00	40.00	60.00
Attribute 18	5.60	3.31	4.50	3.14	30.00	60.00	10.00
Attribute 19	7.10	3.31	6.40	2.95	10.00	60.00	30.00
Attribute 20	**2.80**	2.04	**3.00**	2.21	40.00	50.00	10.00
Attribute 21	**3.40**	2.67	3.50	2.27	30.00	60.00	10.00
Attribute 22	**2.40**	1.51	**2.20**	1.55	30.00	60.00	10.00
Attribute 23	5.90	2.96	5.00	2.83	10.00	60.00	30.00
Attribute 24	5.90	3.31	4.50	3.06	10.00	60.00	30.00
Attribute 25	6.70	2.75	5.80	2.66	0.00	60.00	40.00
Attribute 26	5.40	2.22	4.10	2.47	0.00	80.00	20.00
Attribute 27	5.40	2.22	4.50	2.01	0.00	80.00	20.00

Table 8. Preliminary results for answers collected from the metal industry companies.

For the metal industry companies the response rate was 52.6 %. At first glance there can be seen differences compared to engineer offices which are natural bearing in mind the types of companies that were selected for this survey. For these metal industry companies attributes 2, 7 and 13 hold the highest importance and also these attributes have the highest values in how well the attributes are carried out in the firms. These attributes are the size of customer contracts, skillful workforce and environmental friendliness. One important thing is to notice that the answers of skillful workforce attribute averages almost 10 combined with a low standard deviation which indicates that this attribute is one of the key cornerstones of their business. Also the figures indicate that all except the previously mentioned attributes have relatively low scores in how well they are being executed in the firms.

Lowest importance to the companies hold attributes 22, 20 and 21 which are architecture, building houses and technical construction design. Two of these, attributes 20 and 22, are also seen as ones that are not being focused on as much as the others. The companies also see that attribute 8 has little meaning to their operations and this attribute is the support of the city.

One figure stands out from the calculations and that is how well companies have been able to attract customers compared to expectations (attribute 1). It is the only attribute that has this characteristic. This also applied when taking into account the importance vs. performance from all the companies that took part in the survey as well as for answers gathered only from engineer offices.

Metal industry companies also see the same things growing their importance in the next five years as do the engineer offices (bioenergy related issues). This can be seen from the development indexes for attributes 14 – 17. All the indexes can be seen from table 9. Attributes that seem to be losing their importance in the next five years are numbers 2, 3, 18, 20, 21 and 22 which are the size of customer contracts, the significance of the forest industry, construction, building houses, technical construction design and architecture. It is interesting to see that the companies see that the size of the customer contracts will decline in importance and the number of customers on the other hand will grow its importance. This suggests that the companies are shifting from bigger contracts that tie their resources to smaller ones with a shorter time line. This in turn indicates that the companies are planning to become more flexible in terms delivery times and the types of work contracts.

	Direction of development index	*Gap Index*
Attribute 1	0.20	0.94
Attribute 2	1.30	1.03
Attribute 3	1.60	1.01
Attribute 4	1.20	1.14
Attribute 5	0.80	0.91
Attribute 6	0.80	1.02
Attribute 7	0.80	1.17
Attribute 8	0.90	1.09
Attribute 9	0.60	1.08
Attribute 10	0.90	1.11
Attribute 11	0.50	1.17
Attribute 12	0.80	1.05
Attribute 13	0.60	1.09
Attribute 14	0.50	1.09
Attribute 15	0.40	1.08
Attribute 16	0.30	1.03
Attribute 17	0.40	1.22
Attribute 18	1.20	1.11
Attribute 19	0.80	1.07
Attribute 20	1.30	0.98
Attribute 21	1.20	0.99
Attribute 22	1.20	1.02
Attribute 23	0.80	1.09
Attribute 24	0.80	1.14
Attribute 25	0.60	1.09
Attribute 26	0.80	1.13
Attribute 27	0.80	1.09

Table 9. Development and gap indexes for answers collected from the metal industry companies.

Next we will take a look at how the metal companies see themselves positioning in regard to competitors can be seen from the below table:

	Worse	Same	Better
Attribute 1	30.00	60.00	10.00
Attribute 2	0.00	70.00	30.00
Attribute 3	10.00	60.00	30.00
Attribute 4	10.00	80.00	10.00
Attribute 5	50.00	40.00	10.00
Attribute 6	0.00	90.00	10.00
Attribute 7	0.00	70.00	30.00
Attribute 8	80.00	20.00	0.00
Attribute 9	40.00	50.00	10.00
Attribute 10	40.00	60.00	0.00
Attribute 11	30.00	70.00	0.00
Attribute 12	10.00	70.00	20.00
Attribute 13	0.00	100.00	0.00
Attribute 14	30.00	50.00	20.00
Attribute 15	30.00	60.00	10.00
Attribute 16	30.00	50.00	20.00
Attribute 17	0.00	70.00	30.00
Attribute 18	70.00	30.00	0.00
Attribute 19	30.00	60.00	10.00
Attribute 20	70.00	30.00	0.00
Attribute 21	50.00	50.00	0.00
Attribute 22	60.00	40.00	0.00
Attribute 23	30.00	70.00	0.00
Attribute 24	40.00	50.00	10.00
Attribute 25	0.00	100.00	0.00
Attribute 26	20.00	80.00	0.00
Attribute 27	30.00	70.00	0.00

Table 10. How metal industry companies see themselves compared to other metal industry companies.

When looking at the answers how the companies see themselves positioning against one another it can be seen that a huge portion of the respondents see

themselves in a worse position compared to their competitors. The attributes where this is the case are numbers 5, 8, 18, 20, 21 and 22 (International customers, support from the city, building in general, building houses, construction related technical designing and architecture). The number of respondents that answered that they are worse off compared to their competitors suggests that the companies do not have a realistic picture of their situation since there are not many answers from firms that see themselves positioning as better off than others. In a business environment where there are leaders and followers, the distribution of answers should be more equally distributed among those who are worse or better off than others. Still this is something that should be studied further to see if there are more to this than the previously mentioned reason. One reason for the distribution of the answers is that the attributes that were included to the questionnaire are ones that do not have that much of importance to the company and therefore they answered that they are worse off compared to competitors.

5.2. Critical factor indexes

Nest step in the analysis was to calculate using the previously mentioned formulas the CFIs of the current state of the companies in terms of the attributes. Main goal of this CFI analysis was to provide supporting decision making data for Kouvola Innovation Oy for planning their own strategies for the coming years since the CFIs indicates what areas are needed to be stressed first and what areas are particularly strong. This is one of the key issues of this

thesis since Kouvola Innovation Oy is a newly founded company who's one strategic goal being trying to develop the business environment in the region of Kouvola. And to be able to do this efficiently from the start, the company naturally needs to have a vision of the current state of the companies which have had a strong presence in the area for several years and see if there are possibilities to use the expertise that already is situated in Kouvola in building new sustainable businesses.

In the below table can be seen the results. CFIs were calculated for all the respondents as well as separately for engineer offices and metal industry companies. Figures in red indicate attributes that are to be seen as attributes that are in critical and figures in green illustrate attributes that are considered to be strengths.

	All the companies	*Engineer offices*	*Metal industry companies*
Attribute 1	21.63	14.71	**46.69**
Attribute 2	**2.46**	**3.30**	**1.15**
Attribute 3	8.26	6.69	7.94
Attribute 4	9.21	10.16	9.69
Attribute 5	22.07	**22.86**	19.44
Attribute 6	**3.88**	**5.17**	12.32
Attribute 7	**1.11**	**0.86**	**0.82**
Attribute 8	10.80	8.74	15.50
Attribute 9	9.49	10.10	9.14
Attribute 10	9.01	11.29	7.67
Attribute 11	8.09	6.16	8.70
Attribute 12	16.15	14.56	15.70
Attribute 13	10.82	14.50	**3.29**
Attribute 14	**31.58**	**20.56**	**44.29**
Attribute 15	**22.75**	13.92	37.99
Attribute 16	**34.52**	14.95	**64.79**
Attribute 17	20.77	16.79	24.31
Attribute 18	13.13	12.70	13.93
Attribute 19	12.99	13.24	16.07
Attribute 20	14.77	13.00	12.64
Attribute 21	18.26	**19.88**	15.01
Attribute 22	13.99	10.56	7.97
Attribute 23	17.43	18.27	16.28
Attribute 24	18.85	17.61	18.82
Attribute 25	8.78	13.40	16.69
Attribute 26	12.87	13.32	11.23
Attribute 27	11.20	13.32	9.48

Table 11. CFIs for all the companies and separately calculated for both the engineer offices and metal industry companies.

The CFIs for the all the companies are also displayed in the following graph:

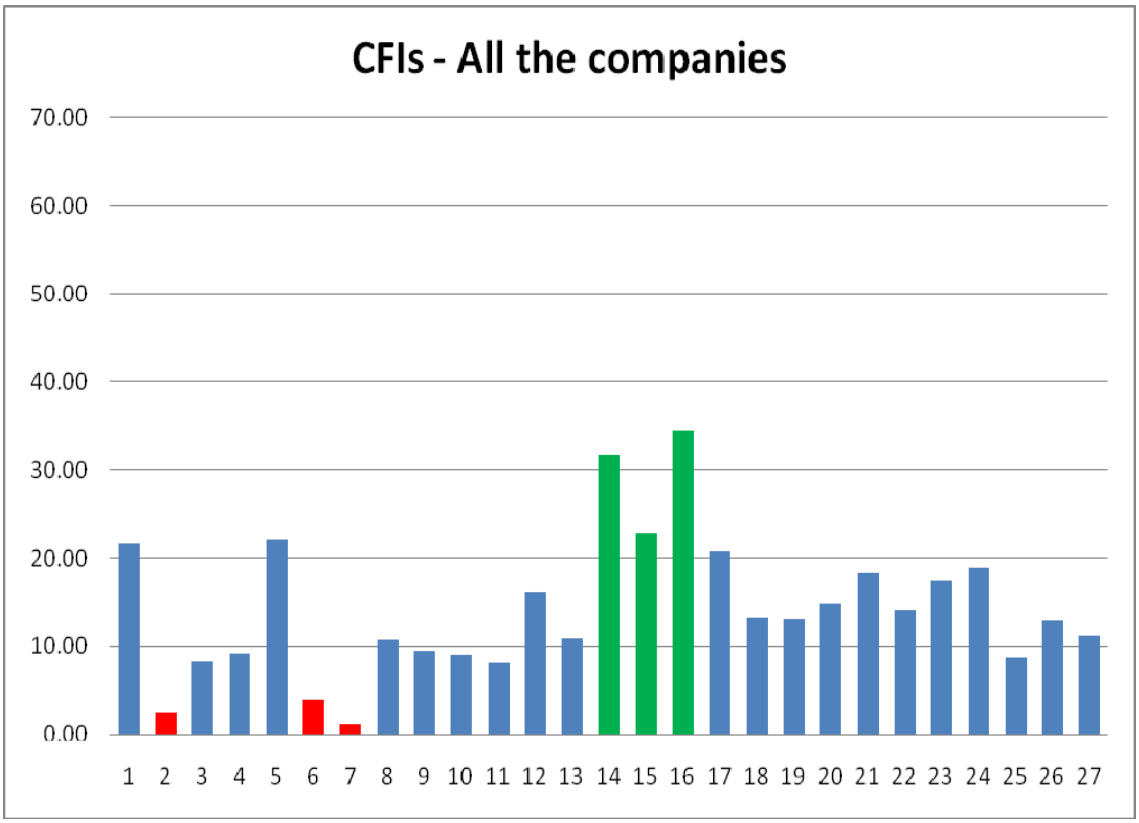

Figure 9. CFIs for all the companies.

The above graph indicates that the highest CFIs for all the companies are attributes 16, 14 and 15 which are bioenergy related device know how, bioenergy and bioenergy related project work. Attributes that are on the "red" are skillful workforce, the size of customer contracts and participation in value chains (Attributes 7, 2 and 6). At this point it is worth noticing that if an attribute is on the "red" it does not necessarily indicate that the attribute is at a critical stage and needs to be addressed as soon as possible. A low CFI value

can also imply of a big gap between expectations and experiences or it can indicate how important an attribute is considered to grow during the selected time frame.

In order to avoid misinterpreting the results, a holistic approach is needed to open the figures more. This enables to plan further actions for the attribute(s) in question accordingly and see beyond just the CFI of the attribute(s). This is the case for attribute 7 which is skillful workforce which all the companies see that it is important to them plus all of them see that they are performing relatively well in this. Reasons behind why it is therefore in the red are that there is a gap between importance and performance even though both of them scored high in the survey plus almost half of the respondents answered that the importance of this attribute will grow significantly in the next five years.

The size of the customer contracts – attribute indicates that companies see that even though it is important for them and they are performing relatively well in this, it will not grow in importance that much in the coming years. In other words the companies even though they see the size of customer contracts being important to them, they will shift their focus more on smaller contracts and/or keep them at the current level. This is supported by the high CFI for the number of clients (attribute 1) which also suggest that companies will focus on attracting new customers which naturally will tie their resources more and restricting them on focusing on just the bigger contracts.

The third attribute that is on the red, participation in value chains, indicates that the companies realize the importance of them in the coming years. Since the companies that were taken into this survey are small and medium sized companies, resources are relatively scarce. By participating in value chains companies are able to put their resources in one basket and together exploit business opportunities by each participant bringing their own area of expertise to the mix.

5.2.1. Engineer office CFIs

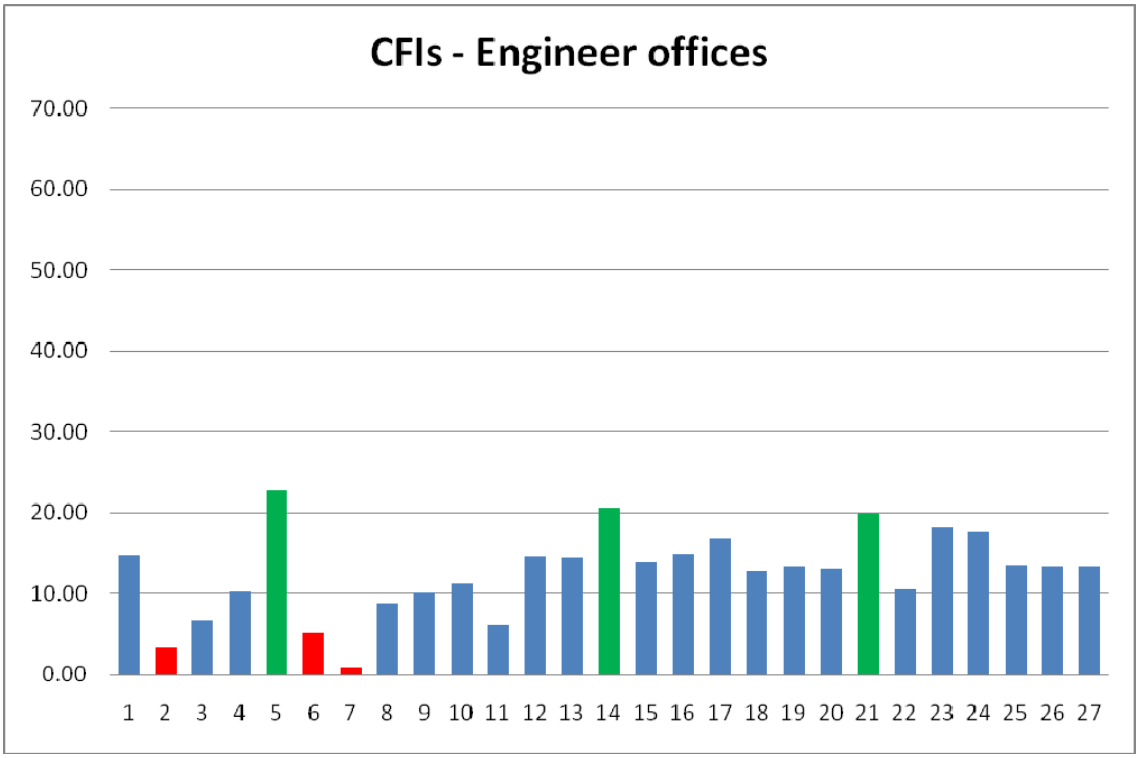

Figure 10. CFIs for the engineer offices.

When looking at the CFI's calculated from the answers collected from the engineer offices it can be seen that the indexes that are on the "red" are the same as they are for all the answers. The reasons mentioned above apply also for the engineer offices. Engineer offices have the design and planning knowhow but they need different types other companies to manufacture their designs. The deeper the co-operation is, the better understanding the counter parties have about each other and this will eventually result in better services and products.

There is though some dispersion in the "green" indexes. International customers and construction related technical designing together with bioenergy are the ones that can be seen as strengths for the engineers offices. Engineer offices see that operating beyond their home market is important to them in the next five years. Over half of the respondents see that exporting knowhow will grow in the next five years. This is a positive sign since Finland in general has for several years had a reputation for offering high end technological products and services. In order to be able compete in the international markets the engineer offices need to develop products/services that are new to the markets or at least offer new ways of doing things, i.e. being the spearheads in certain types of technologies in certain fields. Also the engineers offices see that in order to develop new sustainable businesses that generate turnover and employs them in the coming years, they have to look beyond their home market and expand and penetrate even deeper into international markets.

5.2.2. Metal industry companies CFIs

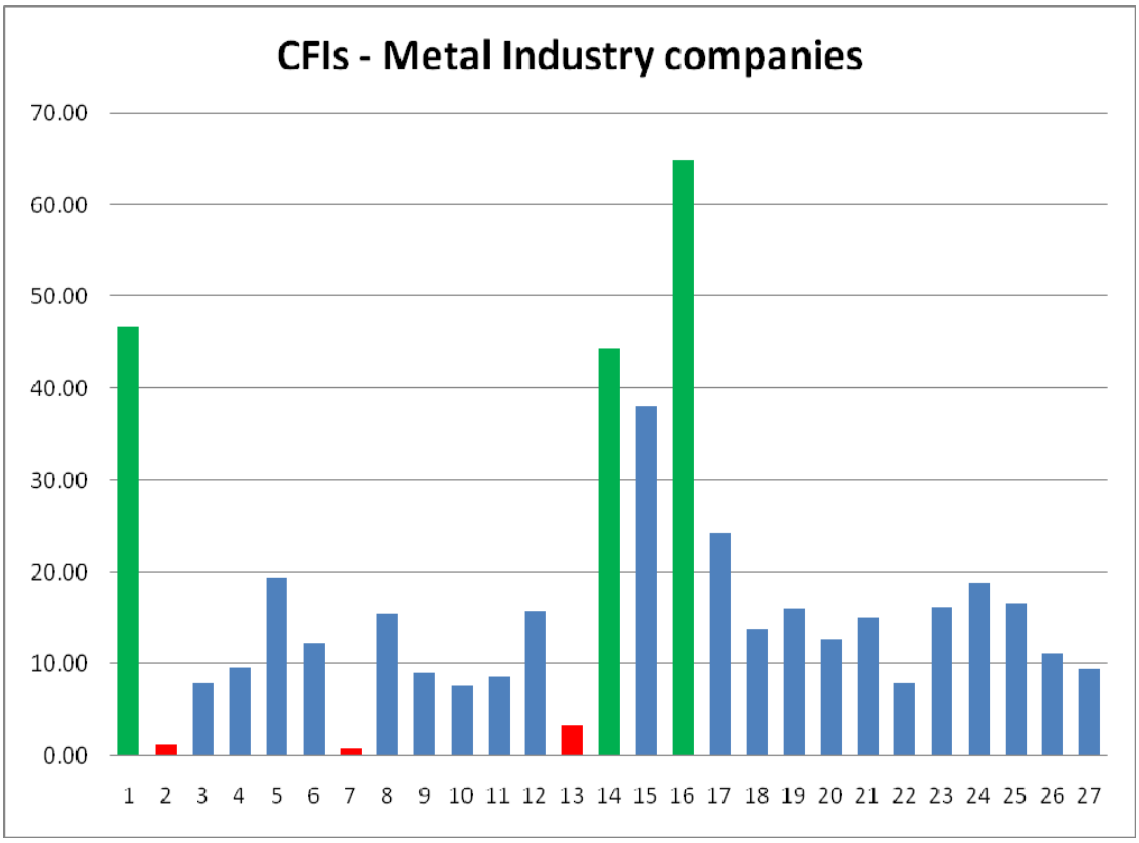

Figure 11. CFIs for the metal industry companies.

The metal industry companies on the other hand follow the same trends as does the total answers in terms of attributes being on the "green". It is worth noticing that that all the three attributes scored relatively high values in the CFI calculations. Even though these attributes have low scores in both importance and performance, companies see that these attributes (Bioenergy, bioenergy

related device knowhow and bioenergy related project knowhow) will grow their importance in the next five years.

Two out of three CFI's that were on the "red" were the same as they were for all the answers. The one that made the difference was the attribute number 13, which is environmental friendliness which scored a lower value than attribute 6, participation in value chains. Even thought environmental friendliness plays a significant role in companies' current processes; they still see that it will have a major role in the coming years since none of the respondents answered that its role would decrease. This in turn implies that also metal industry companies are trying to keep the environment in mind in their processes.

It is also interesting to see that the CFI's that have high values, really have high values and the ones that have low values, then really have low values and the gap between them is much more wider compared to engineer offices. Reasons behind this would need a much deeper analysis on the matter, but one thing that surfaced during the preliminary interviews was that the engineer companies that took part in this are a much more homogeneous group than the metal industry companies, i.e. there were much more of different types of companies included in the metal industry target group which explains to some extent the big sensitivity of the indexes.

5.3. Weak market test

Like mentioned in theory part of this thesis to get further validation and credibility to the results and recommendations for further actions for Kouvola Innovation Oy, a constructive model will be developed and put trough a weak market test. It is important to note that model suggested in this thesis is not the only one possible from the results displayed earlier. The one suggested here is just one possible alternative that would suit the needs and requirements of Kouvola Innovation Oy accordingly.

5.3.1. Model construction

The background to this thesis was to find out what is the current state of the engineer offices and metal industry companies operating in the area that have for long relied on work generating from the forest industry. Because of this long and up till recent years, profitable relationship, engineer offices and the metal industry companies have not focused as much as they should have in product and service development to strengthen their presence in the market and at the same time attracting new businesses from new industries.

Together with the current state analysis, one goal was to find out how interesting the target group saw bioenergy and construction industry as potential new businesses for the area. Kouvola Innovation Oy sees especially bioenergy being one of those new businesses that could create sustainable

employment to the area in the coming years. Reflecting the results against the goals of this thesis, the model constructed in this thesis and what will be put through the previously mentioned weak market test will be introduced next.

Kouvola Innovation Oy must focus their efforts at this point in scouring potential new bioenergy related projects together with the companies, especially with the engineer companies. Like the results suggested the engineer companies hold potential in developing new businesses and Kouvola Innovation Oy should therefore closely work together with them to support them in any way possible. Metal industry companies on the other hand are more or less manufacturing companies and so they can provide local metal manufacturing expertise. Kouvola Innovation Oy has a crucial role together with the companies in finding out suitable partners in the area for one another that could potentially lead to forming value chains and therefore combining the expertise of the companies.

Kouvola Innovation Oy must also maintain a critical point of view in terms of what projects are to be considered as potential ones, i.e. ones that can generate cash flow and profit to the companies. Companies are interested in taking part in new projects as long as it does not tight up too much of their resources and they see that they can benefit from them.

An important part in this model is that Kouvola Innovation Oy tries to establish together with the local companies networks that have on-going discussions that

enable parties to share and discuss potential new businesses opportunities. Product, service and technology development should be encouraged as much as possible since according to the results, this is something that companies need to focus on more. Since Kouvola Innovation Oy is a development company and not an investment company, it should maintain a neutral position towards all the companies and be prepared to help them if possible.

This model would enable to see how a development company, such as Kouvola Innovation Oy, could with their own input affect the development of the business operating environment in the region of Kouvola, i.e. bringing in a fourth element to the three forces affecting technology development introduced by Tuominen et al, 2003.

5.3.2 Weak market test

The above model was introduced to a person that has relevant expertise to comment about it. The person has insight on both the companies operating in the region of Kouvola as well as from renewable energy. The above model passed the weak market test. The person confirmed the conclusions presented above and stated that the above course of actions is a useable one for Kouvola Innovation Oy.

6 DISCUSSIONS AND FURTHER STUDY

The data collected and analyzed in this thesis provide supporting data for Kouvola Innovation Oy in their decision making. The results together with the information gathered through the interviews suggest that the companies need support in developing new business opportunities. Through the interviews it came clear that the companies do not expect that much help from the city of Kouvola or for that matter also not from Kouvola Innovation Oy. It came pretty clear that all the help that Kouvola Innovation Oy can offer to the companies will be considered as a plus but nothing is expected from them. Reasons for behind these thoughts have piled up during the past years and decades and therefore are challenging to alter by just words. The companies want to see concrete ideas and projects from which they can eventually benefit i.e. make profit and create new businesses. Like the big response rate suggested companies are still open to new ideas and projects and they want to take part in them but they are careful on in which ones they do take part in because of the challenging economical situation where also Finland and the rest of the world currently is. Companies are naturally careful where their put their limited resources into use.

They see that the co-operation is to be done so that each party involved are treated as equals and each of them received a fair amount of the revenues, i.e. mutual respect and openness is required.

Most of the times when conducting surveys and analyzing results, one thing is always pointed out: The results are not considered to illustrate the thoughts of all the companies since the response rate was so small. In this thesis thought that was not the case. The response rate was so high, that enables to derive further study subjects that hold greater value. One thing that should be studied further is why the response rate was as high as it was? Was it because the interviewed single handedly took the time and visited all of them, the questionnaire and the background for conducting it was explained or the questionnaire itself was easy to answer and it did not take that much of the respondents time? Or was it the combination of these? One thing that would be worth studying further would be to find out if the new potential business opportunities (bioenergy and construction) would have some other ones, would the results been different? If they would have been different, then it is clear that Kouvola Innovation Oy is on the same page as the target group. If not, then Kouvola Innovation Oy would face challenging times ahead since the results would suggest to certain extend that the companies are in a state were all that is new would interested, regardless of being suitable for them.

One clear and obvious further study would be to conduct this same survey in year 2016 after the selected time frame has passed. Same companies would be chosen as target groups and same attributes would be included in the questionnaire and see what discrepancies there are. This would offer massive amount of date for further analysis since the events that affected the discrepancies would have to be explained. This would also offer Kouvola Innovation Oy the possibility to see how the projects that they have taken part in during the time frame have affected the business environment.

An interesting point of further study would also be to open the answer and see why the standard deviations were so big most of the times. Of course some of the gaps can be explained by the fact that the target groups consisted of different types of companies. The companies are focused on certain types of business and that would naturally explain the diversification of the answers when looking at a certain attribute but still it would be interesting to see if similar companies have answered differently to the same attribute and more importantly, why they see the same attribute so differently?

7. CONCLUSION

This thesis from derived from the need to determine how the changes in the forest industry companies have affected the local engineer offices and metal industry companies and provide supporting decision making data for Kouvola Innovation Oy.

Kouvola Innovation Oy is a development company that focuses on the development of the business operating environment in the region of Kouvola. Kouvola Innovation Oy see that areas that hold potentially new business opportunities to the area are bioenergy and wood based construction.

The theory part of this thesis covered the role of technology foresight in offering competitive advantage to companies that have incorporated it to their own strategies. Sense and respond strategies were also introduced and how small and medium sized companies are able to use them in the spirit of technology foresight in creating competitive advantage.

In the empirical part the Critical Factor Index tool was used to analyze the results. This tool indicated the attributes that were considered as strengths and those that are needed to be addressed first. There were 27 attributes chosen that would illustrate the current situation of the companies as well as their thoughts on bioenergy and wood based construction.

The data collection was conducted so that 40 companies were chosen to be the target group and each of these companies were interviewed and this research was introduced in more detail. Each company was offered the chance to answer a web based questionnaire to collect numerical data that would then analyzed using the critical factor index tool. 29 companies answered the questionnaire.

The results indicated that bioenergy is seen as an interesting business opportunity by the companies. At the same time thought innovation development and innovation productization are not seen important even though they should be if the region wants to develop competitive advantage trough technology development. The results suggest that Kouvola Innovation Oy is on the right path if they decide to concentrate on projects that aim to develop bioenergy related businesses in the region. The results were validated by using a weak market test.

As a conclusion the set goals were met in this thesis and the data gathered and analyzed offers supporting decision making data for Kouvola Innovation Oy in their quest for developing the business operating environment in the region of Kouvola.

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APPENDIX 1. Attributes

Customers

- Number of customers
- Size of customer contracts
- Forest industry as a customer
- Constructual changes that has taken place in the forest industry
- International customers
- Being part of a value chain

Resources and technologies

- Skillful workforce
- Support of the city
- Networking with other companies and schools
- Research and development resources
- Continuous education
- Knowledge of sources of funding and the use of them
- Environmental friendliness
- Bioenergy
- Bioenergy related device knowhow
- Project knowhow related to bioenergy
- Interest towards developing bioenergy related businesses
- Construction

- Industrial construction
- Building houses
- Construction related technical design
- Project knowhow related to construction
- Interest towards developing construction related businesses
- Business plan

Products

- Innovation development
- Productization of innovations

Open questions

- "Do you see any possibilities to develop businesses related to bioenergy or wood based building industry in the region of Kouvola? If so, how?"
- "Do you see any possibilities to develop businesses related to renewable energy in the region of Kouvola? If so, how?"
- "Do you see any potential problems for your own business in the region of Kouvola in near future?"
- "In what kind of development projects related to bioenergy or wood based building could Kouvola Innovation Oy help your company?"

APPENDIX 2. Clarification of questions

Number of customers

Is your business based on volume or more on tailor made solutions?

Forest industry as a customer

How important role does the forest industry have in buying your company's products and/or services?

Constructual changes that has taken place in the forest industry

How has the changes that have taken place in the recent years (production capacity reductions, etc) affected your company?

Being part of a value chain

Is your company part of a value chain? Do you use subcontracting or do others use your company as a subcontractor? Do you actively try to take part in value chains?

Skillful workforce

Can skillful workforce be found from the region of Kouvola? Is it available for your own company?

Support of the city

How do you see the role of the city? Does it support your business enough in your opinion? Etc.

Research and development resources

Does your company have enough resources to develop products, services and the business in general? Are those resources deployed efficiently?

Continuous education

How important do you see continuous education for your company? Do you see it as being important? Is executed efficiently in your company? Do you actively seek possibilities to arrange training for your staff?

Knowledge of sources of funding and the use of them

How well do you see your company being aware of different types of sources of funding for projects? Are these sources used actively?

Environmental friendliness

Does environmental friendliness have any kind of role and if so how much does it affected when you are planning your business, products or services?

Bioenergy

Does your company have any experiences from e.g. biodiesel, biogas, sludge and waste digestion or CHP plant knowhow?

Business plan

Does your company have a business plan? Are you able to implement it? Are your competitors able to carry out their own business plans better or more efficiently than you are? Will you follow the current business plan also in the near future?

Innovation development

Are innovations and continuous development of innovations an essential part of your business?

Productization of innovations

How much are able to productize your innovations? Is it an essential part of your business?