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The Innovation Process – Aiming towards Innovativeness in a Construction Company

Bachelor's thesis

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ABSTRACT

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The bachelor's thesis concentrates on the innovativeness in the construction industry. The purpose of the thesis is to define the innovation as a concept reflected on a context of the construction industry. The second objective is to examine how the construction companies could foster and increase the innovativeness. The third objective was to find out tools, methods and phases of the front-end of the innovation process. The construction industry is often considered as a traditional and an old-fashioned manufacturing industry. The innovation or the innovativeness rarely linked to the construction industry. Productivity is a common problem in the construction industry. The construction industry needs to increase the productivity to compete in a globalized world. The productivity can be increased by the innovation.

The thesis based on a literature review. The findings from the literature include a description of the innovation as a concept, the innovative culture and the innovation process as a context of the construction industry. The phases of the front-end of the innovation process were explained. Customers centered approach was taken into account in the innovation process. The required tools and methods for managing the front-end of the innovation process were illustrated.

The thesis ensures the importance of the innovation facing challenges of the construction industry. Managing the front-end of the innovation is the most important aspect to stand out from the less innovative companies. To take a full advantage of the innovation companies cannot fear of changes. The innovation process requires a full support of the top management of the company. Taking into consideration a theoretical aspect of the thesis a further research is required to respond practical needs of the company. Tools and methods should be considered according the company's needs and activities. Company's existing state and culture should be examined before implementing the front-end of the innovation process to ensure the functionality.

TIIVISTELMÄ

Tekijä: Mikko Lehto

Työn nimi: Innovaatioprosessi – Suunta kohti innovatiivisuutta rakennusyrityksessä

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Hakusanat: innovaatio, innovaatiojohtaminen, innovaatioprosessi, innovaatioprosessin alkupää, innovatiivinen kulttuuri, rakennusala

Kandidaatintyön tarkoituksena oli tutkia innovatiivisuutta rakennusalalla. Tavoitteena oli määrittää innovaatio käsitteenä rakennusalan kontekstissa. Toisena tavoitteena oli tutkia kuinka rakennusalan yritys voisi edistää ja kasvattaa innovatiivisuuttaan. Kolmantena tavoitteena oli etsiä toimivia työkaluja ja toimintatapoja innovaation alkupään johtamiseen. Rakennusalaa pidetään yleisesti perinteisenä ja vanhanaikaisena toimialana. Innovaatiot tai innovatiivisuus liitetään harvoin rakennusalaan. Ongelma rakennusalalla on työn tuottavuus. Rakennusalan tulee nostaa tuottavuutta säilyttääkseen kilpailuasemansa kansainvälistyvässä maailmassa. Tuottavuutta voidaan nostaa innovaatioiden avulla.

Työ toteutettiin kirjallisuustutkimuksena. Kirjallisuustutkimuksen perusteella kuvattiin innovaatiota käsitteenä, innovatiivista kulttuuria sekä innovaatioprosessia rakennusalan kontekstissa. Myös innovaation alkupään vaiheet perusteltiin kirjallisuuden avulla. Asiakaskeskeinen lähestymistapa otettiin huomioon innovaatioprosessissa. Työssä esiteltiin myös tarvittavia työkaluja sekä toimintatapoja innovaatio prosessin alkupään johtamiseen.

Työssä korostettiin innovaatioiden tärkeyttä vastattaessa rakennusalan haasteisiin. Innovaatioiden alkupään hallinta on tärkein tekijä erotuttaessa muista innovatiivisista yrityksistä. Yritys ei voi pelätä muutoksia hyödyntäessään innovaatioprosessia. Innovaatioprosessi edellyttää täyttä tukea yrityksen ylimmältä johdolta. Ottaen huomioon työn teoreettiset lähtökohdat lisätutkimusta tarvitaan vastattaessa yritysten käytännön tarpeisiin. Yrityksen tarpeet sekä kulttuuri tulee ottaa huomioon arvioitaessa työkaluja sekä toimintatapoja. Prosessin toimivuuden varmistamiseksi yrityksen nykytila ja olemassa oleva yrityskulttuuri tulee tutkia.

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ABBREVIATIONS

BIM	Building Information Model
CAD	Computer Aided Design
FEI	Front-End of Innovation
FFE	Fuzzy Front-End
IP	Intellectual Property
IT	Information Technology
NIH	"Not invented here" -effect
NPD	New Product Development
VTT	Technical Research Center of Finland
TEKES	Finnish Funding Agency for Technology and Innovation
TIM	Technology and Innovation Management
TSQ	Technology Stage Gate
QFD	Quality Function Deployment

1. INTRODUCTION

This study is made to the department of industrial management of Lappeenranta University of Technology. It has been done as a literature review. The thesis should be regarded as a background for a further research of the topic. The objective of the thesis is on the innovations and the innovativeness in a context of the construction industry. The focus of the innovativeness is on the front-end phase of the innovation process. The innovation is a hot topic in today's business world. The study presents reasons and sparks to increase the innovativeness in the construction industry to change and to question current procedures and to increase productivity. Major changes in future such as the climate change and the global economic crisis touch the construction industry. Construction companies need to respond and face the changes by creating innovative solutions crossing traditional boundaries of industries. Nowadays the construction industry is fragmented and it develops without any coordination. Companies could get more benefit of the untapped knowledge and the information from the field by a functional innovation process and a determined innovation strategy supported by the top management.

1.1 Background of the thesis

Traditionally the construction industry is divided into two separate sectors according Björkroth, Koponen, Pohjola and Aro (2006, 100-103). The sectors are a service weighted property business and a production based construction engineering. Together these two together establish the construction cluster in Finland. In future, business activities move towards a life cycle approach. The property business is divided to a property services, a property management, a property ownership and a trading of a property and housing. The production based construction engineering can be divided to a new building construction, a renovation and a construction product industry. Generally, the construction engineering can be divided to housing and commercial markets. A construction cluster is one of the key clusters in Finland. All together, the construction clusters total value is 50 billion euro's and it employs a fifth of the working population.

An operational environment in the construction and the property business has changed recently. Changes are still keeping going in future. The global economical crisis affected to the construction industry immediately by decelerating the start-up's of a new building sites. Björkroth et al. (2006,

102-103, 121) focus on the main factors for new directions of the whole industry: a free-floating of the production factors and shifting to the common European currency. The other important factor is a upswing of the renovation construction. The new building construction is nowadays a bigger segment in the construction industry. In future, a relative part of this segment will decrease. Hernesniemi, Kymäläinen, Mäkelä, Rantala, Rautkylä-Willey & Valtakari (in Björkroth et al. 2006) believe that the production and the employment are increasing in the construction engineering in future. They also claim that the employment is decreasing and the growth is only moderate in other part of the construction industry.

Lautanala (2007, 23) claims a four growing trends in the construction industry. Internationalization is growing faster than expected in the field. A home market of the industry is growing to cover area of the Baltic Sea. A *Service sector* covers 70 percent of the gross national production. The construction industry needs to respond changing a customer needs and offer a new kind of service activities. A *Knowledge management* becomes more important to ensure increasing of the service ability, quality and productivity. For example, nowadays Finland is the leader in developing and using of the building information models (BIM). In addition, the climate change is accelerating and energy becomes more expensive in future. A *Life cycle approach* becomes more important in the field. An environmental and eco-friendly solutions and buildings may be the next key success factors on the international level.

Lahdenperä (2007, 16-17) and Brjörkroth et al. (2006, 115-116) describes the differences between the construction industry and other industries. Briefly, the construction industry creates and develops the environment. A characteristic for the construction is the linkage to a location. A main task is to satisfy user's space requirements. Space requirements are actually a perpetuating factor in the construction engineering. A residential and commercial construction satisfies user's needs. Buildings are not homogenous products. Various structures, quantitative and qualitative features make up an actual building. Unique factors for buildings are the linkage to the location that gives specific regulations for a construction. It also affects largely to the value of a building. Buildings and constructed environment are long-life products that can be renovated, modified or improved in several ways. Even when a building is unused, it is still valuable. The value of a building ground might be permanent. An exceptional factor is that the construction is a project-based industry. A project and project organizations are mainly unique which might cause difficulties.

The productivity is common problem in the construction industry. Figure one presents the productivity of the different industries. The productivity is measured by dividing the benefit with a number of employees. Statistics Finland (2009) defines "the value added measures the total value added produced by the various factors of production in an establishment's actual operating activities. The value added is calculated by deducting the costs of operating activities from the income from the activities." Björkroth et al. (2006, 105-108) clarify that the productivity is clearly below compared with the other industries. Only the productivity of a furniture manufacturing and a textile and clothing industry is below the construction industry. The productivity measures how well companies transform inputs to the final products. Generally, ineffectiveness reflects higher prices and in some cases, it may indicate a lack of competition. The productivity is better in highly competitive markets than other markets. The productivity in the construction industry has increased very weakly during the last ten years.

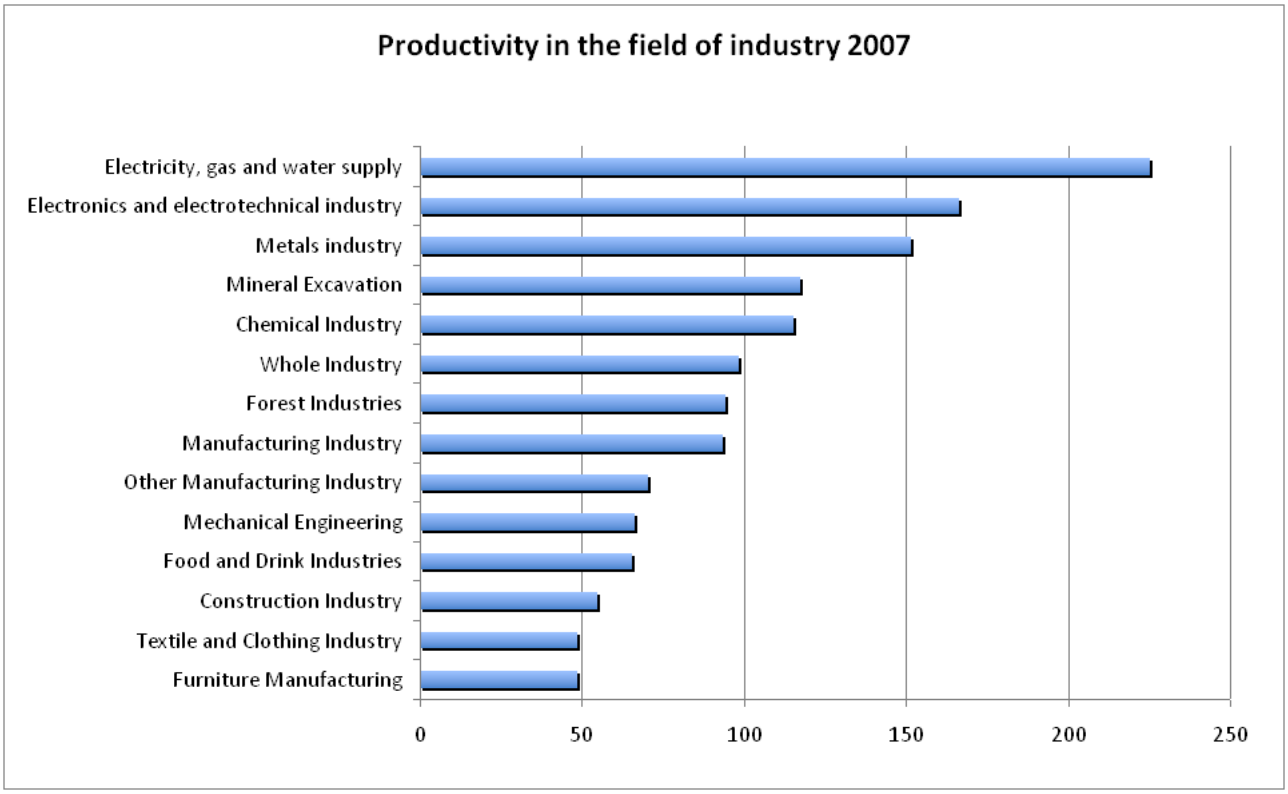

Figure 1. The productivity in the field of industries in 2007 (Storgårds 2009a & 2009b).

The ministry of employment and the economy of Finland (2008, 3-10) have aligned the strategy of the innovation politics for 2009 in October 2008. An economic growth and an increase of welfare require improvement of the productivity in companies and other communities. To achieve desired goals innovations are required. At the target state, Finnish companies outperform and increase mar-

ket shares internationally by a knowledge and a development of the productivity. A reduction of the labor force and a high-level of expenses cause challenges to industries. A higher productivity and innovations are required to respond the challenges in future. To succeed and achieve goals Finland need to lead the way in selected areas of innovation activities. Finland can decrease unemployment by creating new solutions through a knowhow and an efficient productivity. Innovation creation requires usage of new ideas, an implementation of a new technology, a skilful labor, an internal entrepreneurship and highly developed processes. A resource allocation is necessary to concentrate on strategically important industries. Companies have the best possibilities to growth and compete in a certain fields of a knowhow. Economist Xavier Sala-iMartin (in Himanen 2007, 13) describes a three basic principles of a competitive advantage 1) make cheaper than others, 2) make at same price but better than others and 3) make something that anyone cannot or does not do. By looking from the Finnish point of view, principles one and two become more and more difficult to reach. The last principle competition based on innovativeness remains the only choice.

To increase collaboration between enterprise sectors, educational institutions and research areas the strategic centers are vital. The ministry of Employment and the Economy (2009) decided to start up a Strategic Centre for Science, Technology and Innovation for the Built Environment. A development of new products and services should base on user needs (Lautanala, 2007, 25). Weak signals from a user needs should be identified. An increase of a research and development (R&D) investments and the innovativeness are the main success factors to outperform in an international competition. The creation of the strategic centre demands a collaboration, will and perseverance between a leading and the most developed companies.

1.2 Purpose of the thesis and the research questions

This research based on a literature review. The main purpose of the thesis is to find out the phases of the front-end of the innovation process based on the literature review. To get through of the purpose, an innovation, as a concept, is clearly defined to understand an importance and meaning of different phases of the front-end of the innovation process. The front-end of the innovation is reflected in a context of the construction industry. The front-end phase stands for an opportunity analysis, an idea generation, a development and an evaluation phases. A theoretical framework of the thesis is presented in the figure two.

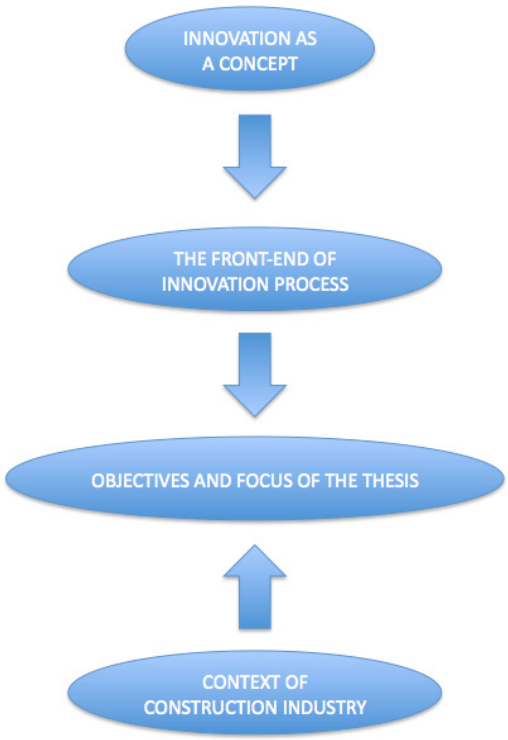

Figure 2. The theoretical framework of the thesis.

At the same time, the overall objective is to examine how the construction industry and construction companies could foster and increase the innovativeness. The thesis take into account a specific characteristic features of the construction industry such as a project based business activities. Managing the front-end phase of the innovation process is essential to deal with innovations and to increase the innovativeness despite of industry. To manage the front-end of the innovation process the phases need to be described and certain tools need to be implemented into a practice. The process should be as a part of daily business activities to gather ideas and to take an advantage of a explicit and a tacit knowledge of the company. Procedures and tools to screen, evaluate or store ideas are vital to avoid mistakes and to reduce risks. By reasonable innovation process, the company could avoid waste time and expenses. A functional innovation process could increase the productivity and a usage of employees' knowledge. This thesis proposes the process descriptions and the tools to raise a spark towards the innovativeness in a construction companies.

The main research questions of the thesis are as follows:

- How the concept of an innovation is defined in the literature?
- How the construction industry and companies could foster and increase the innovativeness?
- How phases of the front-end of the innovation process are described in the literature?

- What kind of tools and methods is needed to control and benefit the front-end of the innovation process?

1.3 Limitations of the thesis

The innovativeness and the innovation process are extensive concepts though this thesis concentrates only on the front-end of the innovation process. This research concentrates firstly on definitions of an innovation as a concept and the front-end of the innovation process. Secondly, how companies could increase the innovativeness and create an innovative culture. A practical objective of the thesis is to find out a concrete tools for managing the innovation process. The exact innovation process need to be described and implemented depending on the single company's culture, habits and procedures. Thus, a result of this thesis is not a functional and a strict process description. A certain objectives are limited to avoid expanding of the thesis. Predefined limitations include protecting of innovations, measuring and rewarding the innovativeness and implementing of the innovation process to the company.

1.4 Structure of the thesis

The thesis is structured according the practices and the instructions from Department of Industrial Engineering of Lappeenranta University of Technology (LUT). The thesis is divided to following parts: introduction, managing innovation, innovativeness in construction industry, the front-end of the innovation process and conclusions.

After the introduction and the background of the thesis, the innovation is described as a concept and as a process. That part also consists on a innovative culture and a concept of the open innovation. Next part, the innovativeness in the construction industry, concerns on a specific factors and a characteristic features of the industry as well as how to foster and increase the innovativeness. The following part focuses on the front-end of the innovation process. At that part, the front-end of the innovation process is divided to phases, which are described one at the time. Tools and methods to manage the process are discussed as well as a customer-centered approach.

At the last part, conclusion, the results of the thesis are discussed and evaluated. The directions and recommendations for the further development of the subject are provided for the construction companies according the literature review.

1.5 Definition of the key terms

This chapter defines the key terms and concepts, which are in use at the thesis. The definitions are summaries of the key terms. Presented definitions covers only the most important concepts of the thesis.

Innovation – Means a successfully commercially used and technically working new idea or invention turned to a widely used practice (Tidd, Bessant & Pavitt (2005, 65-66).

Innovative culture – Reflects supportive parts of the innovativeness in the organization (Apilo et al., 2007, 97 & 229).

Invention – An invention means only a new idea although it is often mixed and confused to the innovation. To convert an invention to an innovation a commercial success and technically functionality is required. (Tidd et al. 2005, 65-67)

Open innovation – Not all of the innovative potential exist in the one single company. The open innovation is about using the external sources to gather ideas together with the company's internal research processes. (Chesbrough 2003a, 17-19).

Innovation process – It describes the process of turning new ideas into practice (Tidd et al. 2005, 65, 78-84). The innovation process includes the front end of the innovation, a product process, a product launching and a production (Apilo et al., 2007, 228).

Innovation strategy – Describes how the company innovates and uses innovations in the business operations towards its vision (Apilo et al., 2007, 60-61).

Front-end phase of the innovation process – The term describes a chaotic, an unpredictable and a "fuzzy" phase of an early new idea development process. It uses an intellectual property (IP) as a

resource. The front-end phase of the innovation process can be shortened simply as a front-end of innovation (FEI). (Koen, Ajamian, Boyce, Clamen, Fisher, Fountoulakis, Johnson, Puri and Seibert 2002, 13, 30; Brem and Voigt 2008, 3; Boeddrich, 2004, 275)

Fuzzy front-end – A synonym for the front-end of the innovation. The term highlights a fuzziness and chaos of the early phases of the innovation process.

2. MANAGING INNOVATIONS

A management of the innovation is essential to succeed, outperform and compete in the globalized, rapidly changing world. Tidd et al. (2005, 65, 78-84) remind that an invention is a first step of bringing a new idea to a market or in an effective use. The innovation management is much wider concept than just a R&D or a new product development. Can companies actually *manage* innovations? Tidd et al. highlights: *"There is certainly no easy recipe for success."* The innovation management is about creating circumstances in the organization to produce and to create new ideas from uncertain areas. It is important to notice that simply copying the management methods or the processes from other organizations do not necessary help or benefit the organization. The core competences and changes in organizations base on learning from experiences. Copying is not possible as it is, although competing organizations might have an enormous potential and handle innovation management well. Each company should find own routines and methods in the managing of the innovations. A learning from other's experiences and procedures might be helpful, but in any case, a knowledge or methods must be converted to the own organization to match on an early experiences and the business activities. *"Business innovation is not a potion that can be bought in a store – it must be brewed at home"* (Hammer, cited in Boeddrich 2004, 277). Seibert (cited in Brem and Voigt 2008, 2) defines the innovation management as *"a systematic planning and controlling process, which includes all activities to develop and introduce new products and processes for the company."*

2.1 Definition of the innovation

What is innovation and what it is not? The innovation is nowadays a fashion word in the business management. A number of times the word "innovation" is used incorrectly when speaking about an invention or an improvement. Tidd et al. (2005, 66-67) explains that the term actually comes from the Latin – word *innovare* means, "to make something new." Apilo & et al. (2007, 22-23, 63) specifies three categories of the newness of the innovation: *a new to the company, a new to the industry* or *a new to the world*. A customer and a company often see the innovations in a different way. The company can also discover the innovations elsewhere from a customer needs for example by changing the line of business or by developing technology. In addition, all of the innovations originate from ideas and an idea emerges by a creativity or a rational brainwork of employees, customers,

suppliers or universities inside or outside of the company. (Boeddrich 2004, 274). Tidd et al (2005, 3-4) reminds although the technology is in the key role in the innovations, it is not all about opening new markets or inventing new products. It can mean changes in the business activities or providing new services in the traditional and mature markets. The innovation ability means ability to spot the innovations by seeing connections, analyzing opportunities and taking advantage from these.

Lahdenperä (2007, 58-59) remarks that only one process or solution cannot increase the innovativeness itself. Diffusion of the innovativeness can be encouraged in a many ways. It is important to notice that use of a certain method does not guarantee the innovations. By creating innovative circumstances, implementing the innovation process or operations model, the company only fosters possibility to find new ideas. A basic objective of the innovation is to collect as many promising ideas as possible (Thom cited in Brem and Voigt 2008, 2). A large number of ideas relates to the company's success in future (Boeddrich, H 2004, 274).

Apilo et al. (2007, 23-24) divide innovations to a couple of sectors: *a radical, an incremental* and *service innovations*. Tidd et al. (2005, 11-13) specifies the incremental (continuous) and the radical (discontinuous) innovations as a degree of the innovations novelty. A figure three describes the continuous changes from the incremental to the radical innovation. The both types of the innovation can be on a component or a system level. In addition, product innovations are rarely a radical "new to the world" -innovations and process innovations are typically optimization of the current process. A number of the "New to the world" -innovations is only 6 to 10 percent of all innovations.

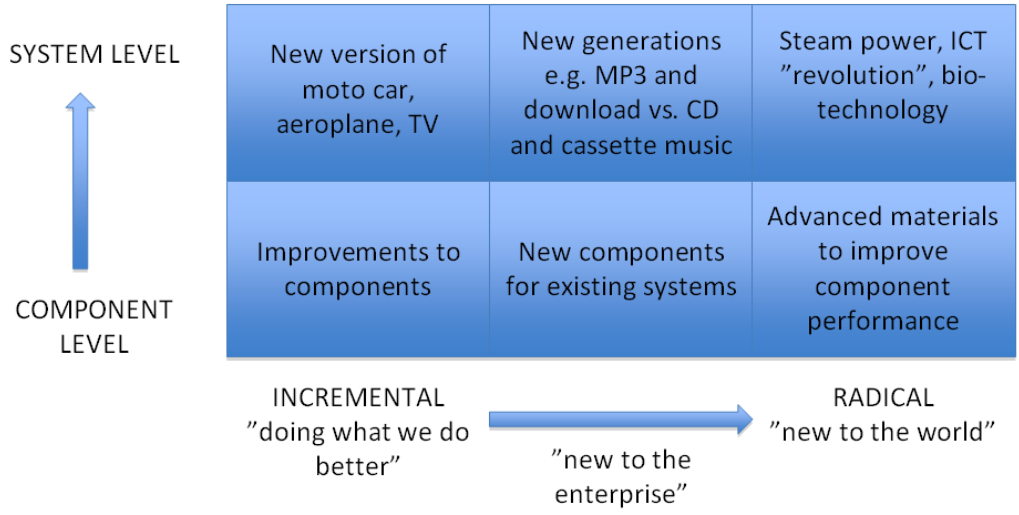

Figure 3. The degrees of innovation novelty (Tidd et al. (2005, 12).

Apilo et al. (2007, 23-24, 40) defines the radical innovation as a change of the company's business concepts. Radical innovations is always a new to the market. The company needs to change the existing business concept when doing radical innovations. A contingency is usually linked to radical innovations. In addition, incremental innovations base on the company's existing business strategy. Although incremental innovations might contains a risk factor. Apilo et al. (2007, 26-27, 41-44) describes that service innovations changes the way of creating value to the customer. A physical product can be part of a service innovation but service innovations are more extensive concept than product innovations. Service innovations change processes and procedures between the company and a customer as well as the internal structures of the company. An example of a service innovation in the construction industry is building highways using a life-cycle model.

Tidd et al. (2005, 10-11) describes four categories, "four P's", of the innovation: *a product innovation, a process innovation, a position innovation* and *a paradigm innovation*. The product innovation means changes in products or services. The process innovation is a change of business activity – how to create and/or deliver products or services. The difference between the product and the process innovation is indistinct. The position innovation can be described as repositioning markets of the products or processes to a particular user context. For example, Henry Ford changed fundamentally transportation and a mass-production at that time. The paradigm innovation means changes in mental models what the organization does. Making changes in practices requires also the product and the process innovations. Example of paradigm innovations is shifting to the low-cost airlines or the online insurance services.

A figure four illustrates changes from the incremental to the radical innovation at the context of the four categories of the innovation by Tidd et al. (2005, 12-13): paradigm, product, position and process, which were described earlier. Figure shows possible innovation spaces where organization can operate. The innovation strategy defines an actual space where the organization explores and exploits innovations. A degree of the novelty should also be considered in a context. The incremental innovation can be a major technological step for a small organization despite the same innovation can be a minor change for a technologically advanced organization.

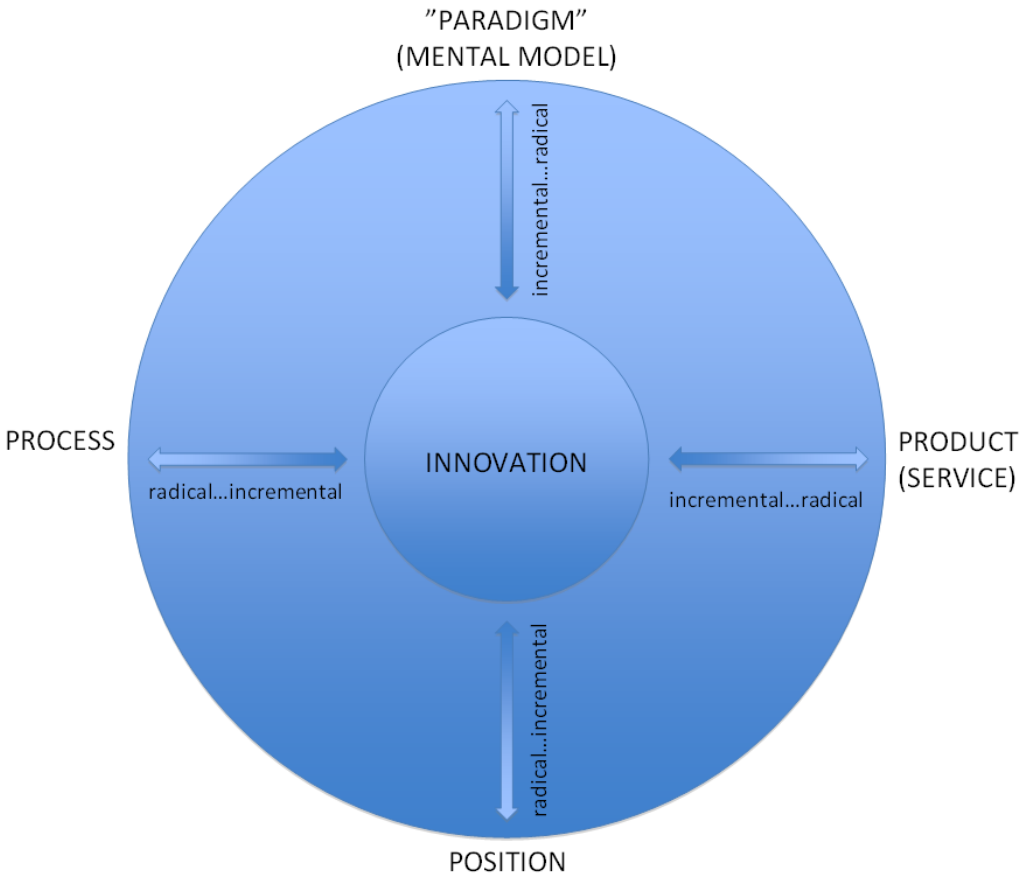

Figure 4. Changes from incremental to the radical associated the four types of the innovation (Tidd et al. 2005, 13).

A simple two-by-two matrix in the figure five presents a novelty of a technology and markets in case of a different approach of development and commercialization (Tidd et al. (2005, 242-243). *A differentiated* sector stands for a mature technology and markets. A customer needs are responded by an existing technology. Differences to products or services are e.g. packaging, pricing or supporting. *An Architectural* sector utilizes an existing technology as well but products, services, applications or combinations are novel to a specific market area. Typically, the architectural innovation originates with potential customers to fill an existing market niche. *A Technological* sector uses novel technologies to respond to known customer needs. In mature markets competition base on performance rather than price or quality. Developers mainly drive products and services development. *A complex* sector shows evolve both of technologies and markets. A new technology is not known yet therefore a lead-user method can be used at the development process.

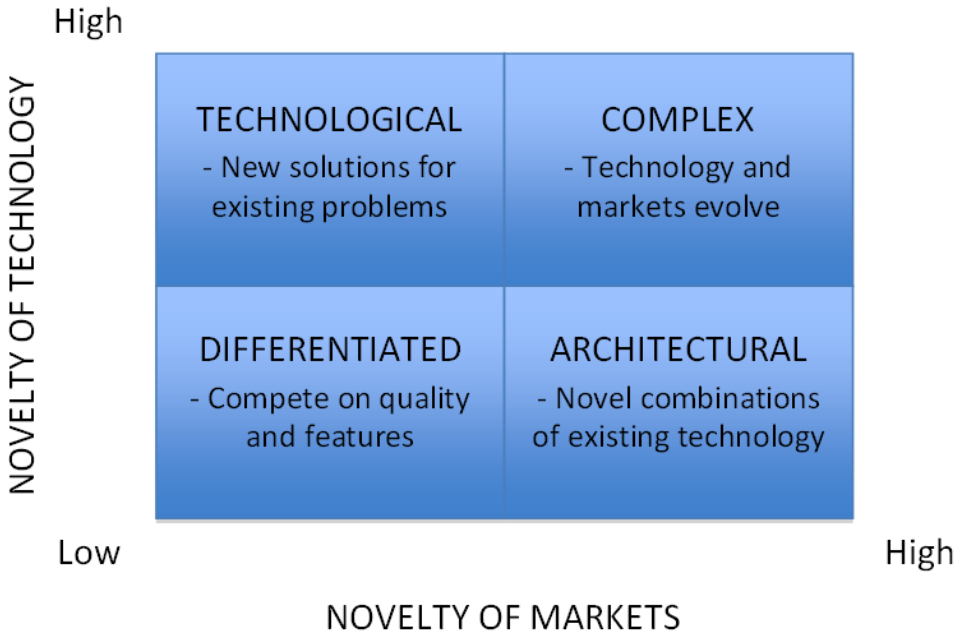

Figure 5. The novelty of a technology and markets (Tidd et al. (2005, 243).

Apilo et al. (2007, 51-53) argues that the innovation management is often considered as a R&D or product development even economical aspects are included. Traditionally the R&D has been a separate process from the rest of the organization. Nowadays the modern innovation process should be one of the main processes of the company. Companies often mix inventions or new ideas with the innovation. Occasionally companies nominate an inventor as an innovator. A problem appears when an inventor is awarded because of patents thus the people who have been believed in radical innovations are ignored. Measurement of innovations should be considered to support and increase the innovativeness in the organization. Koen et al. (2002, 20-21) and Brem and Voigt (2008, 3, 13) suggest that the measurement indicator could be e.g. a number of ideas per team or year, a percentage of new products in an entire product portfolio, a percentage of commercialized ideas, a value of ideas in a portfolio (or at an idea store), a number of patents or a percentage of accepted ideas. By measuring the innovativeness, organizations can reward and motivate employees to increase and initiate creativity. For implementing new ideas an individuals could be rewarded exclusively (Boeddrich (2004, 282). The reward can be something else than an award – It can be e.g. a peer recognition or a performance appraisal to stimulate ideation (Koen et al. 2002, 20).

To summarize, the innovation is a successfully commercially used and technologically working new idea (Tidd, Bessant & Pavitt (2005, 65-66). Customer needs is the main driver of innovations although innovations can arise from inside the company's knowledge or influenced by an external factors. An innovation could be incremental or radical depending on a context of an idea and a nov-

elty of a technology and markets. A success of innovations consist a risk factor although it is an incremental innovation. Managing and controlling the innovation process is essential to develop the company to succeed and compete in a globalized world in future. The innovation process should be one of the key processes of the company though a R&D is often considered as a separate process. The process cannot be copied as it is from other company because of the company's knowledge, routines and methods are part of the innovation process.

2.2 Innovative culture

"Innovations has nothing to do with how many R&D dollars you have…it's not about money. It's about the people you have, how you're led, and how much you get it." Steve Jobs, interview in Fortune Magazine, 1998 (in Tidd et al. 2005, 467). Tidd et al. (2005, 12) convince that innovative companies outperform their competitors measured in a market share, a profitability, a growth or a market capitalization. The innovative company stands for using innovations to improve processes or to differentiate products and services.

Apilo et al. (2007, 97-99, 101-102, 113, 126) reminds that the change of a culture is a persistent process. Implementing culture changes should happen widely across all the organization levels. A continuously changes increase the innovativeness. An encouragement and merit pays should support the innovativeness and creativity. In addition, separate parts of the innovation process require a different kind of control. Freedom is required in the front-end phase of the innovation process. Developing and converting business concepts or single ideas to an innovation involves a lot of a hard work from the organization. Creativity is a major part of an ideation and generating innovations. An innovative organization and a creative organization are similar together. Managing a creativity and creative persons, controlling of innovation systems and processes are vital in both kind of organizations. Companies need to offer a working time and enough resources to development and to innovate. Employees need to allocate a specific time for innovating. For example, 3M allows employees to use 15 percent of the working time to innovate freely.

To outperform in innovations companies need to take care of personnel's motivation and comfort suggest Apilo et al. (2007, 102, 106-108). Because of the reputation of an innovative company, recruiting an innovative people is easier. The innovative organization takes advantage of personnel's different backgrounds of an ethnicity, education, knowledge and experience. The construction in-

dustry is well known as a homogeneous industry – Employees are mainly white male engineers. The diversity is more than requirement especially in the front-end phase of the innovation process. Although differences and diversity brings challenges to the company, it increases the innovativeness and creativity by challenging traditional methods and business activities. It is not enough that the company accepts diversity. The company has to learn to take an advantage of it. Innovations emerge by an intercourse of the people. The company needs to create official and unofficial possibilities to collaborate. The collaboration with cross-functional units increases the innovativeness.

Apilo et al. (2007, 116, 122-123) notes that innovations base on learning. The organization cannot learn without individuals. The innovation management is about usage of a data, information and knowledge. An interesting case is a concealment of confidential information in projects. The concealment has put a finish sharing knowledge. Actually, companies prevent employees to seek information from company's data systems to be on the safe side. A task circulation can be used as a method to seek new viewpoints, challenging current operations and to prevent routines. A frequent task rotation encourages employees to share their knowledge and to extend their network. At an orientation phase, a new employee could be used to question current practices, routines and process by him/her previous knowledge (Reid and Brentani 2004). For example, Nokia considers routines one of the blocker of creativeness.

The main abilities to manage innovations in the organization named by Tidd et al. (2005, 84) are as follows:

- Recognizing – Seeking the clues and the weak signals from the environment is essential.
- Aligning – Balancing the company's strategy and the innovation strategy is important to find possibilities to change.
- Acquiring – Essential is to become conscious of the restrictions of the company's own experience and knowledge to understand needs from the external sources.
- Generating – Developing and generating a new ideas internally is a basic ability to create an innovations and usage of the employees' knowledge.
- Choosing – Selecting the most suitable clues and weak signals from the field is necessity to succeed.
- Executing – Monitoring and controlling the development projects through the innovation process is important

- Implementing – Managing the change in the organization is essential to use innovations effectively.
- Learning – Lessons learned and reflecting the previous experiences is a leading skill avoiding mistakes.
- Developing the organization – Changes in structures, processes, business activities and behavior is a prerequisite succeeding in the innovation management.

The innovation strategy is a big step towards the innovative culture. Companies need innovations to change and companies need to change to succeed. Henry Chesbrough (2003a) aggravates, "Companies that don't innovate die … In today's world where the only constant is change, the task of managing innovation is vital for companies of every size and every industry." Apilo et al. (2007, 60-61) define that the innovation strategy is about how the company innovate and how it uses innovations in business operations. The innovation strategy defines customers, innovation types and situation of the competition.

2.3 Open innovation

An open innovation means that not all of the innovative potential exists in the one single company. Chesbrough (2003a, 17-19) describes that an internal R&D is a strategic advantage to big companies and it works as a barrier for other companies to entry to new market areas. Commonly the internal research of companies generates many of new ideas, which are not useful to the company itself. However, some other companies might benefit from valuable ideas and make an innovation from the specific idea. A table 1 presents the basic principles and differences of a paradigm between the closed and the open innovation.

Table 1. The principles and differences between the paradigm of the closed and the open innovation.

Closed innovation	Open innovation
The smart people in our field work for us.	Not all the smart people work for us so we must find and tap into the knowledge and expertise of bright individuals outside our company
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value
If we discover it ourselves, we will get it to market first	We do not have to originate the research in order to profit from it.
If we are the first to commercialize an innovation, we will win.	Building a better business model is better than getting to market first.
If we create the most and best ideas in the industry, we will win.	If we make the best use of internal *and* external ideas, we will win.
We should control our intellectual property (IP) so that our competitors do not profit from our ideas.	We should profit from others' use of our intellectual property (IP), and we should buy others' IP whenever it advances our own business model.

Source: Chesbrough (2003a, 26)

Chesbrough (2003a, 22-25) underlines that though the open innovation is about using external sources to gather ideas – it does not mean that the open innovation replace the company's own internal research processes. The logic is to internal and external sources to gather ideas but the internal research converts new ideas to functional business concepts, innovations. A figure five and six illustrates different models of the both innovation processes. The closed innovation model in the figure six shows that companies need to generate, develop, manufacture, market and distribute all ideas all by their own. On the other hand, in the figure seven a dash line border between the company and the environment represents the company's possibility to seek and use internal as well as external ideas to develop new products or services to the market. The major factor towards the open innovation is a managing a knowledge. A personnel turnover is high in the construction industry. Therefore, an emerging competitive advantage flows to competitors with a new employee's knowledge. Managing the company's the most important resource, employees, is essential to keep employees in the company and to minimize the personnel's turnover (Apilo et al. (2007, 47).

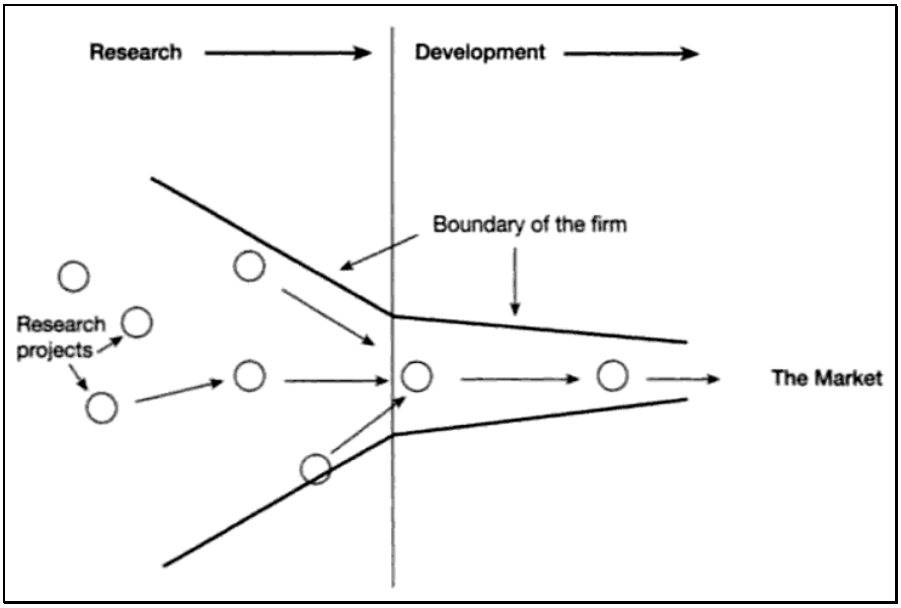

Figure 6. The closed paradigm for managing an industrial R&D (Chesbrough 2003a, 22).

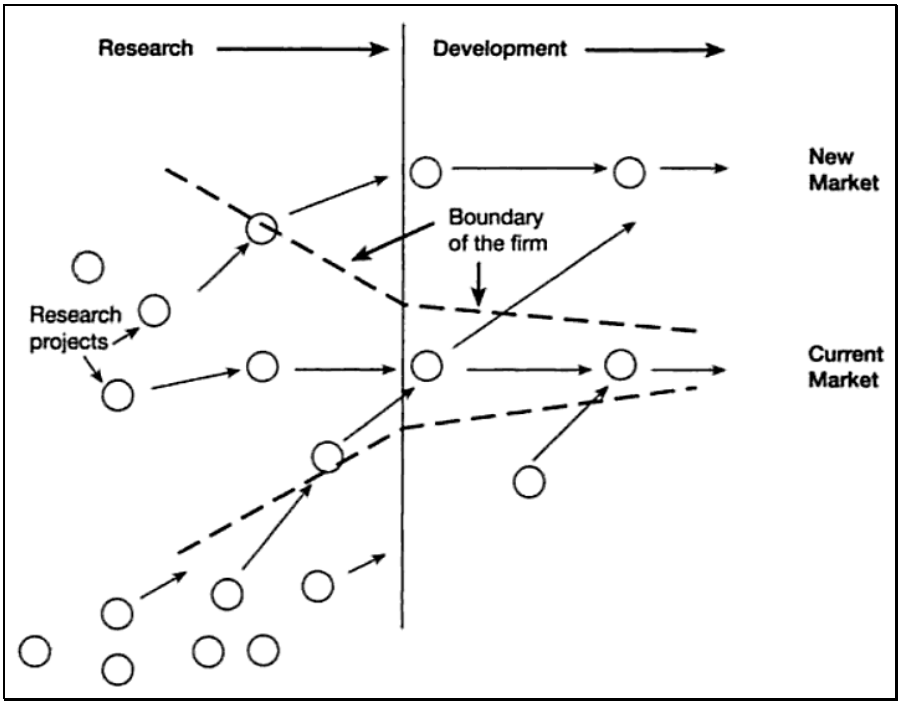

Figure 7. The open innovation paradigm for managing an industrial R&D (Chesbrough 2003a, 25).

Chesbrough (2003b) describes that opening borders between the company and the environment increases possibility to screen and separate a "false positive" and a "false negative" ideas. The "false positive" means bad ideas that look promising and the "false negative" means the opposite – ideas, which are not promising but are significantly valuable. A classic example of the "false negative"

ideas are Ethernet and the graphical user interface (GUI) which were invented by Xerox. Inventions were not valuable to Xerox but other companies commercialized both inventions successfully.

Apilo et al. (2007, 49-51) brings forward barriers towards a networked innovation process. Some companies consider the R&D as a company's core competence. In addition, some companies have an attitude that "we know the best" – they think they are better than others and do not respect other companies solutions. A project management and a systematic approach are more important in networks than in a internal R&D projects.

2.4 Innovation process

To handle progress of innovations, the company needs to create the innovation process according Apilo et al. (2007, 110-112). The innovation process should be recognized as a common business activity neither than an exceptional case nor than a supporting process. The top management needs to highlight the importance of the innovation. Besides the innovation process, organizations need certain flexibility and risk-taking ability to feed creativity and the innovativeness. If the organization's aim is to create radical innovations, more freedom is required in the process and necessary changes must be accepted. Some sources claims that creativity and generation of ideas emerge only in a chaotic environment and managing or controlling the process or systematic structures is not possible (Boeddrich, H 2004, 275).

The whole innovation process is typically divided to a three parts: *a front end of innovation, a new product development* and *a commercialization* Koen et al. (2002, 6). Main differences between the front-end and the new product development processes are showed in table two.

Table 2. Main differences between the front-end and the new product development processes.

Front-end of innovation	New product development
Nature of work is experimental and chaotic. Planning is difficult. Idea is easy to change.	Nature of the work is disciplined and goal-oriented with a project plans. Idea is difficult to change.
Commercialization date is unpredictable and uncertain.	Commercialization date is definable.
Funding is variable.	Funding is budgeted.
Revenue exceptions are uncertain with a high level of speculation.	Revenue expectations are predictable in accordance with analysis and documentation.
Individuals and teams are main activity resource.	Activity based on organized multifunction product and/or process development team.
Decisions are qualitative, informal and approximate.	Decisions are quantitative, formal and precise.
Rejecting idea is easy.	Rejecting idea is more difficult.
Number of ideas or concepts can be used to measure progress.	Progress is measured by achievement of milestones.

Source: Koen et al. (2002, 6); Koen, Ajamian, Burkart, Clamen, Davidson, D'Amore, Elkins, Herald, Incorvia, Johnson, Karol, Seibert, Slavejkov and Wagner (2001, 47); Kim and Wilemon 2002, 270).

According Tidd et al. (2005, 67-68, 89-97) the innovation process contains a four phases: *searching, selecting, implementing* and *learning*. The searching phase refers to the front-end of the innovation process. It is about scanning an internal and an external environment for weak signals and opportunities for a change. The selecting phase is about deciding, which weak signals and opportunities are important enough to respond. Essential in this phase is to make right choices to match the company's innovation strategy. The implementing phase is about decision to trigger an idea to a market. The implementing phase actually consist a four sub-categories; *acquiring knowledge resources*, *executing the project, launching* and *sustaining the innovation*. Through the innovation process, the organization can learn, build their knowledge and improve the whole process. The innovation process is a continuous process and by learning organization can avoid repeating previous mistakes and prevent "reinventing the wheel."

The innovation process is not possible to benchmark as it is from another company to another. Apilo et al. (2007, 34-37) highlights that the innovation process is constantly unique because of the company itself and its strategy, culture and a special characteristic of products and processes. The process should be one of the main processes of the company. A commitment of a management, a personnel and a network is assured when the innovation process is one of the key processes.

Managing the innovation process requires different leadership in different phases according Apilo et al. (2007, 113-115). Typical for the early stages is a freedom, creativity and a lack of critic. Later on

leading is more collaborating employees, allocating resources and supporting. The challenge is to make the people think and look things from the other point of view. At the last stage important is effectiveness on managing the development project. The last stage needs control of schedules and resources. Tidd et al. (2005, 28) warns that the innovation process needs a careful management to avoid the extreme case, which is termed as the "not invented here" -effect. The "not invented here" -effect, NIH, means that firm research a technology but does not catch on it. A famous example of the NIH-effect is Bell's telephone, which dismissed by Western Union. Western Union, in 1876, explains *"This "telephone" has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us."*

3. INNOVATIVENESS IN THE CONSTRUCTION INDUSTRY

The construction industry is a traditional, an old-fashioned manufacturing industry. The innovation or the innovativeness linked rarely to the construction industry. Although in the long run the industry has changed and developed a lot. A quality of the construction has increased and the building regulations tighten up all the time. No one is responsible for the whole value network of the construction industry. Thus, the competition based mostly on expenses. The main problem in the field seemed to be the productivity. Productivity problems are explained in the background of the thesis in the chapter one. Because of characteristics of the construction industry, delay elements of the innovativeness can be explained due the basic rules of the industry. The main delay elements of the innovativeness in the construction industry according Lahdenperä (2007, 16-17) are as follows:

- Project-based production – Continuous development and systematic collection of knowledge is challenging because of unique projects and changing project organizations.
- Product lifecycle – The building and civil construction products are long-life products. Avoiding new solutions is general habit. Tested and approved solutions and materials are more in use.
- Purchase procedures – The client usually outsource planning and call for a tender of the building contract. The price of the tender defines the winner. Contractors are avoiding freedom, innovative solutions and surpassing building regulations because the price is determinant factor.
- Complexity of projects – Almost an every building contract is unique and planning solutions are variable. Commonly project organizations have not worked together previously so collaboration is vulnerable for a disruption. Because of that, contract terms are strict with sanctions. Procedure constrains the innovativeness and suggests doing as always.
- Regulations – Building regulations controls strictly the construction industry. Building regulations demands how different solutions need to implement. Detailed demands reduce new development and the innovativeness.

3.1 Importance of innovations in the construction industry

As described earlier in the background of the thesis and briefly on previous chapter, the main problem in the construction industry is a lack of the productivity. The productivity can be increased by innovations in Finland. Actually, in future that is the only way to compete in the globalized world. The ministry of employment and the economy of Finland confirm this statement in the innovation politics for Finland 2009.

Björkroth et al. (2006, 109-114) argues that the innovativeness is a prerequisite to a positive development of the productivity. In last years R&D expenses has been on increase in the construction industry. However, it is hard to separate the process and the product development from all of the R&D investments. The R&D investments contribute positively to quality of the final product. Innovation investments seem to be in conflict between investments and growth of the productivity in the construction industry. Of course, the innovation investments appear with delay to the productivity. On the other hand, the Finnish construction industry is doing well comparing the R&D investments to the other countries of the Europe in a proportion to the construction production. Lautanala (2007, 24) defines the R&D volume was 230 million euro's in 2006. Companies share was 170 million euro's and share of the public sector was about 60 million. Regardless Finnish successes on the R&D investments in the European level, the investments are only 0.5 percent of the whole production and maintenance and only 0.9 percent of the turnover of companies – it is still considerably below than the social requirements and the national economy requires.

3.2 Fostering factors towards the innovativeness in the construction industry

Lahdenperä (2007, 17, 19-34) summarize that a separate R&D is not enough in the construction industry. Therefore, the R&D should tie as a part of the construction projects and contract tenders. Lahdenperä claims other fostering elements for improving the innovativeness in the construction industry. These twelve catalyst stands for basic principles and plan of action to increase the innovativeness in the construction industry. Part of these catalysts is already broadly in use. Construction companies improve throughout processes so understandably radical innovations are rare. Director General Tarmo Pipatti from the confederation of Finnish construction industries (in Lautanala 2007, 24-25) claims that one delay factor of the development in the construction industry is the procurement which highlights the cheapest tender price. Business Development Director Olli Niemi from NCC (in Lautanala 2007, 25) explains change resistance is broad and business activities emphasizes doing as always thus the present method contains plenty of problems. He claims the organization and employee's time goes solving problems caused by poor process control.

Fostering factors towards the innovativeness according Lahdenperä (2007, 19-34) are as follows:

- Active and skillful client – The client is key participant in the construction project. The client defines objectives and standards for the project. The main part of the innovation potential is also in the client's hand although it requires more investments from the client.
- Functionality and requirements – Demands for functionality is often more reasonable solution than the traditional technical documents for increasing the innovativeness. In practice, a good procedure is that client describes requirements in a free form so tacit knowledge and implied intention is brought out.
- Long-range targets – Unique projects are delay elements for the development. Development investments are profitless if a budget monitoring follows only a specific project. Long-range targets and collaborations increase continuous improvements and the innovativeness.
- Partner in co-operation – A collaboration, which based on price, is common at the construction industry. With this method, costs decreases but benefits and additional values do not grow.
- Networking – Project organizations build up from broad and variety group of companies. The innovativeness requires integration of the whole value network. Activity of the network correlates the innovativeness.

- Organizing project – Generally integrating the production and planning increase the innovativeness. Therefore, the project development -based construction increase the innovativeness by integrating subcontractors and suppliers to the project. Thus, standard processes and activity systems decrease the innovativeness.
- Confidence and transparency – To innovate the collaboration is necessary. It requires confidence and transparency to succeed. Sharing knowledge and common objectives are important matters to succeed in the collaboration.
- Project interaction – Many innovative solutions are made by suppliers and/or manufacturers. A commitment of suppliers and manufactures to a project in an early phase gives possibility to evaluate plans and to find new innovative solutions during the project.
- Collaboration after project – A long-range collaboration offers flexibility to find innovative solutions. Both parties should reach for the continuous improvement by doing a cooperation project after project. Chasing own interest in single project delay the development. For example, successful project may lead to extension of a contract to following project by the client.
- Proprietary rights – Concisely, boost of the innovativeness can reach only if an innovator itself benefit from it. A proprietary rights and usage of ideas causes difficulties when working in networks. In addition, the publicity of contract documents in the public procurement decreases the innovativeness – Gained advantages and assets vanish as early as one tender. Competitors can reach also to classified tender documents at least after legal proceeding.
- Spread of risk – An implementation of new materials, components or solutions contains high risks, because of the long lifecycle of the construction. To increase the development and the innovativeness the client should take at least a part of a possible risk or reward financially for outperform in a production.
- Managing knowledge – Ability to learn from experiences and mistakes from previous projects is essential. The organizations ability to manage knowledge is the foremost factor to innovate. Managing a knowledge is important because use of a tacit knowledge.

One good example of the innovation and indication for change in the construction industry is a building information modeling (BIM). The BIM is three-dimensional model of a building. It is used to illustrate and manage all of the product information about the building during its life cycle. The BIM is actually a massive innovation in the construction industry that will change the whole way of thinking in production and it will increase the productivity. The building model simulation, optimi-

zation and prototyping tools are powerful and effective way to observe impacts of changes (Gordon et al. 2008, 54). Lautanala (2007, 25-26) remarks the most significant innovations spring up from interface between different operations, processes and line of businesses. Finland has invested considerably to development of the BIM compared on an international level. Advantages of the BIM in the construction and the lifecycle management are indicated clearly but usage and spreading of the BIM is still poor in the field. This describes well NCC's Olli Niemi's thoughts of the change resistance in the construction industry.

4. THE FRONT-END OF THE INNOVATION PROCESS

"It is useful to think of the FFE as a precursor to a betting process. At the end of the FFE we will put our investment in products development at risk in return for a change to earn profits." (Reinertsen, 1999, 25).

A characteristic for the front-end of the innovation (FEI) process is experimental, ambiguous, chaotic and uncertainty (Koen et al. 2002, 13). Apilo et al. (2007, 38-39, 114, 132) argues that a freedom, creativity and lack of critic emphasizes at the early stage. Managing the FEI is more like a leadership than a management. Important things' leading the early stage is support to employee's new ideas and enable a creative internal and external collaborations. Managing the innovations is not only a problem for a R&D-department it should be part of an every profit center's key process. Every organizational level should be involved to the innovation process. The FEI process should be considered as a continuous process. The company defines central factors of a technology, markets and customer needs in the early phase. At the end of the innovation process changes are more difficult to implement and costs are much higher. Managing the FEI brings a sustainable competitive innovation advantage to the company (Brem and Voigt 2008, 3).

Tidd et al. (2005, 91) confirms that the front-end of the innovation consist high uncertainty about a technology, market demands, competitors behavior and regulations. At this phase, knowledge about these factors based on "the best guesses." Verworn, Herstatt and Nagahira (2008, 3) explains that gathering a relevant information reduce risks, uncertainty and gives better possibilities to success after the FEI process in a New Product Development (NPD) process. Cooper and Kleinschmidt (cited in Verworn et al. 2008, 1-2) emphasize the importance of the early stages of the innovation process claiming, *"The greatest differences between winners and losers were found in the quality of pre-development activities."* Biggest decisions about the quality, cost, timing and execution of a new product or service are done during the front-end phase. Controlling and understanding the importance of the FEI helps companies to success in developing new products or services. Rice (cited in Verworn et al. 2008, 1-2) convinces that most challenging part of the product lifecycle is in the front-end phase. The FEI represents the weakest area in the innovation process (Koen et al. 2001, 53).

4.1 The phases of the front-end of the innovation process

The chaos and the fuzziness involves in the front-end of the innovation process. Smith and Reinertsen made the term "The fuzzy front end" (FFE) popular though it first appeared already in 1985 (Reinertsen 1999, 25). The FEI is considered as the first phase of the NPD process. It covers phases from the idea generation to its approval for development or its termination. Apilo et al. (2007, 134) claims that the front-end of the innovation process is not a strict process although specific tasks can be identified such as an opportunity identification, an idea generation, an idea development and an idea evaluation. Cooper (cited in Verworn et al. 2008, 1-2) categorises the fuzzy front-end in a four phase: a generation of an idea, an initial screening, a preliminary evaluation and a concept evaluation. On the other hand Khurana and Rosenthal (cited in Verworn et al. 2008, 1-2) expands the fuzzy front-end to cover a product strategy formulation and communication, an opportunity identification and an assessment, an idea generation, a product definition, a project planning and an executive reviews. The coordination of the front-end of the innovation process should be a formal role for the process owner (Koen et al. 2002, 21).

Better understanding of the FEI leads to the competitive advantage. At that phase the most important timesavings can be done with least expense according Reid and Brentani (2004, 172). Thus, at the early phase comparison between many ideas is possible without need to implement any of the ideas. Buggie (2002, 11-12) outlines that the cost of a new product increase exponentially with elapsed time. Controlling and usage the front-end is essential to avoid wasting time and money. In worst case, a new product gets all the way to the market and then flops. On the other hand, it is important to notice that the FEI is not about killing a new candidate – It suppose to courage an ideation and the development of concepts.

Koen et al. (2002, 8) and Koen et al. (2001, 46-49) have shown a new form of a new concept development model. It consists on a three key parts. The new concept development model is presented in a figure eight. *An engine* describes leadership, culture and business strategies, which are expected for a successful innovation. The engine controls a five key elements of model. *The five key elements* are the activity elements of the FEI: opportunity identification, opportunity analysis, idea generation and enrichment, idea selection and concept definition. The five key elements are designated as elements rather than processes. An outer ring consist influencing factors from the environment e.g. distribution channels, law, government policy, customers, competitors, political and economic cli-

mate. These environmental factors affect on the whole innovation process. The company cannot control these factors. An arrows pointing to the model represents starting points and indicates beginning of a project. The existing arrow represents how concepts leave from the model to the new product development process (NPD) or a technology stage gate process (TSG).

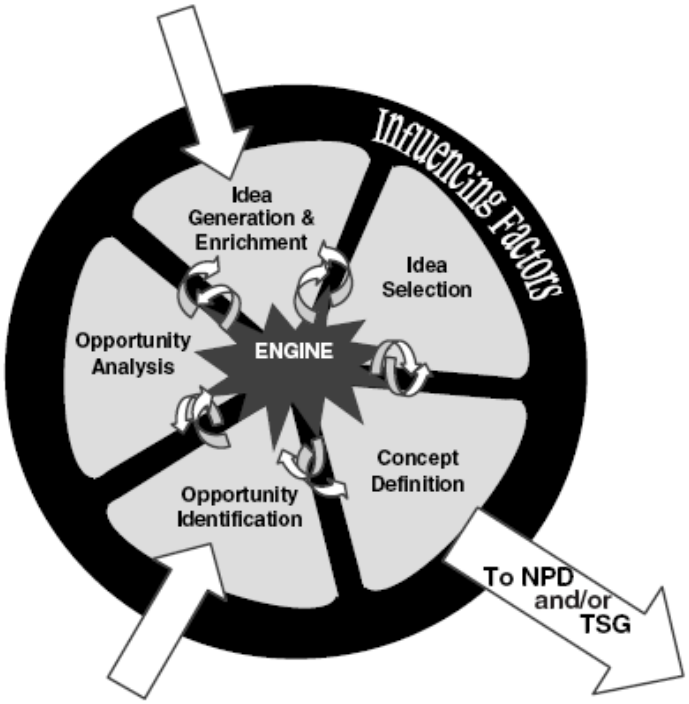

Figure 8. The new concept development model (Koen et al. 2002, 8; Koen et al. 2001, 47).

The shape of the model describes flowing and circulation of ideas between and among all of the five key elements (Koen et al. 2002, 8-9, 30; Koen et al. 2001, 48-49). A looping and iteration are part of the FEI activities. Any order or combination of the elements can be used more than once. The front-end of the innovation is not a linear process with a specific timings and steps. Although the five key elements are discussed in a clockwise, the procedure moves randomly between different areas. Thus, the looping back delays the FEI process it shortens the total cycle time of the product development and commercialization. As described earlier the overall project cycle time and costs grow exponentially with the elapsed time. A clear definition of markets, technical requirements and mapping of risks in business plan enables effective management in the development and commercialization stages. It also decrease "redo" and "redirect" activities later on.

The recent study (Verworn et al. 2008, 9-10, 13) has shown differences between the radical and the incremental NPD processes. Radical projects need a new technical knowledge, technical compo-

nents, product lines and production processes. Incremental projects could often use existing technology. Radical projects offer significantly higher competitive advantage. In sum, their result shows that differences between the radical and the incremental fuzzy front-end processes are only minor.

The study by Verworn et al. (2008, 12) observes that the intensity of the planning before a start of the development process is the key to success. They recommend that: *1) "Product development effectiveness can be achieved by an early reduction of technical and market uncertainty supported by intensive initial planning." 2) "Managers should focus on the reduction of technical uncertainty early in the NPD process and ensure high-quality initial planning when aiming for efficient product development." 3) "Intensive initial planning reduces market and technical uncertainty during the fuzzy front-end."* Lessons learned from Japanese Companies in Verworn et al. (2008, 13) study has shown using early prototypes reduce a technical uncertainty. Prototypes allow an early check of a technical feasibility and it improves communication between the development team, customers and/or the top management. It also enhances the management support and responding on customer needs.

4.1.1 Opportunity identification

An opportunity could be a minor upgrade for an existing product, entirely a new direction for the business, a new product platform, a new manufacturing process, a new service or a new marketing or sales method (Koen et al. 2001, 50). According Koen et al. (2002, 7, 15) the opportunity identification means finding business or technology gaps between the company and surrounding environment to respond to a threat, capture of a competitive advantage or solve a problem. It is about finding additional information to translate opportunities to match the company's innovation strategy. At this phase, the technology and the market uncertainty remains high therefore the further development is assessed. The company might have informal opportunity activities or a formal identification process. The opportunity identification is driven by objectives of the company's innovation strategy (Koen et al. 2001, 50). Apilo et al. (2007, 134) describes that the opportunity identification should be part of the job description for every employee. The opportunity identification includes understanding of a customer needs, understanding of own and other industries changes, utilization of technology and different expertise of employees. Company's task is to create brainstorming sessions to employees with different expertise to share their knowledge with each other. Tidd et al. (2005, 15) confirms that the innovation is about a knowledge. Ideas might already exist in employ-

ees brains in an explicit or a tacit form. The explicit form means that others can access, discuss and transfer knowledge. In contrast, the tacit knowledge cannot put into words.

Tidd et al. (2005, 24, 28, 90) notes that the challenge to the company is to pick up weak signals from areas where they do not normally do research. Over the time, this creates gap to find radical innovations. The problem is to understand market needs though there are no such markets yet. Many external factors influences and brings a plenty of uncertainty to the company's innovation process. Such factors are e.g. *political, economical, social, technological, environmental* and *legal factors* (PESTEL). Bröring and Leker (2007, 165-167, 171) confirm that companies do not manage a relevant knowledge outside traditional industry boundaries to recognize, assimilate and integrate new potential opportunities. The lack of experience or knowledge might weaken possibilities to generate and select products with distinct features into so-called *hybrid* products. Thus, companies can focus on the existing "traditional" industry segment without any adaptation or try to find opportunities from convergences between different industries.

Bröring and Leker (2007, 165-167, 171) proposes joining the strategic partners from other industries to the front-end phase to reduce gaps by using their experiences and knowledge. Innovation managers need to examine opportunities across industry boundaries because some critical aspects might be developed in other fields. A convergence of different industries may lead to the development of a new inter-industry segment or new value chain. According Greenstein and Khanna (cited in Bröring and Leker 2007, 166) convergence might cause the integration of two separate industries (1 + 1 = 2) or even an emergence of a entirely new, exceptional industry segment creating a synergy effect (1 + 1 = 3). Buggie (2002, 14) notes that obviously companies does not know how close or how far a radical innovation is from the present business strategy. Knowing the relevant potential applications and markets brings challenges, fuzziness and uncertainty to the FEI.

An impulse or a "spark" to innovation can be established by *a market pull, a technology push* or *a regulatory push* according Brem and Voigt (2008, 5, 13-14). The market pull means satisfying customer needs and solving problems in markets. The technology push drives the development of new products, applications or processes to markets by the new technology. The characteristic for the market pull is that innovations are incremental changes or replacements while the typical technology push innovation is radical or major improvements. The term regulatory push creates "eco-innovations" from ecological aspects and changes in laws, expected regulations, standards or politi-

cal decisions. The regulatory push might influence indirectly through market needs for example a need for a new tool or a material because of law changes

An external sources and an environment is the most important input to gather ideas according Reid and Brentani (2004, 179-180). Individual employees are looking for the environment to gain information e.g. about a new technology before bringing an idea awareness to others in the company. Individuals actually connects the company to outside sources of knowledge and information because organizations itself "does not intuit." Employees gather the information by reading a technical literature and by communicating with external experts. Employees are an efficient channel to transfer the external information into the organization.

4.1.2 Idea generation

An idea means primitive form of a new product, a process or a service and it is often identified at the opportunity identification phase (Koen et al. 2002, 7). According Boeddrich (2004, 275) the idea generation should base on the company's innovation strategy. The top management should set the innovation strategy to guide and control innovations. The idea generation is useless without any connection to the innovation strategy. Apilo et al. (2007, 139, 143) recommends that the idea generation phase should be done purposefully. The company's innovation strategy commands what kind of innovations it is trying to find – incremental or radical innovations. On the other hand, selected customer needs indicate course for the innovation strategy. By directing innovations towards certain area, the idea generation is easier by using already defined problems. Secondly, the organization is willing to accept ideas without any doubts. This kind of business activity is working well with the incremental innovations. In case of the radical innovations, preparation is not possible to do in advance. Creation of ideas is not the problem instead collecting relevant ideas and defining categories for ideas is the complication.

The effective use of the key competences and the human capital requires that ideas do not stay on employee's brains (Boeddrich, H 2004, 278). According Brem and Voigt (2008, 3) companies have two ways to collect ideas. Firstly, ideas might already exist in the mind of an employee or a group and the company's task is to collect ideas. Secondly, the company could develop and generate ideas using creative methods and suitable tools. This method should be done purposefully through the

process and it should base on the company's innovation strategy. Either way, the company needs to fulfill and pay attention to following specific requirements to success (Boeddrich 2004, 275-277):

- The company's innovation strategy – Guidelines and goal setting need to be considered
- Target audience e.g. customers or users need to benefit of ideas
- Managing the idea-collection process need to be conducted and systematically structured
- Criteria for selecting and implementing ideas need to be predefined transparently
- The company need to define idea categories
- Owner of the innovation or the idea management process need to be named and committed
- The innovation process need to be simple and flexible enough to manage
- Involve and influence of the top management to the front-end phase is essential

Every company has many new ideas for improvement or change existing working methods according Boeddrich (2004, 278-279). Saying "we have no ideas" actually means that the company does not have a creative atmosphere, a system to collect ideas or leaders who are not able to receive ideas. At the front-end phase, ideas are only rough drafts and needs development to a feasible form. Managers should imagine new ideas as an improvement than a critic or coming up against the supervisors. Realizing ideas increases a motivation of employees. By contrast, when ignoring ideas they lose interest to the company's goals. By knowing where and how to deliver new ideas creative employees stay motivated and they do not frustrate. The idea gathering needs to support peoples thinking of ideas consequences and changes in the workplace. Thus, asking a "hard" success factors e.g. ROI or market shares are not important and actually forbidden at the idea generation phase.

Companies could easily gather new ideas internally if the tools for collecting ideas are available. Apilo et al. (2007, 143-144) explains an example of an intranet application as collecting, evaluating and presenting new ideas. The intranet is a good channel for increase communication in the organization. The company should encourage and motivate employees to publish ideas to the intranet so a peer group could evaluate ideas quickly and easily. The original innovator should get rapidly feedback about progressing of the idea.

New ideas can come into existence by a supplier offering a new material or an unusual request by a user (Koen et al. 2001, 51). Apilo et al. (2007, 143-145) proposes a method how companies could get many new ideas: organizing innovation competitions for the organization itself or to its interest

groups. The target group on the innovation competition could also be limited on a group of employees e.g. sales or service department. The organization can also organize the innovation competition as an open competition when customers or students could be innovators. As well as getting new ideas, the company's reputation increase as an innovative work place.

4.1.3 Idea development

An idea development phase is about combine, modify, reshape, upgrade, examine, study, discuss and iterate a generated idea (Koen et al. 2002, 19-20). Koen et al. defines that the idea development phase can be done as a formal process. This phase is the most challenging phase of the front-end of the innovation process according to Apilo et al. (2007, 148-149). On the other hand, at this phase it is easier to catch on real innovations by the further development of unfinished ideas. If the development phase is skipped or done badly the idea might be discarded at the evaluation phase. The easiest way to stand out from the less innovative companies is to utilize the idea development phase well. Every organization or company can generate ideas but only the innovative organization can develop a new idea to an innovation. Necessary resources, knowledge and a different point of views are critical skills to develop and convert ideas to innovations. The idea generation can be placed into the practice in simplest way by giving an existing idea to an other person than an actual developer or a team. After the commentary and the improvement phase the further development of an idea can be analyzed at the workshop with users, buyers and/or sellers. Several parties can involve enhancing activity such as customers, users, other companies, institutions and suppliers. A development team or an individual can manage and enrich existing ideas by using a certain tools. Virtual tools can be used for the further development of ideas.

The most important purpose of the idea development phase is to consider the developed idea critically by reflecting the idea to the company's innovation strategy and customer needs according Apilo et al. (2007, 149). At this phase it is important to consider and estimate required resources and potentiality. Changes for visualization, prototyping and further clarification can be done continuously. The development phase is critical because at the next phase ideas are compared and evaluated between other ideas. Thus, every new idea is competing of the same capital and available resources. Only the best ideas are implemented or developed further. The biggest changes are worth of doing as early as possible to conserve capital and wasting of time. The organization should encourage employees to spend unscheduled time to test and validate their own and others' ideas.

4.1.4 Idea evaluation

The future of a developed idea is determined at an evaluation phase. Of course, not all ideas can be realized and implemented. In many cases, there are so many ideas that the evaluation process is the critical activity (Koen et al. 2001, 51). The problem is to select which ideas to pursue and achieve the most value (Koen et al 2002, 22). Practices to screen and evaluate ideas are essential (Boeddrich 2004, 279). Making a good selection is critical for the company's future although there is no certain process, which guarantees a good selection (Koen et al. 2002, 22). Apilo et al. (2007, 150) emphasizes that before the actual decision of idea's future the implementation method and required resources should be considered exactly. The method of implementation depends on the type of idea. Important is to consider does a new idea require a separate concept phase, can it be used as it is or can it be merged to the existing R&D-project. The concept means well-defined written and visual descriptions of the product with primary features and customer benefits combined on needed technology (Koen et al. 2002, 7). On the other hand, the idea can be rejected. The rejected idea can leaved on hold to wait for better timing, return to the development or to wait a new opportunity.

Reinertsen (1999, 26-27, 29) stated that evaluators can make two types of mistakes – Incorrectly rejecting a good idea or incorrectly accepting a bad idea. The incorrect acceptance can activate an investment that turns out worthless. On the other hand, an incorrect rejection has minor cost if the organization has several other ideas. The flow control strategy on evaluation of the new ideas is typically "first-in, first-out." By changing sequence and priorities of ideas so high-cost-of-delay ideas comes before lower costs of delay. This improves the process by accelerating important ideas lead-time. It is important to bear in a mind that only one out of 3000 ideas succeeds (Stephens and Burley cited in Reinertsen 1999, 28).

According Apilo et al. (2007, 151) the idea evaluation process should consider three primary matters: a customer needs, a method of implementation and suitability for the company's innovation strategy. A new idea should resolve some recognized customer needs and it supposes to be technologically and legally possible. The new idea might lead to change in the company's innovation strategy or even to the corporate strategy. The top management needs to execute new strategies or plans quickly and effectively when needed according to early foresights (Koen et al. 2002, 12). The foresight is about finding weak signals and connecting different predictions of the future (Apilo et al. 2007, 71).

The evaluation and the selection can base on a self-generated options or a formal portfolio management method according Koen et al. (2002, 22, 29). A formal decision process is difficult to manage due the limited information and understanding at the early phases of an idea. In addition, financial analyses and estimations of future incomes are "wild guesses." The idea evaluation should be strict because ideas must allow growing and advancing at the development phase. The idea evaluation phase is not about abandoning promising and good ideas – It is more about judging is an idea interesting or ready for implement to the present business activity or not. Evaluators need a positive attitude rather than filtering out less attractive ideas. Evaluator's mindset should encourage creativity and strengthening concepts to support modifying ideas rather than determine which ideas to be executed. The additional way is to invest defining a concept after an idea has been evaluated and selected. The evaluation process should be flexible for example, boosting the process in case of potential innovations.

According Koen et al. (2002, 22-24) decisions are mainly made on an emotional or "gut" level. Therefore, individuals mind is always part of the selection process. Without any visible evaluation process or a formal decision process most of new ideas disappear. The owner of the process should be named to control and maintain the whole process with the full support of the top management. Essential is to clearly understand roles and responsibilities of people involved at the evaluation process. Without visible process, the stream of new ideas dries up. Communicating and giving feedback to the creator of idea is essential to maintain ideation in future. In addition, the criteria should be visible to help innovators to determine attractiveness of an idea.

A challenge for evaluation phase comes from a lack of information. Koen et al. (2002, 22-23, 29) explains that at the beginning the length of an idea description might be only a one-line. If the idea is attractive, the next step is usually to request the author or someone else to gather more information about it. Usually the author is motivated to pursue it further. In addition, if the idea is assigned to someone else the author might feel that his or her idea has taken away. When more information is gathered, the idea goes to another evaluation process and so on. After all, the next step is to prioritize and select the best ideas. An incremental innovation can be measured with traditional financial measurements such as sales and profit forecast or discounted cash flow calculations. More novel a radical innovation need to measure by using e.g. net present value or internal rate of return break down method. In many cases, evaluating novel innovations by traditional financial methods is un-

suitable because of the uncertain revenue expectations. In addition, possible technical and commercial risks should be considered and analyzed in any case.

To increase information and make an evaluation process easier an innovator can be requested to fill a business case. Koen et al. (2002, 26-27) and Koen et al. (2001, 51) reveals that the business case should consist a qualitative and a quantitative information. The business case should consider about objectives, the company's innovation strategy, a size of opportunity, a respond to a market or a customer needs, a market potential, investment requirements, competitor assessments, a commercial and a technical risk factor, an environmental, a health and a safety issues and a project plan included estimation of resources and timing. Of course, need for the information depends on the nature and the type of the idea e.g. a nature of opportunity (new market, new technology), need of resources, organizational requirements or a business culture.

4.2 The customer centered approach

It is important to define who really the company's customers are and who it should be. Apilo et al. (2007, 134-136, 140-141) notice that the company's present customers are not necessarily the desired customers. Understanding of customer needs is essential to succeed in producing innovations. To understand customer needs the organization needs to understand customers business first.

In consumer markets it is essential to know what the actual problem is and how a product or a service is going to solve it. The company gathers a lot of information about customer needs from selling, service and spare part and other units, which are dealing with the customer. By using all the available knowledge from different organizational levels, the company collects broad review of the customer needs. Often the customer cannot describe in words what he or she really need but the customer can describe what the problem is. Solutions for customers undefined needs could be explore by using user- and usability studies.

The most important factor for clarifying customer needs is observation of the actual users of the product (Kelley (cited in Tidd et al. 2005, 242). Kelley states that asking what people think of something is not enough because the lack of vocabulary might give the wrong impression – "you need to put yourself to customers' shoes." Kelley describes a five important factor to success in learning from the user:

1. *Understand the market, client and technology.*
2. *Observe users and potential users in real life situations.*
3. *Visualize new concepts and the customers who might use them, using prototyping, models and simulations.*
4. *Evaluate and refine the prototypes in a series of quick iterations.*
5. *Implement the new concept for commercialization.*

Akao (cited in Tan, Tang and Forrester 2004, 804-806) proposes a well-know tool to reveal customers' needs. *A Quality Function Deployment* (QFD) was developed in 1960's at Japan. It links marketing and technical functions to reflect customers' needs and to concern quality. The QFD ensures and guides the correct development of the product by linking the "voice of customer" in practice. Tidd et al. (2005, 246-249) claims that the QFD, also know as "the house of quality", helped Toyota to reduce development times and costs by 40 percent. The QFD provides communication between engineering, production, development and marketing. It is useful technique to identify and transform customer needs and requirements. Illustration of the QFD matrix is presented in figure nine.

QFD matrix contains the following steps according Tidd et al. (2005, 246):

1. *Identify customer requirements, primary and secondary, and any major dislikes.*
2. *Rank requirements according to importance*
3. *Translate requirements into measurable characteristics*
4. *Establish the relationship between the customer requirements and technical product characteriscs, and estimate the strength of the relationship.*
5. *Choose appropriate units of measurement and determine target values based on customer requirements and competitor benchmarks*

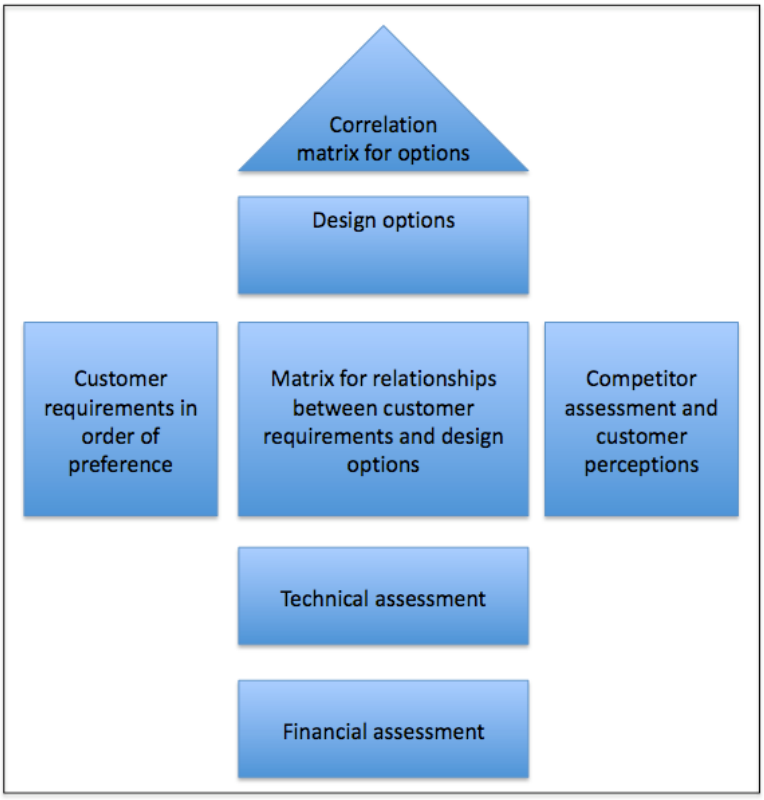

Figure 9. The quality Function Deployment (QFD) matrix (Tidd et al. 2005, 248).

Customer's involvement to the developing process is consequential. Apilo et al. (2007, 142, 147) claims collaboration with customers are behind many success products. A key position in successful relationship with the customer is to ask right questions. To find out what customers really need they could ask to describe the problem. Von Hippel (1988, 106-108) proposes the lead user -method to connect customers in the product development. Von Hippel explains that ordinary users are often out of date at the developing phase. Lead users have real and essential needs for develop novel products. The biggest problem exploitation of the lead user -method is to recognize lead users from ordinary users.

Von Hippel (1988, 107) accentuate the typical features of lead users:

1) *"Lead users face needs that will be general in a marketplace, but they face them months or years before the bulk of that marketplace encounters them."*
2) *"Lead users are positioned to benefit significantly by obtaining a solution to those needs."*

Lead users can forecast the customer needs months or years in advance according Von Hippel (1988, 107). Using lead users in the new product development process, the company can correspond

to customers needs before ordinary users even notice that they need a new product. The lead user method provides a valuable information and design data to the company. Von Hippel (2005, 21-22) argues that the cited studies have undervalued user's role in the development process. Cited studies claim that most user-developed products have only a minor significance. Von Hippel defends user-innovators by saying: "minor innovations are cumulatively responsible for much or most technical progress." Although the most of the user-developed enhancements are minor but obviously, users are not restricted to develop only a minor or an incremental innovation. Lead users should courage to innovate and develop innovations that are more radical. Lead users are at "the leading edge of an important market trend(s)" and they benefit from the new solutions, which respond to their needs.

4.3 Tools and methods for managing the front end of the innovation

A roadmapping, a customer and a technology trend analysis and forecasting, a competitive intelligence analysis, a market research and a scenario planning are typical tools and methods to the identify opportunities according Koen et al. (2002, 16). The roadmapping is about capturing forces of the business in graphical form to enhance communication and insight. The roadmapping is done because of a mapping process neither than because of a documents. The mapping process offers invaluable way to share knowledge, capabilities and skills of a project team. People who are not part of the project team can be involved easily to an ideation or a development process by using the roadmapping tool.

The alternative possibilities for the future are considered by using the roadmapping (Apilo et al. 2007, 71). In addition, future risks and direction for the company's future can be controlled. A t*echnological roadmap* is more about creating the future strategies for the company than predicting a single technology. Help of the roadmap can direct the company's strategy towards a potential technology. It can be used to compare causes of different technological choices. A different roadmap can be done to products. By using *a product roadmap*, the company can evaluate importance of a certain technology or a development project to achieve a particular product, a process or a service concept. The product roadmap covers typically next five to ten years.

Koen et al. (2002, 16-19) describes that the competitive intelligence analysis examine the strategic knowledge of competitor's position, size, efforts and trends. This can be done as a structured process by collecting, analyzing and communicating with the relevant available information outside the

company. Identifying of competitors helps to decide what kind of products are needed to gain the competitive advantage. Internally the company can analyze how a single opportunity fits to the company's strategy and to markets by weakening gaps and threats. Market segments can be analyzed more detail level by looking for possible market size, growth rate and market share. Major customer needs have to take into account in every analysis. A full time multifunctional team is required to gain effective results from the opportunity analysis. Typically the team consist three to five marketing and R&D persons. To minimize risks and to support decisions analyzing should be done as detailed as possible. In many cases, analyzing opportunities generate more entirely new opportunities and concepts that were not discovered at the beginning of the project.

Apilo et al. (2007, 140-141) emphasize that the technique for the idea generation is different depending on the situation. Number of ideas is much more important than the way of generating ideas. Most of the techniques based on creating as many ideas as possible so radical ideas can be released as soon as possible. Due the continuous rush companies utilize different idea generation methods shiftlessly. A simple brainstorming session is commonly used method. The idea generation should be considered as a learning process to the organization. Users should know the idea generating process well so they could focus entirely to the activity. An outside or internal consult can be used to make the idea generation method working more effective. A simplified improvement is to change the way of giving feedback by forbidding negative feedback and criticism in the traditional brainstorming session. Another good way is to give a couple of positive comment or feedback instead of the total knockout. After the positive feedback, possible critic can form as a development of ideas.

Gordon, Tarafdar, Cook, Maksimoski and Rogowitz (2008, 50-52) outline that the information technology (IT) could help to increase the innovativeness in the front-end phase. IT tools can be used for example to improve the competitive intelligence by data collection, knowledge management, project scoping, prototyping, managing project, managing portfolio and computer aided design (CAD) for modelling and visualizing. A creativity and brainstorming is needed at the ideation phase to find "The spark of the innovation." IT can be an effective support to the process by helping communication, collaboration and intelligence gathering.

According Gordon et al. (2008, 51-53) innovators create their own IT tools at many companies. They propose that innovators should take more advantage of IT products and systems to improve effectively the FEI. The organization should eliminate the barrier between a creative people and a IT staff to seek opportunities and suitable tools to support creativeness and ideation. Nowadays the

most frequently used collaboration method is an email although there is more developed technologies available. Potential and easily implemented tools are e.g. instant messaging, electronic bulletin boards, teleconferencing, portals, blogs and wikis. In an international company the use of electronic bulleting board can solve problems within a couple of hours from posting a problem. Responses can be received from different business units from different continents. Another practical experience is IBM's online brainstorming session called the "Innovation jam." In 2006 IBM gathered over 46 000 ideas from 150 000 employees in 104 countries under 72 hours.

Organizations may use IT tools for a while for the idea generation but the problem is the commitment of the organization to use tools continuously according Gordon et al. (2008, 55-56). The most of IT tools require frequent use to get benefit out of the tool. Employees should be encouraged, assisted and educated to use tools. IT tools should be developed to be more intuitive and easier to use and learn. In most cases tools are developed by a third party. Thus, the further development of the tool is not possible by the organization itself. One solution could be training a "ideation facilitators" to help and support groups or organizations to generate new ideas. When the group or the organization needs an ideation session the facilitator helps to customize a framework for the session to meet the group or the organizational needs. By utilizing the "ideation facilitator" usage of different tools or methods is not a problem. "Innovation sessions" is proposed to stimulate unlike minds to find a potential application for new ideas or technologies (Buggie 2002, 14).

While the IT can help the ideation, modelling, analyzing and gathering ideas the challenge is to store potential ideas which are not useful at the present time (Gordon et al. 2008, 54). Brem and Voigt (2008, 14) and Apilo et al. (2007, 146) defines that rejected ideas are moved to the pool or the store because of the unsuitability to the current innovation strategy, lack of technology, a production or development costs, incorrect definition of customer needs or a need for redesign or redefinition. Thus, the rejected idea can be valuable later on when integrated it to another idea or after a technological development. The idea bank or the idea store could work as a tool for controlling idea database. A constructive feedback from rejected ideas is essential to involve an employee to maintain further ideation. A further development of idea is also easier for other people because of a well-constructed and documented feedback. Boeddrich (2004, 278-279) argues that the value of idea increase every time it is put back into consideration. This kind of "idea loop" could work through the idea pool or the idea store. A full potential of the creative ideas is utilized in the company only by a working idea loop. A lessons learned information is valuable to avoid repeating of same mistakes. Koen et al. (2002, 20) recommends putting the idea bank to the web or to the company's

intranet to allow employees to watch and follow new ideas easily. The web based idea bank allows access for the company's interest group and at the same time linking them to the development process.

The recent study (Brem and Voigt 2008, 11) has shown a method of bringing an internal and an external experts to so-called "stakeholder workshops." The workshop base on mixing diverse experts from a different fields such as technology, market, regulation, economy, security, R&D, distributors, planning or field service. The workshop is open for external parties from "friendly" organizations and companies. The purpose of the workshop is to ideate, identify and discuss about trends and ideas. Although, may create detailed product or process ideas for a further development.

Brem and Voigt (2008, 11) describes that results from the stakeholder workshop are transferred to a "scenario group." The scenario group consists of different internal and external experts if needed. The aim is to generate scenarios base on trends and ideas recognized at the stakeholder workshops. Scenarios are done for the next five to ten years. An explorative scenario base on the current status quo and by contrast an accrued scenario start from the future. The aim on the latter analysis is to develop scenarios how to get there. Figures ten and eleven illustrates these two scenario-planning concepts. Current products and services are discussed, evaluated and how new scenarios will affect on them. New products and services for the future can be generated. After the stakeholder workshop and the scenario group results are transferred to the innovation process. All the information need to be recorded and documented appropriately for further discussions and presentations. The scenario planning provides disciplined tool for prevent false decisions according Koen et al. (2002, 16). Thus, the challenge for using the scenario analysis is to create an alternative views of the future.

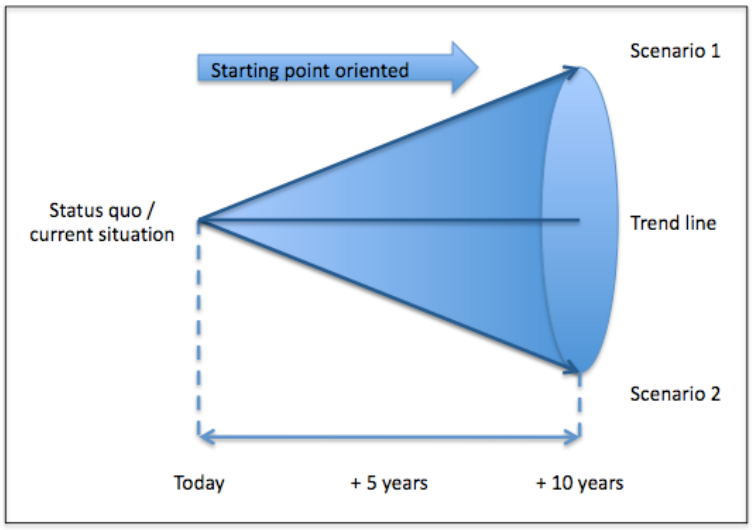

Figure 10. The explorative scenario planning concept (Gausemeier et al. cited in Brem and Voigt 2008, 12).

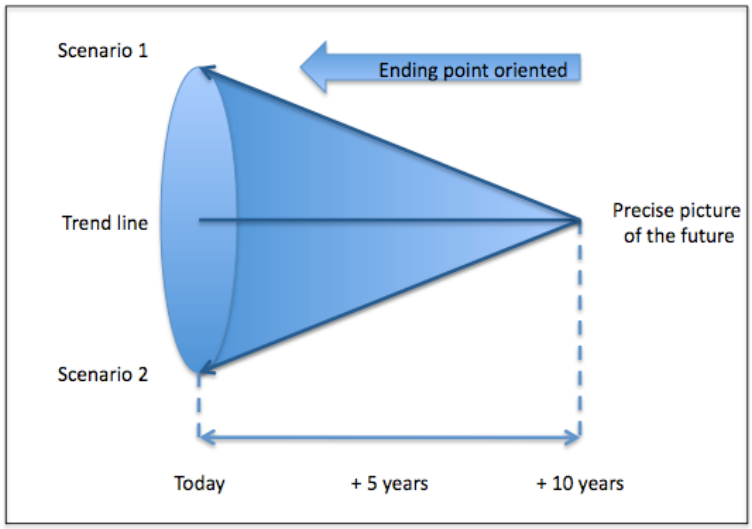

Figure 11. The accrued scenario planning concept (Gausemeier et al. cited in Brem and Voigt 2008, 13).

5. CONCLUSIONS

The thesis ensures the importance of the innovation facing the challenge of the construction industry. Construction companies need to change to survive at the continuously changing markets. To take a full advantage of the innovation companies cannot fear of the change. The top management needs to be courage enough to implement big changes in the organization. Innovations are important to change and without change, the future of the company is sealed. The functional innovation process is needed with the full support of the top management to increase the innovativeness.

This thesis is basis for further research of the subject. The literature review highlighted an importance of to the subject. According the literature review, the phases of the front-end are defined on a theoretical level. Thus, the process should be evaluated to respond the practical needs of the company. In this context important is to concentrate on the context of the construction industry.

5.1 Results from the thesis

This thesis was made as a literature review. The answers to the research questions were found though further research is needed to get a full advantage of the innovation process. The objectives of the thesis focus on following factors:

- Describe and define the concept of innovation according the literature review.
- Describe the phases of the front-end of the innovation process.
- How construction companies could foster and increase the innovativeness.
- What kind of tools and methods is needed to control and get benefit of the front-end phase?

The study emphasizes the importance of the innovation process to succeed in competing. The productivity is the common problem in the field of the construction. To maintain the competitive advantage in the globalized world Finland has to increase the productivity. The typical means to increase the productivity is to make cheaper than others or make at same price but better than others. These ways are not possible or difficult to reach in future. Finland's only choice to maintain the competitive advantage is to make something that anyone cannot or does not do. Managing innovations is essential to increase the productivity in the construction industry. The innovation process

needs to be considered as one of the key process of companies. The innovation strategy made by the top management is essential to direct innovations. The innovation strategy should base on the corporate strategy. This ensures the commitment of the top management and enables ideas passing through without any doubts.

The literature review showed that the amount of the information of the subject is huge. The thesis was limited to concentrate only the front-end phase of the innovation process. Phases of the front-end were different depending on the sources. Main factors were founded and recognized from many different sources but usage of the terms were variable. Main phases of the front-end of the innovation process were the opportunity identification, the idea generation, the idea development and the idea evaluation. To stand out from the less innovative companies managing early phases of the innovation process is important.

The tools for managing the innovation process are variable. The usage of methods needs to be connected to the company's culture and the existing business activities. Innovations are divided to the incremental (continuous) and the radical (discontinuous) innovations. The novelty of the market and the technology determine the type of the innovation. The typical characteristic features of the construction industry need to be considered before implementing the innovation process to the company. The change in the existing business activity is needed. By committing employees to the development and ideation processes, the change resistant can be controlled.

Managing innovations should base on needs of the customer. The customer is the most important element of the business. Thus important is to evaluate the present customer and define who the customer should be for the company. To face the challenge and to utilize the modern innovation process companies need to find ideas outside from the traditional company and the industry boundaries. By adopting the principles of the open innovation, companies could foster the innovativeness and benefit from the ideas outside the company's boundaries. The most important aspect of the open innovation paradigm is to develop and ideate openly with the others. In addition, the main point is to generate and modify ideas to a functional business concept internally.

5.2 Suggestions for further research

According the experiences and the knowledge base on the thesis further research is needed before implementing the front-end of the innovation process to the organization. The further research could be done as a action research by developing the existing innovation process as well as tools and methods for managing the front-end phase. Management tools and methods should be evaluated and applied to respond needs of the organization. The suitability of the theoretical front-end of the innovation process should be judged in a context of the construction industry. Phases should be considered to match to the existing business activity and the culture. The process should be simplified and the specific tools for certain phase of the process should be selected and implemented.

Important is to create an innovative atmosphere and a culture to the company to support an ideation. Firstly, important is to convince the top management of the benefit of innovations. The innovation process is worth of implementing only if the top management is convinced. After that, converting the theoretical innovation process is essential to match the company's specific needs. The company's commitment to the innovation process could be ensured by the innovation strategy made by the top management. The top management full support is the basis of the success.

The further development is needed for evaluating and development of the tools for ideation and to gather ideas from the field. For example, the idea bank or the idea store needs further development. An idea portfolio could work as an idea bank or an idea store. The idea portfolio could be used to evaluate and to store ideas. If doing so, all ideas need to flow throw the idea portfolio. Anyway, the store or the bank is essential in the process to handle all ideas but it needs a lot of further development.

Before evaluating the presented and further developed methods, the company's present state should be examined. By the experience of the present state analysis, new methods and tools could be developed in the direction of the company's needs. After the further development of tools, it is important to try them out before implementing it to the process. The importance of the opportunity analysis and the idea generation should be recognized. The company's employees need to motivate to questioning the current activities. To increase a creativity essential is to allow use working hours to innovate freely. Routines and continual rush demolish the creativity.

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