

Academy-Industry Cooperation: Case Solar Decathlon Competition

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ABSTRACT

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The aim of this study is to explore the academy-industry cooperation in the Solar Decathlon competition project in Finland. Interviews with academics and the companies' representatives answered to four main questions research established; namely the reasons for the both parties to cooperate, the factors that impede and facilitate the collaboration, and the use of the project's results in the future. The findings show that the academy and the industry have different reasons for the cooperation, i.e. the academy is interested in the science development in the research and teaching, while the industry pursues the economic objectives through the publicity and products development. Although they have different aims in cooperation, they have areas of mutual interest and complement each other. This cooperation project has been successful and had no major problems. However, the main challenge arose in the project organization and management due to the large extension of it. Thus, it is important for the parties to evaluate better potential partners in the preplanning stage and to find the strategic fit. In addition to that, the cooperation can be facilitated with the common goal or a social mission that motivates all participants to work harder. Furthermore, good interpersonal relations, high levels of commitment and trust, efficient communication and mutual understanding encourage collaboration. Previous relationships have a positive impact on the future establishment of the cooperation. In general, the academy-industry cooperation can be fostered by providing the industry with interesting cases and practical knowledge. The academy wants to have a greater understanding of the companies' needs. The results of the current cooperation will be used in the development of new collaborative projects between the universities and the companies. The industry will utilize the knowledge generated in this project for production and marketing. The academy will use the results of this project in the development of the multi-scientific teaching and cooperation inside of the Aalto University. This project has also promoted the cooperation among companies and has a deeper meaning for the society's innovation system in whole.

Keywords: academy-industry collaboration, inter-organizational interaction, cooperation, dyadic relationships

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1 INTRODUCTION

This chapter introduces the subject of the academy-industry cooperation and the Solar Decathlon competition project. The research problem and objective are then presented. Following is the restrictions of the study and the definitions of the key terms and concepts are outlined. Finally, the structure of the thesis is presented.

1.1 Background Information

The academy-industry cooperation is a growing trend, which is found to be beneficial for both parties involved in the cooperation process (Gomes, et al., 2005; Miotti & Sachwald, 2003; Sáez, et al., 2002). In the context of current competitive landscape characterized by globalization, resource pressure, rapid technological change, shorter product life-cycles, evolving customer needs and the continual entrance of new players, the industry and the academy are fostered to cooperate and explore new opportunities (Hagen, 2002; Dooley & Kirk, 2007; Santoro & Gopalakrishnan, 2001). In order to remain competitive, the organizations should invest into inter-organizational initiatives, which are “powerful because they enable organizations to share risks, build on jointly shared capabilities, and create synergies for better competitiveness” (Santoro & Gopalakrishnan, 2001, p.163).

Gomes, et al. (2005) argue that increasing the number of collaboration projects between the academy and the industry make an assumption of their economical profitability for both parties. It is generally accepted that through cooperation the companies obtain skilled personnel, innovative ideas and new knowledge for the development of goods and processes. Simultaneously universities gain an access to financing, research objects, traineeships and other recruitment possibilities for the graduates. The collaboration is seen as a means of economizing on scarce resources, and solving complex social and economic problems (Austin, 2000). Some research findings indicate that it has an important positive impact on economic performance (Carayol, 2002). For instance, Drejer and Jorgensen (2004) state that “15% of products developed in the period 1986-1994 could not have been developed in the absence of recent academic research.” In other words, establishing external contacts with the academy, and therefore an access to the knowledge generated inside of the universities is an important source for technological development and innovation, and it will remain

attractive in the future (Gomes, et al., 2005; López-Fernández, et al., 2008). Therefore, this leads to the increased role of the universities in our societies, and is still expected to increase in the future (Caloghirou et al., 2001, p.160).

Beginning from the 1980's the academy-industry cooperation has gained "serious policy attention" (Lee, 2000). In many cases the partnerships between the academy and the industry are enforced and supported by the governments (Tretyak & Popov, 2009; Baba, 2006; Henderson, et al., 2006). The governments are supporting the university-company cooperation through subsidies, policies and establishing intermediate institutions that facilitate knowledge transfer from the universities to the firms (Hagen, 2002; Drejer & Jørgensen, 2004; Zhou, 2008). Zhou (2008, p.120) states that in China the government plays a supporting role in the university-company cooperation directly through "policies and funds; indirectly through building science and technology development zone, technology market, platform for information service and network for large instrument use". The academy-industry cooperation "has recently emerged as one of the priorities in the recent trends in the European innovation policy and also in the OECD countries, through relationships of this type have long been considered crucial to the development of the innovation system in any country" (Sáez et al., 2002, p. 321). The governments are actively supporting the university-industry interaction through national research programs in order to improve the innovation efficiency and enhance wealth creation (Caloghirou et al., 2001, p.154; Barnes, 2002). For instance, in Finland the collaboration between universities and companies has been a desirable goal since the early 2000s (Gomes, et al., 2005).

Although, the academy-industry collaboration is supported by the governments and has a positive impact on the economic performance, the review of literature reveals many other benefits as well as problems associated with the cooperation. Among them the research papers by Gomes, et al. (2005) investigate the reasons for collaboration and the barriers to cooperation between universities and companies. The results show that universities and companies both benefit from collaboration. For example the companies are informational and financial sources for the academic researches; meanwhile companies gain new knowledge and competitiveness through learning and development. Main problems in cooperation arise due to the differences in cultures and basic purposes of the universities and the companies (Dooley & Kirk, 2007; Gomes, et al., 2005; Senker & Senker, 1995; Jacob, et al., 2000; Keithley and Redman, 1997; Drejer & Jørgensen, 2004). There are a number of factors that encourage the firms to cooperate with universities in R&D projects, for example spillovers, R&D intensity, firm size, belonging to a corporate group, the nature of innovation

protection and legal strategy, risk sharing and operating costs (López-Fernández, et al., 2008). This study is taking similar focus as presented in the research papers by Gomes, et al. (2005) and López-Fernández, et al. (2008), i.e. the research is going to examine reasons, challenges and factors that encourage the collaboration between the universities and the companies.

There is a large amount of researches in addition to the previously discussed studies on the reasons, barriers and factors that encourage collaboration. For instance, Levy, et al. (2009) argue that many researches explain the “propensity of particular firms to collaborate with universities” (see e.g. Fontana et al., 2006), the reasons for companies or universities to cooperate (see e.g. Caloghirou et al., 2001; Lee, 2000; Miotti & Sachwald, 2003; Sáez et al., 2002), or the barriers and facilitators in collaboration (see e.g. Hall et al., 2001; Hadjimanolis, 2006; Barnes et al., 2002; Gomes, et al., 2005). Thus, every particular aspect of the academy-industry collaboration has been studied thoroughly. For instance, Carayol (2002) place previous studies on the university-company cooperation in five broad categories, which are the studies on the forms and intensity of interaction, on collaboration agreements, academics’ aims for collaborating, the negative consequences of the collaborations on the academics behavior, and firm’s aims for collaborating. Therefore, there are many researches concentrating on one or another single part of the academy-industry cooperation, but there are little researches that examine several aspects of collaboration in one research. Moreover, there are little researches on dyadic academy-industry relationships, i.e. examining the academy and the industry at the same time. Unlike other previous studies, where research is limited to considering just one part, this study analyses the academy-industry cooperation from the view of both partners, which are the companies and the universities. Although there are many accomplished studies on the academy-industry cooperation, there is a lack of qualitative studies on dyadic academy-industry relationships. Thus, there is still a great need for better understanding of the long-term dynamics of the university-company relationships. Therefore, this research is taking slightly different perspective from previous researches in that it studies qualitatively dyadic exchange relationships, i.e. both parties namely the companies and the universities in collaboration project at the same time.

According to Möller (1992, p.4) inter-organizational exchange forms can be classified into four different types, which are market transactions, short-term dyadic relationships, long-term relationships, and networks of relationships. The focus of this research is on long-term relationships, where actors have joint expectations, develop and make adaptations in the relationship. Other forms of relationships are not considered in this study since they have different

time perspective and unit of analysis. For example, market transaction is a buyer-seller relation under market conditions, while short-term dyadic relationships are an extension of market transactions to more complex interaction, and the network relationships focus on reciprocal interactions between multiple organizations.

There is a multitude of research approaches to study inter-organizational relationships. Möller (1992, pp. 9- 17) argue that there are four major research approaches to explain inter-organizational exchange relationships, which are transaction cost economics or approach, interaction research, political-economy approach, and networks approach. The first approach determines and prescribes efficient governance structures, but it cannot explain the development of relationships, and control mechanisms like authority and trust. For instance, López-Fernández, et al. (2008) use the transaction cost economics approach and the industrial organization approach, but, for example as they state the transaction cost economics approach is limited to operational costs and risks. The political-economy approach integrates economic and behavioral research traditions, and explains member behavior and the forms of dyadic channel relations. It provides good conceptual understanding, but is weak in explanation and prescription. The network approach study multi-organizational structures and exchange relationships between multiple organizations, which is not the aim of this study.

Thus, this study takes the interaction approach, which relies on the inter-organizational resource dependency theory, social exchange theory, and social behavior of small groups. Its goal is to understand and explain dyadic behavior processes, i.e. understand and explain the developing, maintaining and terminating inter-organizational exchange relationships assuming resource interdependence and reciprocate relations (Möller, 1992; Antola, 2009, pp. 36- 38). There are two groups of interaction studies. The first is formed by the Industrial Marketing and Purchasing Group centered work (see, e.g., Håkansson & Snehota, 1995; Håkansson, 1987; Antola, 2009; Svahn, 2004), which rely on the resource interdependency and focus on managerial issues such as realized relationship strategies, resource deployment, organizational forms, and communication. They try to understand long-term bonding, forms of adaptation, and the development of trust and mutuality. The second group is based on the social exchange theory, and explains the development of inter-organizational relationships and their dynamics.

1.2 Case Organizations and Solar Decathlon Competition

Solar Decathlon is a competition project on energy efficient construction and architecture, where twenty high school teams from different European countries plan and implement self-sufficient, solar energy consuming a living house. The objective of the Solar Decathlon competition is to create a harmonic and functional living environment. The Finnish team build zero-energy consuming wooden house, which produce and consume the same amount of energy in the annual rate. The team consists of the students from the Aalto University, i.e. Helsinki University of Technology, Helsinki School of Economics, and University of Art and Design. The competition aims to build energy efficient houses by student teams with the help of the business sector. The idea behind this project is to use best Finnish products and competencies provided by companies like StoraEnso, Isku, Naps Systems, Oras and Ensto. These companies participate in the Solar Decathlon competition project by providing technology, materials, products, knowledge and finance. (Solar Decathlon website 11.11.2009)

The students from the Aalto University developed the concept and designed the energy efficient Luukku house. The members of the board consisting of the academics and the companies' representatives were appointed to manage the project and discuss the project matters. The board members hold meetings and make decisions regarding the project, e.g. allocating the budget and resources, planning, monitoring and managing the project's schedule. In this project several people are appointed from the academy that are in charge of particular tasks, and stay in contact with the key people from the companies they cooperate with. It is the same with the companies, i.e. the companies are assigned a key person or a key group, e.g. project manager, product developers, who take part in this project and stay in touch with university's representatives. The participating companies in this project were selected by members of the board based on their competence in one field or another. Besides the finance, products and materials, the companies also provide their knowledge and competence that made possible to build energy efficient Luukku house. Therefore, the academy is benefiting from this project by using financing, materials, products and knowledge provided by companies. In addition the academics organize seminars and courses to educate the students based on this real case. Thus, the academy-industry cooperation is studied in this research based on above mentioned case organizations.

1.3 Research Problem and Objective

The purpose of this research is to study the cooperation practices between the Aalto University and several Finnish companies building the energy efficient house and participating in the Solar Decathlon Europe 2010 competition. The aim of the study is twofold, i.e. the research aims to understand the view of key actors (namely the academics and the companies' representatives) on cross-professional collaboration. The question is, why universities and companies enter into collaborative relationships, what challenges they face, and what are the conditions to successful collaboration? In addition to that the research is studying how the cooperation project and knowledge generated in it will be used by the companies and the academy in the future. Thus, this research aims to investigate particular university-company cooperative dyadic relationships in the context of the Solar Decathlon competition.

The research problem is presented in the following questions:

Question 1: What are the reasons for the academy and the industry to collaborate? (e.g. aims, objectives, goals, reasons, advantages, benefits)

Question 2: What are the challenges in the academy-industry cooperation? (e.g. possible risks, barriers, costs, conflicts)

Question 3: What are the factors that facilitate the collaboration between the universities and the companies? (i.e. potential actions)

The sub-question of this research is:

Question 4: How will the output/ results of current collaborative project be used by the universities and the companies in the future? (i.e. future impact)

The information identified in the literature regarding the reasons, problems, influences and the use of the output of the university-company cooperation will be used as a theoretical framework for current research. However, the study makes no presumptions and aims to explore, rather than to test previous theories. For this reason the qualitative research was considered most appropriate in order to gather rich empirical data on the academy-industry cooperation. Therefore, the face-to-face interviews with open-ended questions are the main data source in this research.

Austin (2000) states that it is important to understand the nature of collaboration, the potential challenges, and the points to leverage in order to develop and improve the academy-industry cooperation that both of them can achieve their goals and contribute to society. This study will provide general information on the university-company cooperation in wood construction and technology sectors, which can be used for improving existing and developing new academy-industry partnerships. Thus, the empirical findings of this research can be used in order to identify gaps and opportunities, to design efficient relationships, to achieve the potential benefits and advise possible directions for developing collaboration practices. Although the research focuses on case organizations located in Finland and operating in technology and wood construction sectors, the results will be useful for the organizations located in other countries and operating in different industries. The information collected from the study will also make its contribution to current theories and can be used as a ground for the future research.

1.4 Restrictions of the study

The study is restricted to the case organizations located in Finland and operating in education, technology and wood sectors. Case organizations are the Aalto University and the companies such as StoraEnso, Naps Systems and Ensto. There are many other companies participating in the Solar Decathlon project, but this research aims to study the three main relationships in order to study them deeply and qualitatively.

1.5 Definitions of key terms and concepts

The key terms in the study are cooperation, collaboration, partnership, which are used in this research as a synonym. There are many cooperation related concepts such as collaboration, partnership and alliance that more or less have same meaning. The collaboration in this research is defined as “some sort of cooperative activity beyond the simple transaction, undertaken by two or more parties with planned positive outcomes for the participants” (Pender, 2006?, p.1). Bignoux (2006, p. 615) defines the short-term dyadic strategic alliances as “the pooling of separate functions, activities or business units, which are directed at a specific objective...are often of a temporary nature and do not affect the primary mission and the ownership and control of the participating

firms. ...planned short-term dyadic strategic alliances are alliances formed for a pre-determined period of time for the purpose of achieving a specific objective or goal”.

1.6 Structure of the thesis

The study is organized into five chapters. Chapter 1 is the introduction, and includes the background information, description of the case organizations and the Solar Decathlon competition project, research problem and objective, restrictions of the study, definitions of the key terms and concepts, and the structure of the thesis.

Chapter 2 comprises the literature review. It begins with discussions on the inter-organizational interaction presented in the literature. After that it continues with the relevant research on the academy-industry collaboration. Then the aims of cooperation for the universities and the companies identified in the literature are discussed. The next sections are presented as the challenges and the factors that encourage the university-company collaboration. Then, the opportunities for using the output of the cooperation project in the future are outlined. Lastly, based on these discussions the theoretical framework for this master’s thesis is built.

Chapter 3 discusses the methodology of the research, i.e. in the beginning the qualitative research approach is justified, the selection process is reviewed, the data collection and analysis are outlined, validity and reliability issues are discussed, and at the end the case organizations are presented.

Chapter 4 presents the analysis and interpretation of the data. It consists of four subchapters, which are the aims of cooperation for the academics and the companies, the challenges of cooperation for both parties, the facilitating factors in the academy-industry collaboration, and the use of the results of the collaborative project in the future.

Chapter 5 presents the summary and empirical conclusions of the study. Then, it discusses the managerial and theoretical implications of the study. After that the limitations of the study are reviewed, and the future research avenues are suggested.

2 LITERATURE REVIEW

This chapter discusses the inter-organizational interaction identified in the literature. After that it continues with the research on the academy-industry collaboration. Then, the aims for the universities and the companies to cooperate are outlined. Next, the challenges in collaboration and the factors that encourage the university-company cooperation are presented. Thereafter, the dealing with the output of the academy-industry cooperation in the future is presented. Lastly, based on these discussions the theoretical framework for this Master's thesis is built.

2.1 Inter-organizational Interaction

Although the academy-industry cooperation is a relatively new field, the inter-organizational relationships have been studied a long time before, e.g. the research on this relationships began in the 1960s (Mainela, 1998, p.4). The research shows that there are clear benefits for the organizations to collaborate. For instance, Mainela (1998, p.4) states that companies are cooperating with each other in order to learn, to gain economies of scale and exploit new opportunities. Thus, cooperating organizations have benefits and a strong mutual interest (Miotti & Sachwald, 2003; Pender, 2006?). For instance, “by pooling their resources and capabilities with other companies, firms expect to have the ability to initiate projects that they could not have successfully done alone” (Bignoux, 2006, p. 616). The organizations are forced to engage into cooperative relationships due to limited capacities of resources and activities needed to achieve their goals (Gebrekidan & Awuah, 2002, p. 679). For example, Fang, et al. (2008, p.981) argue that “resource complementarity is one of the factors behind the formation of alliances”. Thus, engaging into cooperation is an opportunity to acquire partner capabilities, gain an access to external knowledge, enhance own strategy and operations, and leverage organization's strengths with the help of the partner (Pender, 2006?; Nordin, 2006). In other words, the organizations “complement each other's weaknesses” by pooling their skills and resources in order to achieve benefits, which they cannot achieve separately (Bignoux, 2006, p. 616). One of the most important conditions for the cooperation is that “the partner should possess the resources which the firm is seeking” (Miotti & Sachwald, 2003).

There are many other reasons for starting the cooperation. For instance, Tretyak and Popov (2009) state that in addition to pooling of resources and gaining an access to partners' competencies engaging into relationship allows partners to lower costs, specialize, achieve scale effects and therefore to gain sustained competitive advantage. The partners also cooperate in order to spread the risk of capital investment and innovation (Pender, 2006?, p.2). Miotti and Sachwald (2003) argue that "expensive, risky or complex research projects will seek R&D co-operation". Therefore, the partners can also spread costs and risks, and "leverage their core capabilities by complementing each other in many ways" (Gebrekidan & Awuah, 2002, p. 680).

Håkansson (1987, p. 10-11) states that "relationships are one of the most valuable resources that a company possesses. They have been built up over a long period of time and a lot of manpower, travel expenses and other resources have been invested. In other words they are large and important investments that have to be taken care of and maintained in different ways". Companies are making these investments in order to make additional profits, generate innovation, exchange information, gain reputation benefits, an access to market and thereby to sustain a competitive advantage (Tretyak & Popov, 2009; Pender, 2006?; Gebrekidan & Awuah, 2002). For example, companies are cooperating in order to increase productivity or technical efficiency through adaptations such as in products, production and other processes that can reduce the total costs considerably, to obtain the information from other partners that have the knowledge, and to increase power "through friendship, and through technical and other bonds to counterparts which interlock the various companies" (Håkansson, 1987, p. 10-11). Håkansson and Snehota (1995, p.39) support the idea that "relationships offer the possibility of developing the competence, productivity and innovativeness of the company and are in this respect valuable assets."

Fang, et al. (2008, p. 978) state that innovation, adaptation, and interaction are crucial factors for the development of inter-organizational learning, which is facilitated with mutual trust and interdependence. The collaboration is essentially about learning and playing an important role in the process of knowledge creation and maintenance. Seppänen, et al. (2007) argues that cooperation "has become a critical source of knowledge-based competitiveness and a dynamic capability". This means that the partners transfer the knowledge from one organization to another in order to create new value together (Pender, 2006?). Since the "firms use R&D partnerships to access knowledge and build global R&D networks" (Miotti & Sachwald, 2003), the partners have to be certain that internally developed knowledge is protected from being copied (Tretyak & Popov, 2009). In addition to that, partners should learn how to collaborate, which strongly relates to relationship

performance (Pender, 2006?). Lai, et al. (2009) state that “relationship learning would promote the effectiveness and the efficiency of the relationship, and also ensure steps to enhance the relationship performance”. Thus, one of the main aims of cooperation is learning, where partners gain an experience and learn new skills that can be utilized in the future operations (Gebrekidan & Awuah, 2002, p. 680).

The successful partnerships are characterized by common norms, values and a shared vision of future benefits (Beugelsdijk, et al., 2009, p. 314). Pender (2006?, p.4) argue that managers should “establish a knowledge vision for the collaboration and empower those in their organization to achieve it”, and it is necessary to “treat the relationship as important, understand the interdependent nature of the relationship and what that recognition involves”. Fang, et al. (2008, p. 981) state that “parties should possess compatibility in goals, values and strategies, along with complementarity of resources. Compatibility means that partners should possess a certain level of similarity in areas like business goals, culture, and strategy patterns. An incompatible strategy may lead to conflicts that harm further development of the relationship. Compatible business culture is a key factor in the maintenance of a long-term partnership. Without compatible culture managers must spend more time handling the relationship. In other words, the higher the level of cultural compatibility, the easier the communication between organizations.” Thus, the development of partnership between organizations is facilitated, if organizations have a shared vision, high compatibility in goals, culture, and strategy patterns. Batt and Purchase (2004) argue that “cultural factors are known to influence communication and to shape the behavior of actors in cross-cultural business relationships and networks”. Beugelsdijk, et al. (2009, p. 312) state further that “differences in organizational culture are larger in less successful inter-firm relationships, but do not influence the perceived relationship success significantly”. Thus, the organizations should understand and take into account the differences between their cultures since it influences communication and behavior, and thus has an effect on relationship success.

On the topic of business relationships Antola (2009, p.49) states: “Interaction between individuals strengthens actor bonding, which in itself involves two central sub-processes, the construction of identity and the formation of trust and commitment. Activity coordination often implies efficient system linkages, in which shared information has an essential role. Resource adaptations imply a high degree of interdependence between partners: the more interdependent they are, the more willing they are to adjust and adapt in the relationship. This creates strong resource ties and leads to the relationship becoming strategically integrated.” Therefore, favorable identity, mutual trust,

commitment, information sharing and interdependence are prerequisite for the successful cooperation. The commitment as an intention to maintain a relationship, trust, cooperative information sharing and the quality of communication, perceived goal interdependence, and mutual understanding – all of these lead to “positive interaction behaviors and the creation of group identity, subsequently influencing inter-firm cooperation and perceived satisfaction in a positive way” (Beugelsdijk, et al., 2009, p. 313).

Håkansson and Snehota (1995, p.20) argue that business relationships are a social exchange over time, and there is a mutual interdependence of outcomes. The interdependence assumes that there is flexibility, mutual trust and confidence, adaptations, commitment, and mutual orientation in the relationship (Gebrekidan & Awuah, 2002, p. 691). The partners should have shared goals and mutual understanding of what they are intended to achieve, to understand many things about their partners, such as their capabilities and expected behavior of each party (Pender, 2006?; Tretyak & Popov, 2009; Beugelsdijk, et al., 2008; Lai, et al., 2009). These factors are very decisive for a long and stable relationship and the achievement of a common goal. Santoro and Gopalakrishnan (2001, p. 164) state that “two parties collaborate to pursue mutually compatible interests rather than to act opportunistically”. Thus, in business relationships two mutually oriented and reciprocally committed parties interact, build trust and adapt to achieve a common goal. Beugelsdijk, et al. (2008, p.313) argue that “perceived goal interdependence leads to positive interaction”. Gebrekidan and Awuah (2002, p. 691) support the idea that organizations especially culturally different should have strong mutual orientation, commitment (e.g., investment in physical resources, knowledge, and time), and adaptations that strengthen the bonds between partners. In other words, cooperating organizations should align economic goals and objectives, and also to develop mutual trust and commitment (Fang et al., 2008, p. 978). Pender (2006?, p.4) argue that partners should have clear roles and clarity in collaborative objectives that fosters initial trust between partners. The lack of understanding between partners, inability to evaluate carefully and goal incompatibility are reasons for the cooperation to fail (Vaaland & Håkansson, 2003; Gebrekidan & Awuah, 2002; Pender, 2006?).

Trust and commitment are critical elements for successful relationships, which have a positive or negative effect on each other (Batt & Purchase, 2004; Hadjikhani & Thilenius, 2009; Beugelsdijk, et al., 2008; Fang, et al., 2007; Claro, et al., 2003; Gebrekidan & Awuah, 2002; Santoro & Gopalakrishnan, 2001; Tretyak & Popov, 2009). Batt and Purchase (2004) define the trust as “the willingness to rely upon an exchange partner in whom one has confidence”. Seppänen, et al. (2007)

support this idea further that “trust exists when one party has confidence in the honesty, reliability and integrity of their partner”. It is also the “confidence that the partner has the skills, knowledge, and abilities to complete the required task” (Bignoux, 2006, p. 623). Hadjikhani and Thilenius (2009, p. 683) found that increased trust (i.e., “the willingness to rely on an exchange partner in whom another has confidence”) in the relationship leads to higher commitment (i.e., “the sacrifices made by partners to maintain a relationship”). Moreover, “the counterparts learn to trust through ongoing exchanges and these in turn provide the basis for the further strengthening of the relationship through enhanced commitment” (Hadjikhani & Thilenius, 2009, p. 683). Established trust mitigates an opportunistic behavior on behalf of the partners and facilitates the conflict management (Pender, 2006?; Nordin, 2006). Therefore, opportunistic behavior and violation of norms may destroy trust and dissolve relationship (Tretyak & Popov, 2009; Gebrekidan & Awuah, 2002; Vaaland & Håkansson, 2003). Thus, the greater trust between partners leads to more open communication, information sharing, lower monitoring and control costs as well as less social complexity (Pender, 2006?; Seppänen, et al., 2007). Moreover, the “willingness and ability to cooperate, commitment, and involvement are thus connected to economical win-win for both parties” (Vaaland & Håkansson, 2003, p. 132). Pender (2006?) argues that successfully repeated transactions between partners lead to increased inter-organizational trust. Thus, the trust as a result of long-term interaction and development can reduce transaction costs, limits risks, and it can be used as a substitute for the contract. In addition to that, Bignoux (2006, p. 616) state that the lack of mutual trust is one of the reasons of failure.

Håkansson and Snehota (1995) argue that every company connects different people, various activities and miscellaneous resources with varying degrees of mutual fit. Therefore, what is happening in one relationship affects others. In other words, the organizations are affected by others and are dependent on each other. According to Antola (2009, p. 23), there is “...the necessity for joint decision-making between organizations...organizations cannot act independently in the system, and continuous collaboration in making decisions is required.” Håkansson and Snehota (1995, p.387) state that “the joint action will produce a certain economic value that can be utilized and exploited by those involved.” In addition to that, different perceptions over decision making can cause conflict (Vaaland & Håkansson, 2003, p. 132). Therefore, joint decision making is crucial in any relationship.

According to Beugelsdijk, et al. (2008), the quality of the communication and “cooperative information sharing approaches increase the success of the relationship”. Batt and Purchase (2004)

argue that “communication serves as the process by which persuasive information is transmitted, participative decision making is fostered, programs are coordinated, power is exchanged, commitment and loyalty are encouraged... communication enables information to be exchanged that may reduce certain types of risk perceived by either one of the parties to the transaction... communication may also facilitate other elements of interaction, such as adaptations to the design or application of a product, or the modification of production, distribution, administrative systems”. The information flow should be open and visible in order to build trust, empathy and secure relationships (Pender, 2006?, p.8). Effective communication makes partners more “aware of expectations from the relationship” (Santoro & Gopalakrishnan, 2001, p. 165) and therefore it reduces uncertainty. Moreover, Beugelsdijk, et al. (2009, p. 318-319) argue that personal chemistry and empathy has a positive effect on commitment and information sharing. High level of information sharing is important for successful inter-organizational relationships (Fang, et al., 2008, p. 987), meanwhile the insufficient communication can be a source of the conflict (Nordin, 2006).

Inter-organizational conflict is defined as “the lack of harmony and agreement between the cooperating organizations” (Mora-Valentin, 2004). Gebrekidan and Awuah (2002, p. 681) define three attributes of failures of strategic alliances, which are “inability to carefully evaluate the effects of forming strategic alliances, or lack of good knowledge of a strategic partner and its objectives, or the fact that a partner may behave opportunistically”. For instance, before forming the partnership it is important to assess the value of partner knowledge and its accessibility, tacitness and ease of transfer, and negotiate for mutual value creation (Pender, 2006?, p.4). Vaaland and Håkansson (2003, p. 132) argue that “goal incompatibility, commitment, and involvement are three factors explaining sources to conflict”. In some cases, not all partners may be committed to invest resources, especially if they are short-term oriented (Gebrekidan & Awuah, 2002, p. 681). According to Man (2004, p. 150) in the relationship’s management “five difficulties occur: low speed of decision-making, complex knowledge management, changing power balance, unethical behavior and strain on social ties.” It seems that the relationship governance is being most vulnerable aspect in collaboration. Pender (2006?, p.3) state that parties should develop governance procedures and principles of coordination that improve the joint performance. Antola (2009, p.49) argues that the relationship governance relies upon various social aspects such as trust, continuity, norms, that form the context for a contract; but relying solely on trust is risky, since trust may vary and change over time, and therefore is complementary aspect in relationship governance.

Therefore, the inter-organizational interactions are characterized by mutual orientation, joint-decision making, compatibility of goals, interdependence, information sharing and learning. The trust, commitment and communication are central concepts in the inter-organizational interaction. There are several difficulties occurring in different stages of the relationship starting from pre-establishment until the relationship termination. These difficulties can be for example, lack of knowledge about available partner, lack of understanding between partners, and managerial issues. Similar to inter-organizational relationships the academy-industry cooperation implies constant interplay between partners, and thus the inter-organizational interaction theory can be applied to the university-company collaboration as well. Next section will review the literature on the academy-industry cooperation.

2.2 Academy- Industry Collaboration

This section introduces to the subject of the academy-industry cooperation emphasized in the current literature, and will proceed into discussion of university's and company's aims in cooperation. After that it reviews the factors that impede and facilitate the cooperation between the academy and the industry. Last section outlines how the academics and the companies can use the results of the cooperative project in the future.

The collaboration between the academy and the industry is a growing trend and is strategically important to the partners (Austin, 2000). The university and the industry have mutual interest in interaction (Baba, 2006; Austin, 2000). Similar to intercompany relationships the academy- industry cooperation arise around empirical problem or real case, where parties are working together to find a solution. For instance, the academic knowledge can be used to solve firm's problem, and on the other hand the firm's problem and knowledge can be used to test models and theories. Therefore, the academy and the industry have a natural strategic fit through the mutuality of interests, which is also essential to creating strong collaboration (Austin, 2000). Such joint problem solving makes possible to transfer the knowledge from the academy to the companies through mutual learning, where researchers are able to bring new perspectives, ideas and knowledge (Jacob, et al., 2000).

In cooperation both parties combine their resources to share costs and risks, to produce a cooperative research and to achieve an access to the competencies, resources, knowledge of the partner (Tretyak & Popov, 2009). It "involves the utilization of institutional facilities and

equipment, formal agreements and informal interactions between researchers to enhance communication and the deepening of trust between the partners”. (Dooley & Kirk, 2007) The knowledge and information flow are the prerequisite for the cooperation, where the universities and the companies are “high-intensive knowledge producers”. (Gomes, et al., 2005) Therefore, the cooperation between the universities and the companies is found to be beneficial and economically fruitful (Hagen, 2002; Dooley & Kirk, 2007; Gomes, et al., 2005) for both parties but very challenging and risky task (Keithley and Redman, 1997).

It is generally accepted that the universities collaborate to educate experts for the industry, and to raise external research funds, meanwhile the companies can learn and develop technology, products by using knowledge produced inside of the universities (Gomes, et al., 2005). The university-company cooperation is very diverse subject and can be in many forms as Carayol (2002) argues that “there is no univocal manner for science-industry collaboration”. It can be in the form of joint projects (Jacob, et al., 2000), cooperative research, training programs for company’s employees, consultancy (Dooley & Kirk, 2007; Gomes, et al., 2005), other programs directed on solving particular company’s issue (Zhou, 2008) and education of top talents and employees (Senker & Senker, 1995; Baba, 2006; Gomes, et al., 2005; Henderson, et al., 2006; Drejer & Jørgensen, 2004).

Although there are clear benefits for the university and the company from the interaction, their basic purposes are different, i.e. the academy is focusing on developing science, testing theories and assumptions, producing theories and models, which explain and predict reality, while the industry is looking for “useful artifacts” to be applied in reality (Henderson, et al., 2006; Gomes, et al., 2005). However, having these different basic purposes the academy and the industry support each other, e.g. the industry is “outsourcing verification activities to their partner university but allows the university to benefit since the enabling capability generates new knowledge that allows them verify their previous discovery work” (Dooley & Kirk, 2007). Therefore, the university-company cooperation is seen as a capability for innovation, product development and improvement in R&D (Gomes, et al., 2005; Carayol, 2002), knowledge creation, and “faster transition of discoveries from the lab bench to the marketplace” (Dooley & Kirk, 2007), and is a source for competitive advantage.

Therefore, the university-company cooperation has an important positive impact on economic performance and the performances of the collaborating organizations, the productivity of their innovations and knowledge creation (Carayol, 2002; Drejer & Jørgensen, 2004). However, despite

such positive side of cooperation there are also risks and concerns related to collaboration. For instance, “inopportune modifications of public research agendas toward more applied research or on knowledge disclosure restrictions they may generate” (Carayol, 2002). In addition to that, Austin (2000) states that the lack of information about the availability and suitability of partners makes cross-sector collaborations challenging. These and other issues are discussed in next sections.

2.2.1. The Aims of the Academy in Cooperation

As it has been already discussed the university and the industry both have benefits from collaboration (Hagen, 2002; Dooley & Kirk, 2007). There are many reasons for the academy to collaborate with the industry. According to Dooley and Kirk (2007) “universities are increasing their interaction with industry to play a greater role in the innovation system”, which is resulting in “increased knowledge creation and contribution to economic development”. Thus, the academics are taking a greater role in serving society, solving its problems and enhancing the economic development (Austin, 2000; Mets, 2009; Lee, 2000; Friedman & Silberman, 2003; Carayol, 2002). The basic purpose of the academy is science development and therefore the main aim in cooperation is knowledge creation, producing and testing theories and models (Jacob, et al., 2000; Henderson, et al., 2006; Dooley & Kirk, 2007).

Most commonly known benefit for the universities to engage into cooperation with the industry is an access to funding as an alternative source of income for teaching and research (Zhou, 2008; Gomes, et al., 2005; Henderson, et al., 2006; Carayol, 2002; Dooley & Kirk, 2007; Austin, 2000; Mets, 2009; Abramo, et al., 2009; Santoro & Gopalakrishnan, 2001; Friedman & Silberman, 2003; Stephan, 2001; Lee, 2000; Sáez, et al., 2002; Santoro & Chakrabarti, 2002). Dooley and Kirk (2007) argue that it “allows the managers of research centers to deepen their competencies and increase the capacity of research undertaken, and retaining research staff.” The student training and work opportunities are another generally accepted benefit in the university-company cooperation (Senker & Senker, 1995; Baba, 2006; Gomes, et al., 2005; Henderson, et al., 2006; Drejer & Jørgensen, 2004; Carayol, 2002; Austin, 2000; Mets, 2009; Santoro & Gopalakrishnan, 2001; Stephan, 2001; Lee, 2000; Santoro & Chakrabarti, 2002).

The companies and the universities are undertaking collaborative research (Baba, 2006; Keithley and Redman, 1997; Dooley & Kirk, 2007; Mets, 2009) for mutual learning (Jacob, et al., 2000;

Gomes, et al., 2005), and in order to gain an access to the knowledge networks (Gomes, et al., 2005). They generally collaborate with each other for technique improvement (Zhou, 2008), where both sides develop new organizational competences (Keithley and Redman, 1997), and the academics also gain new research ideas (Gray, et al., 2001). For the universities it is a valuable opportunity to work with employees and develop practical education (Zhou, 2008; Gomes, et al., 2005; Henderson, et al., 2006; Austin, 2000; Drejer & Jørgensen, 2004; Grossman, et al., 2001; Lee, 2000). For example, Henderson, et al. (2006) state that universities can prepare the “case study materials to support teaching”. Also cooperation is about “diffusing of know-how through networking, for instance when company representatives act as visiting lecturers” (Gomes, et al., 2005) and “knowledge spill-over” through research-based teaching of students (Drejer & Jørgensen, 2004). Thus, the academy can improve teaching of science and get valuable competency that they alone was “unable to bring to the education and developmental processes” (Austin, 2000).

The academy-industry cooperation means “joint problem solving” (Jacob, et al., 2000), where the university gains an access to empirical data to resolve interesting real problem in practice (Jacob, et al., 2000; Gomes, et al., 2005; Drejer & Jørgensen, 2004; Santoro & Gopalakrishnan, 2001; Santoro & Chakrabarti, 2002), while the company get knowledge of how to solve problems. Sharing common concern about a particular problem, the university and the company can bring together complementary capabilities and in such synergy they can achieve more together than separately (Austin, 2000). Academics also face resource pressures (Hagen, 2002), and through cooperation the university gets an access to other firm’s resources, such as data and equipment, experience, competence and technology (Dooley & Kirk, 2007; Santoro & Gopalakrishnan, 2001; Austin, 2000; Abramo, et al., 2009, p.503). Austin (2000) argues that through shared facilities, services or activities the university can economize on scarce resources and enhance efficiency.

Therefore, in cooperation the university “could gain valuable experience of current management training needs and manufacturing techniques” (Keithley and Redman, 1997), and increase the “industrial relevance in academics research and teaching” (Henderson, et al., 2006). All of these have a positive effect on a curriculum (Stephan, 2001; Friedman & Silberman, 2003). Moreover, the practical problem makes possible to test and verify theories and practices (Baba, 2006; Dooley & Kirk, 2007; Lee, 2000), where the university has an “outsider’s perspective” (Gomes, et al., 2005). Dooley and Kirk (2007) argue that the academy-industry cooperation creates “faster

feedback loops”, i.e. the research findings of universities can be verified more quickly by the industry.

Among other reasons for cooperation are royalties and fees generated, a number of inventions commercialized, a number of licenses signed, and a number of patterns awarded (Carayol, 2002). Henderson, et al. (2006) believes one of the benefits for the universities is the publication of conference and journal papers. However, Abramo, et al. (2009, p.504) argue that “scientific production deriving from university-industry collaboration does not achieve positioning in particularly prestigious journals”. In addition to that universities can increase their “portfolios of externally funded projects” (Jacob, et al., 2000). It is also a good opportunity for establishing further partnerships (Henderson, et al., 2006; Austin, 2000), and is seen as a source of business opportunity for the academics (Carayol, 2002; Lee, 2000). Moreover, in cooperation the universities can enhance their status and name recognition, i.e. to gain prestige, visibility and word-of-mouth benefits (Dooley & Kirk, 2007; Keithley and Redman, 1997; Gomes, et al., 2005; Abramo, et al., 2009, p.503; Austin, 2000). Friedman and Silberman (2003) argue that it is “a marketing tool to attract students, faculty and additional industrial research support”. Therefore, there are many benefits for the academy in cooperation.

2.2.2. The Aims of the Industry in Cooperation

In general, the companies collaborate with the academics to improve technologies, to develop products and processes, and to gain new ideas (Zhou, 2008; Santoro & Gopalakrishnan, 2001; Grossman, et al., 2001; Caloghirou, et al., 2001; Lee, 2000; Barnes, 2002). The collaborative research is seen as a “meta-capability for innovation” (Gomes, et al., 2005), which increase the performance of collaborating organizations and the productivity of their innovations (Carayol, 2002). Moreover, Lee (2000) states that the companies can reorient their R&D agenda in cooperation with the academy. These help companies to improve the product development processes, and therefore to keep ahead of the competition through collaboration (Gomes, et al., 2005; Dooley & Kirk, 2007).

The companies with a lack of resources or internal knowledge capabilities look for an external support and access to base scientific competence to overcome their own technical limitations and barriers to growth (Hagen, 2002; Gomes, et al., 2005; Drejer & Jørgensen, 2004). Therefore,

through the cooperation with the academy and collaborative research they get an access to data and equipment, to knowledge and scientific competence (Dooley & Kirk, 2007; Baba, 2006; Gomes, et al., 2005; Jacob, et al., 2000; Henderson, et al., 2006; Levy, et al., 2009, p.2; Grossman, et al., 2001; Gray, et al., 2001; Lee, 2000; Sáez, et al., 2002; Santoro & Chakrabarti, 2002; Dooley & Kirk, 2007). Barnes (2002) argues that the companies get an “access to greater breadth and depth of knowledge and technologies than would normally be possible through internal development”. Moreover, the companies gain an access to rich sources of highly skilled researchers to complement their own business analysts (Dooley & Kirk, 2007; Gomes, et al., 2005).

The industry benefits from “outsourcing verification activities to their partner university” (Dooley & Kirk, 2007), e.g. university is a good “arena for testing innovations” (Austin, 2000). In other words, it is attractive for the companies to use university’s research laboratories and large-scale testing by the universities in order to share risks and R&D costs and delegate selected development activities (Gomes, et al., 2005; Dooley & Kirk, 2007; Hagen, 2002; Austin, 2000; Caloghirou, et al., 2001; Barnes, 2002). The companies are using power of science as a source of knowledge for research and product development, competence building, and as an ability to apply knowledge to resolve problems in practice (Zhou, 2008; Drejer & Jørgensen, 2004; Santoro & Chakrabarti, 2002; Lee, 2000; Baba, 2006). Thus, new ideas, knowledge, perspectives and public research can be a source for developing products, processes and patents, and improving existed industrial technologies (Zhou, 2008; Jacob, et al., 2000; Gomes, et al., 2005; Carayol, 2002; Henderson, et al., 2006; Drejer & Jørgensen, 2004).

The most widely known reason for the companies to cooperate is employing graduate level staff and student training (Senker & Senker, 1995; Baba, 2006; Gomes, et al., 2005; Henderson, et al., 2006; Drejer & Jørgensen, 2004; Austin, 2000; Bjerregaard, 2009; Gray, et al., 2001; Lee, 2000; Santoro & Chakrabarti, 2002). In addition Austin (2000) argues that through cooperation with the academy the companies can “attract better employees, enhance employee motivation and morale and thereby strengthening company loyalty and retention”. Other benefits for the companies are gaining of reputation, visibility and social status (Gomes, et al., 2005; Austin, 2000). Some companies “maintain an ongoing relationship and network with the university” (Lee, 2000) probably because “large companies are interested in association with top tier or more prestigious universities for network effect” (Santoro & Chakrabarti, 2002). Thus, the companies can enrich their strategy as being conscious of its social responsibility, and therefore “creating cohesion through common values” among employees (Austin, 2000). For some companies the cooperation

with the academics is a way of obtaining research funds through government investment in development (Henderson, et al., 2006; Sáez, et al., 2002).

The academy and the industry cooperation are a “meta-capability for innovation” (Gomes, et al., 2005), where both gain outsider’s perspective and access to knowledge networks for learning and developing (Senker & Senker, 1995; Gomes, et al., 2005). The collaborative research is a mutual learning process, where both gain an access to knowledge networks and learn from one’s partner (Senker & Senker, 1995; Gomes, et al., 2005; Jacob, et al., 2000). Thus, the companies acquire competitive advantage through cooperation with the universities, and “thereby enhancing the product development process” (Dooley & Kirk, 2007; Gomes, et al., 2005). The companies also benefit from external linkages with the universities since this interaction help to generate income and new business, expand networks, relationships and markets (Austin, 2000; Jacob, et al., 2000). Therefore, the academy-industry collaboration is economically viable for both parties (Gomes, et al., 2005).

2.2.3. Challenges in Cooperation

Although, the review of literature indicates significant benefits for both parties to interact, Dooley and Kirk (2007) state that “the intensity of these [university-company] relationships and the tangible outcomes generally lags behind”. For example, the information on availability of potential partners and “mechanisms for establishing connections are lacking” (Austin, 2000). There are other significant challenges that must be overcome, for instance, Gomes, et al. (2005) describe three categories of barriers to collaboration, namely cultural, institutional and operational. The cultural difference is reflected in the different value systems, incentives and norms, divergent goals, objectives, time orientations, basic assumptions, organizational set-up and languages used (Dooley & Kirk, 2007; Keithley and Redman, 1997; Jacob, et al., 2000; Senker & Senker, 1995; Gomes, et al., 2005; Drejer & Jørgensen, 2004; Hagen, 2002; Austin, 2000; Bjerregaard, 2009; Ponds, 2008, p. 80; Hadjimanolis, 2006; Barnes, 2002). Keithley and Redman (1997) state that any cooperation “have points of “friction”, particularly as staff from two very different organizational cultures with very different ways of operating are brought into close contact”. Austin (2000) argues that the cultural difference is the hardest challenge, e.g. the companies move much faster, and they have different negotiations and accountability. In addition to that partners have different performance measures, competitive dynamics, decision-making styles, personal competencies,

professional languages, incentive and motivational structures and emotional content (Gomes, et al., 2005; Austin, 2000). Bjerregaard (2009) states that “cultural differences are often portrayed as barriers to collaboration and a constraining factor on the transfer and diffusion of knowledge”.

According to Hagen (2002) “partnerships between universities and industry are not achieving their goals because of cultural differences between the partners, differences in their products and nature of work”. Therefore, there is a collaboration gap between the academy and the industry owing to difference of aims and interests, objectives and lack of compatibility in their goals (Gomes, et al., 2005; Keithley and Redman, 1997; Henderson, et al., 2006; Hagen, 2002; Dooley & Kirk, 2007; Bjerregaard, 2009; Ponds, 2008; Siegel et al., 2001; Hall et al., 2001; Hadjimanolis, 2006; Barnes, 2002). For instance, the universities produce tacit knowledge, abstract, complex and ambiguous information in long time periods; meanwhile the companies need an explicit knowledge, which can be directly applied (Gomes, et al., 2005; Henderson, et al., 2006; Bjerregaard, 2009). Keithley and Redman (1997) argue that academics tend to “concentrate on what they can teach easily, what they find personally interesting; company want to focus on immediate specific concerns and place less emphasis on wider educational objectives”. The companies are pursuing profits and action oriented outcomes, while the universities look for the science development and research based outcomes (Gomes, et al., 2005; Henderson, et al., 2006).

Dooley and Kirk (2007) state that the academy wants to publish the results while the industry wants to maintain secrecy to secure intellectual property rights and thereby to maintain competitive advantage. This desire moves the academic research towards secrecy, and is in a conflict with standard academic practices of openness (Adams et al., 2001). Another problem in collaboration for the academics is in the form of shifting from basic to applied research (Carayol, 2002; Gomes, et al., 2005; Hagen, 2002; Dooley & Kirk, 2007; Lam, 2007; Levy, et al., 2009; Adams, et al., 2001; Friedman & Silberman, 2003; Stephan, 2001). Dooley and Kirk (2007) raise the concerns regarding the freedom of the academic research if the university engages in cooperation with the companies. Hagen (2002) also state that “universities should concentrate on teaching and research and withdraw from contributions to industry”. Friedman and Silberman (2003, p. 18) point out a number of “drawbacks including negative impact on culture of open science could affect the types of research questions addressed, could reduce the quantity and quality of basic research, and academics could spend less time on teaching and service.” Thus, the negative consequences of collaborations with the industry on the academics include the “scope of academic freedom” (Dooley & Kirk, 2007), “blurred the boundaries between basic research and

applied” (Lam, 2007, p.996), “the restrictions in knowledge disclosure (fewer publications), as well as modifications in the research agenda, oriented toward more applied research” (Levy, et al., 2009, p.2), and the delay in publication of the research findings (Adams, et al., 2001; Stephan, 2001).

In addition to that there are issues relating to ownership of intellectual property rights and the division of revenue amongst the parties, e.g. in case the company steals the discoveries of the academics, starts to produce and thereby generates revenue (Dooley & Kirk, 2007). There is increasing importance of intellectual property rights issues (see e.g., Ponds, 2008; Grossman, et al., 2001; Siegel, et al., 2001; Hadjimanolis, 2006; Gomes, et al., 2005; Bjerregaard, 2009). Mets (2009) states that “universities started to take ownership with their intellectual property (IP) in new technical solutions”. However, Lee (2000) argues that “the idea of confidentiality runs counter to academic freedom and openness, it becomes the bedrock of industrial competition- especially when the research breaks new ground”. Moreover, the intellectual property rights are the barrier that “inhibits firms from partnering in research with universities” (Hall, et al., 2001). In other words, the “unintended flows of knowledge through university” alienate the companies from the cooperation (Gomes, et al., 2005). In addition to that the companies are more worried about the outcome of collaboration, such as insignificant outcome of cooperation relative to the investment, and prolonged waiting time for the final work, which makes an additional barrier for the companies to cooperate (Gomes, et al., 2005).

In addition to previously mentioned factors Gomes, et al. (2005) found in their research that the “lack of knowledge or experience regarding how to collaborate” and “lack of practical knowledge in the universities” are additional barriers. Gomes, et al. (2005) state that “companies accuse universities of having knowledge poor in practical and real application- professors are ignorant as far as solving problems is concerned”. The companies have a “perception that university research is not directly applicable to their particular problems” (Hadjimanolis, 2006), and that the university has a “lack of understanding” of their business (Hall et al., 2001). Moreover, Hadjimanolis (2006) argues that there is a “lack of infrastructure in universities to transfer technological knowledge”. Therefore, the academics should have more understanding of the industry’s needs, provide practical knowledge and importantly build efficient knowledge transaction mechanisms.

There are other important barriers to cooperation such as time horizons, bureaucracy, costs, firm size and the cooperation with other parties. For instance, the academics have long time spans,

while the companies move much faster and need faster solutions (Gomes, et al., 2005; Dooley & Kirk, 2007; Austin, 2000; Bjerregaard, 2009; Hadjimanolis, 2006). There is also a bureaucracy involved in the university-industry interaction, which impedes the cooperation (Hadjimanolis, 2006; Gomes, et al., 2005). Usually the costs of collaboration are the justification factor for the parties to cooperate or not (López-Fernández, et al., 2008; Drejer & Jørgensen, 2004; Abramo, et al., 2009). Abramo, et al. (2009, p.499) argue that “transaction costs resulting from needs to negotiate and mediate objectives, choose methodologies, manage gatherings, face-to-face meetings, further coordination- create disincentive towards collaboration”. López-Fernández, et al. (2008) found that “high costs of technology transaction constitute an obstacle to R&D cooperation”. Moreover, they argue that “small companies have fewer tendencies to cooperate”, and “cooperation with customers and suppliers is a significant and negative effect on manufacturing and service firms’ propensity to cooperate with universities”. In addition to that for the companies is important “the degree to which the knowledge or product can contribute to the development of the firm” (Drejer & Jørgensen, 2004). Therefore, there are many factors that influence the decision to cooperate or not.

There are a number of problems associated with the partner selection and planning stage where the four Cs, namely compatibility, capability, commitment, control, must be addressed to ensure strategic fit (Hagen, 2002). For example, partners can have time consuming start up negotiations with key actors that can be an obstacle for the cooperation (Jacob, et al., 2000). There are also conflicts because of uncertainty and imprecise expectations since the “companies are subject to unexpected radical changes” (Gomes, et al., 2005). Drejer and Jørgensen (2004) argue that good planning stage through goals, time schedules, and budgets can reduce uncertainty. In addition to that partners must adapt their strategies in response to their external environments (Dooley & Kirk, 2007).

Probably the main challenge is lying in “a need to shift the focus of attention from discrete projects and the funding arrangements for these to that of building a relationship between the research team and the practitioners with whom they interacted” (Jacob, et al., 2000). Moreover, for the successful cooperation it is important to have mutual trust. Tretyak and Popov (2009) argue that the opportunism and violation of norms may destroy trust and dissolve the relationships. Austin (2000) states that the mind-set barrier, e.g. stereotyping and aversion to change as well as bad interpersonal relations can destroy a partnership. In addition to that, the “impulsive decisions on

the basis of inadequate information” and “weak company management can harm collaborative relationships” (Senker & Senker, 1995).

There are a number of other challenges that the universities and the companies face. For instance, “ignoring differences in identities and competence” (Jacob, et al., 2000), and “imprecise expectations” (Gomes, et al., 2005) can harm the relationship. As a result, main challenges arise in the alignment of cultures, strategy, values, personal connections, communication and relationship management. It is important to mention that “little progress could be made if either the university or the company took a rigid stance over a particular issue” (Keithley and Redman, 1997). Thus, despite many benefits of the academy-industry cooperation, they also have many challenges. Probably the main explanation of all barriers to collaboration is lying in that these two sectors evolve separately with “rare points of contact” (Gomes, et al., 2005).

2.2.4. Encouraging Factors

López-Fernández, et al. (2008) argue that the decisions regarding the collaboration are influenced by many factors such as spillovers, R&D intensity, firm size, belonging to corporate group, the nature of innovation protection and legal strategy. In addition to that “cost, profit, and the degree to which the knowledge/product can contribute to the development of the firm” influence the company’s propensity to cooperate (Drejer & Jørgensen, 2004). There are many other factors that affect the university-company cooperation, such as “cultural tradition, practical base, strong needs from local industry development, and productive academic results available to be capitalized” (Zhou, 2008). However, Senker and Senker (1995) argue that the success of the university-company cooperation is not dependent from the firms’ size, sector of the economy or the type of academic expertise. They found in their study several factors are most significant for the outcome of the project, namely the relationships between the organizations, commitment to the project, remaining within agreed objectives and goals, efficiency of monitoring, and clarity and cohesiveness of its objectives.

There are many factors that support the academy-industry cooperation, but first of all it is important to mention that the policymakers are increasingly stimulating collaboration through national research programs (Ponds, 2008; Caloghirou, et al., 2001; Hadjimanolis, 2006; Zhou, 2008). Ponds (2008, p. 77) argues that “national policymakers on the other hand are generally

focusing on the stimulation of academia-industry collaboration within their country with goal to improve the interaction between science and technology and, hereby, to stimulate innovation”.

In addition to that, Austin (2000) believes that the collaboration can be fostered with the assistance from market makers that help to make connections and to form partnerships, e.g. creating an understanding of strategic collaboration, ensuring strategic fit, generating the value, and managing the relationship. Although the intermediary institutions or professional service organizations can help create alliances and provide information on availability of partners, the organizations can engage in a proactive search by identifying intersections of their interests (Austin, 2000). In Denmark there are intermediate institutions that facilitate the knowledge transfer from public research institutions to the companies (Drejer & Jorgensen, 2004). Thus, cooperating organizations should have the infrastructure that helps to transfer the knowledge. For instance, the universities could have technology transfer offices (TTO) that help transfer the technology from the universities to the firms (Siegel, et al., 2001; Meseri & Maital, 2001). Friedman and Silberman (2003) state that “universities have established TTO’s to foster interaction with industry and commercialization of research”. In addition to that, the partners can have some “scheme which enables universities to create and disseminate knowledge and business management expertise to company partners” (Hagen, 2002).

For successful collaboration it is important to have mutual understanding, to understand methods and approaches involved, to have clear ideas about the project (Dooley & Kirk, 2007; Hagen, 2002; Austin, 2000; Bjerregaard, 2009; Ponds, 2008), as well as adapting and making ongoing adjustments to facilitate the interaction (Keithley and Redman, 1997; Austin, 2000). Moreover, Mora-Valentin (2004) states that the “clear definition of objectives comes up as a vital factor in cooperative relationships”. It is necessary that objectives are agreed, clear and cohesive, and the cooperation remains within them (Senker & Senker, 1995; Dooley & Kirk, 2007; Austin, 2000; Bjerregaard, 2009; Hadjimanolis, 2006). Thus, the partners should be open and clear about obligations and rights (Drejer & Jørgensen, 2004).

Barnes (2002) states that the expectation of both partners should be managed and the responsibilities should be clearly communicated and agreed from the beginning. Austin (2000) further suggests that “high expectations generate high performance standards, which promote value creation and foster mutual accountability, which in turn motivate execution responsibility.” The execution capability and commitment make possible to transfer expectations into results,

which can be possible if partners meet regularly to inquire whether their expectations are being met (Austin, 2000).

The efficient communication is important for success. Mora-Valentin (2004) defines communication as “a process of exchanging information, concepts and ideas between individuals that belong to different organizations”. Dooley and Kirk (2007) argue that communication should be “self-managed within appropriate normative controls” to implement “continuous, high-quality exchange of information and knowledge”. The systems of norms can be, for example, when companies have an access to pre-publication researches, and can delay publication, have an access to research labs and have constant meetings or contacts (Dooley & Kirk, 2007). Bjerregaard (2009) states that smooth exchange of knowledge “was reflected in the project’s low level of formalization in written contracts”. Thus, the communication is facilitated with low formalization. Internal communication is also important since employees feel that they are “helping to achieve some good” (Austin, 2000). The communication should be honest, forthright, frequent, and meaningful, and it is central to the trust-building process (Austin, 2000).

Trust is defined as “the willingness to believe in the other partner within a context where the actions taken by one partner make the other vulnerable” (Mora-Valentin, 2004). Santoro and Gopalakrishnan (2001) states that the “firm’s trust of its university partner is the cornerstone of developing a stable relationship, and have greater technology transfer activities”. Frequent interaction helps to build deeper relationships, level of trust and tolerance, and openness between the partners (Ponds, et al., 2007; Barnes, 2002; Dooley & Kirk, 2007; Drejer & Jørgensen, 2004; Jacob, et al., 2000; Hagen, 2002). Mutual trust is also necessary in order to overcome problems (Ponds, et al., 2007). In other words, the partners should have sufficient mutual respect, trust and tolerance that they can talk about problems and issues in an open manner (Austin, 2000).

In addition to that, the commitment of both partners to cooperate is essential (Hagen, 2002; Senker & Senker, 1995; Henderson, et al., 2006; Drejer & Jørgensen, 2004; Hadjimanolis, 2006; Barnes, 2002). Meseri and Maital (2001) state that “technology transfer project is strongly related to the quality and motivation of the project team”. According to Mora-Valentin (2004) “the higher the degree of participation and involvement of the partners and of the senior executives the more effective the cooperative relationship will be.” Therefore, the commitment to the project is extremely important for its success.

Garrick, Chan and Lai (2004) state that the “productivity in firms depends on the development of effective interaction patterns and team work.” The personal dynamic capabilities and social relationships in cooperation must motivate, encourage, and produce tangible benefits for all parties (Dooley & Kirk, 2007; Hagen, 2002). Moreover, Bjerregaard (2009) argues that “informal contact mechanisms such as social networks were perceived to be more critical for establishing the collaborations”. Austin (2000) states that it is important to make a “strong message to their respective organizations about the importance of the collaboration and gives employees the liberty to actively engage in the partnership”. The efficient interpersonal relationships help to develop effective interaction patterns and team work that is beneficial for the collaboration (Garrick et al., 2004; Dooley & Kirk, 2007; Hagen, 2002; Barnes, 2002). Austin (2000) argues that “the partnership’s staying power derives from the personal relationships that have developed because of individuals’ personal interest in and connection”. Personal relationships and communication is also important for the development of trust (Hadjimanolis, 2006). Moreover, Austin, (2000) states that “social purpose partnerships appear to be motivationally fueled by the emotional connection individuals make with the social mission and with their counterparts in the other organization”. Thus, good interpersonal relationships, emotional connection of individuals with the social mission and awareness of the importance of the partnership is critical for the success.

Austin (2000) argues that partners should invest in managing the relationship or their interactions through building of trust, effective communication, commitment and the ability to fulfill obligations, being clear about expectations, and continually learning. Tretyak and Popov (2009) state that the relationship between participants is “governed by norms and informal self-enforcement mechanisms that evolve after certain level of trust, commitment and satisfaction achieved in relationship...Violation of norms may destroy trust and dissolve relationships.” It takes time to build good relationship, for example, the collaboration and negotiation of disagreements can take many hours (Keithley & Redman, 1997). According to Hagen (2002) the “management of the contradictions and tensions between differentiation and integration...will be difficult and require a change, not only of universities’ surface structures but also deeper structures of values, beliefs and culture intrinsic to the traditional university role.” Therefore, successful cooperation requires effective management, building up mutual trust, norms, credibility and levels of tolerance (Hagen, 2002; Jacob, et al., 2000; Senker & Senker, 1995; Tretyak & Popov, 2009; Drejer & Jørgensen, 2004; Dooley & Kirk, 2007).

According to Hagen (2002) addressing the four Cs, namely compatibility, capability, commitment and control, is essential in partner selection and planning stage to ensure strategic fit between the partners and thereby the success of the alliance. Austin (2000) states that partners can ensure strategic fit through “investment of time and commitment for dialogue, meshing mission, matching needs and capabilities, and overlapping values, clarifying purpose and fit”. In general, in the cooperation it is important to monitor the project efficiently (Senker & Senker, 1995), and to have simple information channels, guidelines, project management and division of labor, trust and team-building (Drejer & Jørgensen, 2004). In addition, the top management should be engaged in the project, which is critical to partnership success (Austin, 2000; Barnes, 2002).

Hagen (2002) state that formality of structure “facilitates the faster movement of the heuristic knowledge into the formal processes of the organization”. However, Dooley and Kirk (2007) argue that it is important to “reduce institutional barriers that impede effective knowledge exchange”. They also state that organizational designs should provide flexibility and high productivity. The “low degree of formalization of the R&D projects through contractual arrangements” is supported with high understanding of the project goals (Bjerregaard, 2009, p.105). Thus, the partners should have mutual understanding and low formalization.

Cooperating with the universities and using public information is an important source for the innovation. Drejer and Jorgensen (2004) argue that absorptive capacity as “the ability of firms to utilize the public research results is dependent on the level of prior related knowledge in the firm, which makes possible to recognize the value of new information, assimilate it, and to apply it for commercial ends”. López-Fernández, et al. (2008) found that the “larger firm size fosters in-house technological capabilities and increase “absorptive capacity”, as well as “undertaking in-house R&D activity significantly fosters a firm’s propensity to cooperate with universities”. Sáez, et al. (2002) state that “in order to be able to absorb the scientific knowledge transferred by research centers, firms need to have a strong internal capacity for R&D; firms appear to combine both the internal and cooperative options in their R&D activity”. Fontana, et al. (2006) also support this idea that “firms that invest heavily in R&D are likely to possess a high technological capability that also allows them to absorb the knowledge developed outside the firm”. Therefore, external knowledge is more effective if the company’s absorptive capacity is high, i.e. the firm engages in its own R&D activity.

Knowledge protection mechanisms and spillovers play an important role in the decision to participate in collaboration or not. In some cases it is necessary that internally developed knowledge is protected from being copied (Tretyak & Popov, 2009). López-Fernández, et al. (2008) found that “legal protection is a significant for manufacturing, but not for the service firms”. However, Dooley and Kirk (2007) state that “increased focus on licensing and patenting can act as a constraint on the speed at which knowledge can flow between the parties”. Thus, the knowledge protection and spillovers are important factors for some companies.

There are other important justification factors for cooperation, which are costs and risks sharing, firm size, and the degree to which the knowledge or product can contribute to the development of the firm. Fontana, et al. (2006) state that “usually larger firms and start-ups have a higher probability of benefiting from academic research”. López-Fernández, et al. (2008) discovered that the companies have “greater tendency to cooperate when firm size increases”. Lam (2007, p.997) also state that “many large firms seek to collaborate with research universities”. These occur probably because “large-sized firms have greater technology transfer activities due to their slack resources” (Santoro & Gopalakrishnan, 2001). López-Fernández, et al. (2008) found in their study that firms are more cooperative with universities when “operating costs represent an important obstacle to innovation”. Adams, et al. (2001) state that the companies decide to collaborate with the universities if the costs are significant and this cooperative project should be more productive than company’s internal research.

The cooperation with the academics and public information is an important source for the innovation (López-Fernández et al., 2008). Therefore, the companies are expecting that “productive academic results available to be capitalized” (Zhou, 2008), and for them is important “the degree to which the knowledge or product can contribute to the development of the firm” (Drejer & Jørgensen, 2004). Sáez, et al. (2002) also support this idea that “there is also a demand for more specific knowledge, more directly focused on problem-solving and product design and development”. Dooley and Kirk (2007) argue that “the focus of the funded research must be of sufficient intellectual challenge and scope”, and “research has to be of sufficient priority for all stakeholders to ensure the necessary resources are available”. Therefore, the research should be of significant strategic importance to all partners (Barnes, 2002). The cooperation must produce tangible benefits for all parties, and present significant strategic, economic or financial returns and benefits (Abramo, et al., 2009; Dooley & Kirk, 2007; Gray, et al., 2001).

The geographical proximity also contributes to the establishment and development of cooperative relationships between partners, and is claimed to be beneficial for successful collaboration and knowledge exchange (Mora-Valentin, 2004; Hadjimanolis, 2006). Santoro and Gopalakrishnan (2001) state that “the geographic proximity between the firm and its university partner play a significant role in the technology transfer process; geographical proximity facilitates on-going dialogue due to lower travel costs; greater geographic proximity is related to greater technology transfer activities”. There is an “importance of face-to-face contacts for the exchange of tacit knowledge” (Ponds, et al., 2007, p. 441), because “physical proximity between partners simplifies the task of controlling the cooperative partnership, which may contribute to the efficiency of these alliances” (Sáez et al., 2002). Moreover, Abramo, et al. (2009, p.506) argue that “business tended to finance applied research in universities found within 100 miles of their base, even if these did not demonstrate high levels of excellence”.

The positive past collaborative experience has a good impact for new cooperation’s (Barnes, 2002; Hadjimanolis, 2006). Moreover, Mora-Valentin (2004) argues that “the partner’s reputation is a key factor that influences both the success of the cooperative relationships”, and “the outcome of the cooperative relationships would be better if the partners have had previous cooperative experiences”. Therefore, the universities and the companies should understand all the complexities involved, the resources required, to adapt to a long term strategic approach, and to develop organizational designs that are tailored for each alliance and provide for flexibility and high productivity (Hagen, 2002; Dooley & Kirk, 2007).

2.2.5. Dealing with the Outputs

In general, the future impact of the cooperative project is consistent with the aims of the collaboration. For example, the companies can use the results of the cooperation in the development of products, while the academy can use it in the science development. There are little studies on how the results of the cooperation can be used in the future. Regarding the use of output of joint projects Gomes, et al. (2005) found considerably low number of solutions to explore the results from collaboration, which is found to be compatible with the high number of respondents lacking the knowledge or experience in cooperation. Lee (2000) found that there is a high likelihood to continue the research collaboration between the university and the companies in the future. In general, for the companies is more important that the results of collaboration is used in “media”

(e.g. “announcement of joint projects and/or results in the media”), “encouragement to organization change via feedback and critical thinking”, “consultancy/training”, and changing technology and processes (Gomes, et al., 2005). Gomes, et al. (2005) state that the academics should be “more creative when presenting their work to companies” and it is necessary to improve the dialogue between the academy and the industry.

Hagen (2002) is stating that the future of universities will be major players in regional regeneration, i.e. universities will become a key player in a regional “knowledge network”. For example, IBM proved that “long-lasting relationships with universities helped to shape company’s future, and made it dominant firm in its industry for decades” (Baba, 2006). Austin (2000) argues that partnership has a social benefit and is a “catalyst for other alliances”.

2.3 Theoretical Framework

This section presents the theoretical framework of the study, which is created on the bases of the previously discussed literature on the inter-organizational interaction and the academy-industry cooperation. The theoretical framework presented in the Figure 1 depicts the aims of the academy and the industry, the challenges, the factors that facilitate the collaboration, and the impact of the cooperation on the future. The figure shows that the academy and the industry have their own as well as mutual aims in the cooperation. There are many factors that affect the success of the collaboration, which are presented in the figure in two separate groups as facilitators and challenges. The cooperation has an impact on the future and there are several ways how the results of the cooperation can be used by both parties. This framework provides general picture on the academy-industry collaboration and can be used to analyze and develop the cooperation.

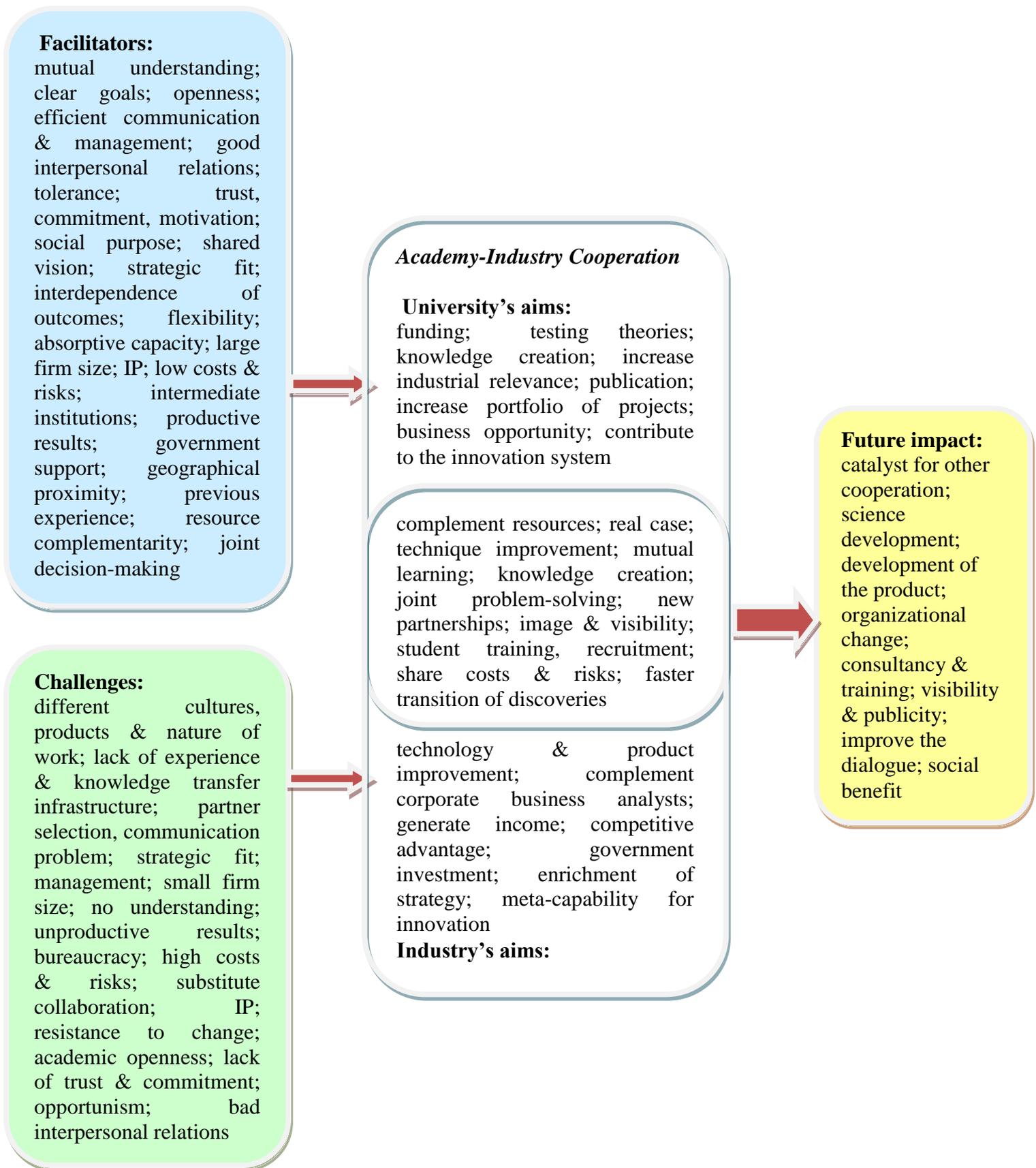


Figure 1: Theoretical framework for the academy-industry cooperation

3 METHODOLOGY

This chapter discusses the methodology of the research, i.e. it justifies the qualitative approach and outlines the selection process. Then, the data collection and analysis as well as the validity and reliability issues are discussed. Finally, the case organizations are presented.

3.1 The Qualitative Research Approach

This research studies the academy-industry cooperation in Finland in the Solar Decathlon competition project and aims to gather information from both participating parties, i.e. the academy and the industry. The primary purpose of the empirical part of the study is to define reasons, challenges as well as encouraging factors in collaboration. Also the study aims to explore how the academics and the companies plan to use the results of the cooperation project in the future.

The research began with collecting theory on the inter-organizational interaction and the academy-industry cooperation, and forming theoretical framework based on which the methodology of the research was developed. The purpose of theory was to guide an understanding of the subject. With the pace of the research process the theory was modified to address an empirical problem. Thus, the theoretical framework has constitutive values of “accuracy, simplicity, internal and external consistency, breadth of scope (explanatory power) and fruitfulness” (Moisander & Valtonen, 2006, p.39).

The purpose of this thesis is to examine the dyadic academy-industry relationships. Therefore, the qualitative research method was chosen because it allows deep and comprehensive understanding of the phenomenon. It helps to discover new areas and understand better “how respondents map the subject; what dimensions and connections are of importance to them” (Chrzanowska, 2002, p. 14). The data was collected through semi-structured interviews with the key people from the universities and the companies participating in the Solar Decathlon competition project. The interview has been chosen as a research method since it is a direct and efficient method of collecting data, which serves the purposes of the qualitative research on exploring motivations, desires, needs, meanings and qualities of the process (Chrzanowska, 2002; Moisander & Valtonen, 2006). Although the interviews are time consuming and challenging to perform they give rich data and in-depth understanding of the subject under investigation.

3.2 Selection Process

This study is conducted on cross-sector collaboration, and thus covers both the universities and the companies. It was important for this study to find dyadic relationships in order to examine views of the academics and the industry's representatives on the cross-sector collaboration in the particular relationships. The initial idea was to study four dyadic relationships, but since one company did not want to participate only three dyadic relationships are studied. After careful consideration the three dyadic exchange relationships were selected. These relationships represent different universities and companies, who are actively involved in the cooperative project. The University of Art and Design and the Helsinki University of Technology are representing the academics, and three companies from wood and technology industry, namely StoraEnso, Naps Systems and Ensto, represent the industry. Research sampling consists of three representatives from the companies and four academics. The participants were chosen based on their degree of involvement in the Solar Decathlon project. The three dyadic relationships is an appropriate number to study each relationship in-depth, and at the same time concentrating on different industries and areas of expertise.

The case organizations were selected by the end of December 2009 with the assistance of the Solar Decathlon project's board member who helped to identify appropriate dyadic relationships. The dyadic relationships were selected based on the following criteria: first, it has to be committed and a long-term relational exchange rather than transactional; second, it has to be important for the Solar Decathlon competition project, i.e. the involvement and input of the companies in the project is sufficient. In other words, it does not restrict only to financial support; third, academics and companies have to be willing to participate in the research. The selection criteria were based on the need to collect reach data and to gather deep understanding of the academy-industry cooperation. In general, the selection process was successful as three most important dyadic relationships were identified. In addition, people were motivated to participate in the study.

3.3 Data Collection and Analysis

Data was collected through semi-structured interviews with the key participants in the project. The interviewees from the universities and the companies were selected based on their level of involvement in the project and their level of interaction with each other. The interviewees represent the companies and the universities since the study is examining the relationship from the both sides. The qualification of the academics ranged from lecturers to professors in the engineering and architecture. The status of industry participants varies from chief officer to business development director. All of them are deeply involved in the Solar Decathlon cooperation project. In the appendix 1 there are more details on the interviewees.

In total eight face-to-face interviews during November 2009-April 2010 were conducted in Helsinki. Every interviewee was contacted by e-mail and requested to participate in the interview, and at the same time the research questions were sent to each interviewee. After that the place and the time of the interview was agreed. The plan of interview and open-ended questions were designed prior to interviews. The duration of interviews is around an hour. Every interview was transcribed word-by-word and ended up with around 65 transcribed pages. The interviews started with introductory and general questions, and after followed by direct questions. During interviews the trust and empathy were created that respondents could express their thoughts openly (Chrzanowska, 2002, p. 24). All of interviews were performed in English language, tape recorded and then transcribed. The positive fact in this empirical study is that all of interviewees were highly committed to participate in the interview and were available for further discussions.

The interviews were designed in order to collect two groups of data (see Appendix 2). The first group deals with general data, including position and role in the project, previous experience with collaboration projects. The second group of data concerned the respondents' views on ongoing collaboration. This group addressed such questions as:

- 1) Why the universities and the companies cooperate?
- 2) What are the challenges in collaboration between the universities and the companies revealed in this project?
- 3) What factors encourage the collaboration between the universities and the companies in this project?
- 4) How will the results of this cooperation be used in the future?

However, there are some limitations regarding the data-collection process. First, the interviews were tape recorded which probably could have a negative impact on how openly the interviewees were able to speak. Second, the English language was not the mother tongue for the interviewees. It is possible that the outcome of the interview could be better if interviewees speak their mother language. However, it is not seen as a big difficulty since the interviewees were quite open and expressed their thoughts effectively. In general the outcomes of the interviews were very positive.

The transcribing of interviews was very time-consuming, and it took about six hours to transcribe each interview. The recordings were listened sometimes couple of times, and then transferred word-by-word into the texts in the MO Word program. It was necessary to listen to the recordings many times, because sometimes it was difficult to understand technical language and professional expressions.

The transcribed texts were carefully analyzed according to cultural research technique “hermeneutic circling”, where “part-to-whole iterations” were done (Moisander & Valtonen, 2006, p. 111). Thus, the transcribed texts were read to identify higher-order meanings, and then read again and again to find lesser meanings. After that lesser meanings were rearranged into groups according to identified high-order meanings. Then, the data were put into a dialogue with a theory, and “understandings emerge through an iterative process of matching up data and theory” (Moisander & Valtonen, 2006, pp. 104-105). Therefore, the abductive reasoning logic is followed in this research, i.e. first, the theory is used as a lens for studying empirical data, and after that the results of the study are compared with the theory (Antola, 2009, p. 102). In other words, the theory and the data interact with each other and the theory guide interpretation of the real-world.

3.4 Validity and Reliability

The validity is defined by Moisander and Valtonen (2006, p. 24) as “...the truth or accuracy of the representations and generalizations made by the researcher; how true the claims made in the study are or how accurate the interpretations are.” Although, the disadvantage of the interviews is in terms that “there may be a gap between respondents’ perceptions and explanations” (Chrzanowska, 2002, p.25), i.e. the interviewer can interpret data in a subjective way. However, the demonstration of selected textual excerpts can clarify this problem. Thus, the accuracy of generalizations and interpretations is proved by the textual excerpts. The validity of this research is ensured from the

research design to the robustness of the final finding by accurate analysis, constant comparison, reporting the view of respondents in detail, and producing empirical analysis that reflect the “real” situation.

Moisander and Valtonen (2006, p. 27) argue that “reliability usually refers to the degree to which the findings of a study are independent of accidental circumstances of their production”. The triangulation method was also applied for cross-confirmations by comparing data from different actors involved in the collaboration. In this research different interviewees were giving similar responses, and therefore the results of this research can be replicated by future researchers. In addition to that all interviews are carefully recorded and after transcribed. All the transcribed texts were read several times and constantly compared. In addition to that, long extracts from the data are presented in the research report. Moreover, the whole research process is made “transparent by describing the different methodological practices and processes in a sufficiently detailed manner in the research report” (Moisander & Valtonen, 2006, p. 27).

3.5 Case Organizations

In this research the three dyadic relationships are studied, which contains the academy namely the University of Art and Design and the Helsinki University of Technology, and the three companies from wood and technology industry, namely StoraEnso, Naps Systems and Ensto, representing the industry.

The University of Art and Design namely the wood studio of this university participate in the Solar Decathlon project. Karola Sahi represents the wood studio, and has been involved in this project for around one and half of the year, from December 2008. She is a teacher and the lecturer and also a member of the board in the Solar Decathlon competition project. The wood studio is working as a partner with a wood program from the Helsinki University of Technology, and has designed the interior furniture for the house. From the wood studio altogether 24 people are involved in this project, e.g. 2 teachers and 22 students. From the September 2009 the wood studio is cooperating with Isku Oy, who has built the kitchen for the Luukku house. The wood studio has been cooperating with companies before, but this project is first of this kind. Isku and the wood studio have been actively cooperating in this project, having meetings about details and materials to build the kitchen. This relationship has been very positive and cooperative.

The wood program at the Helsinki University of Technology is the initiator of the Solar Decathlon competition project. The research manager Kimmo Lylykangas heard about this competition on energy efficient buildings and induced other professors and teachers from the Helsinki University of Technology to participate in this project. They applied to the Solar Decathlon competition and in October 2008 they have been selected to participate in this project. After that the development of the project's house has been started. More than 70 students, approximately 20 professors, and approximately 20 other members of staff participate in this project. The students of this program have designed and developed the concept of the Luukku house. This university has been developing further and monitoring the project and also selecting companies to participate in it. The idea behind this project was to show best Finnish products and competence, know-how. Therefore, only best Finnish companies with needed products have been contacted to participate in this project. The academics analyzed the design of the house and decided which of the companies would be the best suppliers of the products or system needed for the house. It was relatively easy to convince companies to participate in the project since the first zero-energy house have been building in Finland, and especially with new requirements for energy efficient construction and common goal of diminishing CO2 emission it turned to be an interesting case for everyone. Thus, about 30 companies are participating in this project donating materials, financing and providing assistance in building the Luukku house. Some of the companies are participating in this project less and some of them are very active, e.g. companies' representatives are members of the board, they attend meetings and provide assistance in the building of the house. Thus, the board of the project consists of the academics and industry's representatives, who are meeting weekly to discuss the deliverables, time schedule and financial issues of this project. The academy representatives in this project are Professor Pekka Heikkinen, research manager Kimmo Lylykangas, and researcher Yrsa Cronhjort. In this project Pekka Heikkinen is a project manager, responsible for wooden parts of the project, and he is a contact person to StoraEnso and NapsSystems. Kimmo Lylykangas initiated the projects, he has been contacting companies and fundraising, and he is responsible for the electrical and technical parts of the project, i.e. he is a key contact person to Naps Systems and StoraEnso. Also he has been teaching students who have designed the house. Yrsa Cronhjort is a project coordinator, teacher, and she has been involved in the project from the beginning, for example, writing the technical proposal. Although the Helsinki University of Technology has previous experience in cooperation with companies (i.e. every year they cooperate with companies), the scale of this project is much larger and more ambitious.

Stora Enso Oyj is a global pulp and paper manufacturer formed by the merger of Swedish and Finnish companies in the 1998. The company produces the newsprint, book and magazine paper, fine paper, consumer board, industrial packaging and wood products. The company is headquartered in Helsinki, and it has approximately 27 000 employees and production facilities in many countries worldwide. The company's total paper and board annual capacity is 12.7 million tones and 6.9 million cubic meters of sawn wood products. In 2009 company's sales were EUR 8.9 billion in total. Stora Enso has a strong global marketing network, and is listed on NASDAQ OMX in Helsinki and Stockholm. (Stora Enso website 11.11.2009)

StoraEnso is cooperating in the Solar Decathlon competition project for a year, starting in the spring 2009. The company's effex wood panel products, which they launched last year, are used in the whole interior of the Luukku house. StoraEnso provide their knowledge and materials for the project, and also financing. From StoraEnso there is one person actively involved in this project and few people in the supportive role for this project. The business development director Duncan Mayes is a representative leader from the company, who decide what and how to participate. He has been in contact mainly with Pekka Heikkinen, Kimmo Lylykangas, Yrsa Cronhjort, and some of the students. Duncan Mayes has been following the Solar Decathlon project, giving advice, ideas, arranging deliveries, and participating in seminars and board meetings. StoraEnso cooperates on many projects with universities, both with University of Technology and University of Art and Design, for example on product development projects and sponsors Master's thesis works every year. Thus, company has a lot of experience in cooperation with universities, but nothing as advanced as this project. The cooperation in this project has been successful.

Naps Systems Oy is a Finnish solar electricity company, which operates since 1982 as a department within Neste Corporation, and was incorporated into a separate company in the 2000. Naps Systems is headquartered in Finland, and it has sales offices in Sweden and the UK. Naps Systems supplies complete solar electricity systems, which consist of the solar modules, control units and batteries, and a full service packages. The company has a worldwide distribution network, and has already delivered solar electricity systems to more than fifty countries all over the world. (Naps Systems website 11.11.2009). The company participates in the Solar Decathlon project for about a year as a financer and a solar system seller. Naps provided the solar system, which provides most of electricity to the electricity system of the whole Luukku house. The chief technical officer Mikko

Juntunen is representing this company and is a member of the board in the Solar Decathlon competition project. He has been in contact with Kimmo Lylykangas and Pekka Heikkinen.

Ensto Group is an international technology company founded in 1958 in Finland. Ensto produces the electrical solutions and products for the transmission of power, and thus plays an essential role in the distribution and energy efficient use of electrical power. The company has approximately 1250 employees, 170 million euros turnover, and operates in 19 countries. (Ensto website 11.11.2009). The company participates in the Solar Decathlon project for a year by providing finance, assistance and supplying the house with the energy-efficient lighting, heat recovery and ventilation system. Matti Rae has been the key contact person for this project, and has been cooperating mostly with Pekka Heikkinen.

4 ANALYSIS AND INTERPRETATION OF THE DATA

This chapter presents the analysis and interpretation of the data. It consists of four subchapters: first, the aims of cooperation for the academics and the companies; second, the challenges of cooperation for both parties; third, the factors that facilitate the academy-industry collaboration; and fourth, dealing with the results of cooperation in the future.

The analysis of the empirical data shows that all of the interviewees see the university-company cooperation in the context of Solar Decathlon competition as successful and fruitful. It has been for both participants an interesting project and a real case for teaching, learning and developing products. The whole project turned to be a very interesting case, but more extensive than it was assumed. In general, the cooperation between the universities and the companies have been successful, having little challenges, mainly concerning rising the money and product development, all of which are solved by the means of effective communication.

4.1 Cooperation's Aims for Both Parties

The Solar Decathlon competition project has many aims. The main aim of the project is to build first zero-energy house in Finland by students with the help of the business sector and to participate in the Solar Decathlon competition in Spain. It also promotes energy-efficient wood construction and solar power technologies in Finland, and contributes into national CO2 emission targets:

The project as a building has many aims- one of our target is to create a zero energy in Finland, in Madrid this will be a plus energy house. ...This means the promotion of quite far taking innovations as it would be the first building in Finland of this kind ever. ...Also we have smaller targets within this one- for example, CO2 emissions. ...It is a competition between universities and students, not companies. (Yrsa Cronhjort)

I hope we can promote energy-efficient wood construction in Finland and prove that there is a lot more potential in solar power than people in general tend to think. Also we tend to prove that energy-efficient solutions are not necessarily very expensive, and we also have to prove that comfortable housing can be zero-energy housing. And that the solutions we are expected to have in the year 2021 can be realized already now with present technologies. That is my expectation to

make a statement by Aalto University- these new technologies, the Finnish know-how. (Kimmo Lylykangas)

Therefore the main idea of the project is not to develop the relationships or cooperation practices between the universities and the companies, rather to build energy efficient house, to participate in the competition and, of course, to learn from this case. It turned to be that the universities and the companies had to cooperate in order to build the house. The academics and industry participants have a common goal in this project that is to develop first zero-energy house in Finland and to contribute into CO2 emission research and development projects. In addition to that the academy wants to promote energy efficient wood construction and Finnish know-how. Thus, this project is relevant for the future since it is addressing issues of global warming and is developing first zero-energy house in Finland. In other words, this house can be a good starting point for the development of new Finnish market of energy efficient housing. Therefore, this project is more than just a good real study case for the university-company cooperation, but it has a deeper meaning for the society and economy in the development of new generation of products, solutions and architecture. In other words, this cooperation is enhancing innovation and economic development (Dooley & Kirk, 2007; Mets, 2009; Friedman & Silberman, 2003). Thus, both the academy and the industry are taking “greater role in solving society’s problems” (Austin, 2000).

Although the university and the companies are cooperating in this project for the single aim- to built energy efficient house, they also have different reasons to participate in this project, e.g. the academy pursue science development while the industry wants to develop its offering. Thus, they have mutual interest and dependence, e.g. companies are financing and giving their expertise, knowledge and products, whereas universities are developing creative solutions, testing and giving ideas and visibility with the project:

Without companies we could not build the house- you know, we need companies to put their best knowledge and to get the products, because the house will be build out of this products. The Isku is a very good partner for us- they will give us their knowledge of the details and materials and of course as a sponsor they will support the project. ...At least we got a lot of knowledge from ISKU already of some detailing... I think they want to be involved in this kind of first class project. They get experience, they can market it and get new ideas from this project. (Karola Sahi)

For universities- it is multi-scientific side of the project, we now got a very good beginning start for the multi-scientific teaching and research, and we have many new research projects starting on this base looking forward to the future. ...They [the companies] are financers, we offer them an opportunity to get visibility with this kind of project- unique building in Finland, we give them an

opportunity to develop their products, looking towards the future, they have an opportunity to show the sustainability in their products. ...It is very important in our case as we work on innovations, innovative products- we cannot do all of this by ourselves, we need companies with products to develop, and of course we need companies with the interest to develop the products. Which means that it is a cooperation between both- innovative university and innovative companies. (Yrsa Cronhjort)

I think they are very much dependent on us since we provide the material. We are only one producing this particular type of material. They have strong dependence on us to participate. If we had not agreed to participate than they would not use the materials that they have now in the building. (StoraEnso)

That [the academy-industry cooperation] is vital I would say. It would not be possible to build the house without very close cooperation between companies and universities. ...With StoraEnso also we have been able even to develop new solutions, so that has been a very good cooperation with StoraEnso. ...the technical support that we got from Ensto has been very valuable for us too. ...I hope that for Naps we promoted solar energy and we made a statement that you can run the house with the solar energy even in Finland, and in the international context we are promoting their know-how, saying that we also have good solar technology in Finland, even though we come from the north. ...for StoraEnso, I think, the most valuable contribution is publicity, but also the innovative ideas of interior surfaces... for the Enervent we are promoting their ventilation units, which are very good even in European comparison. For Ensto themselves it is a possibility of upgrading up the product way with which you can charge the electrical vehicles, promoting is also important, and then introducing the whole technical concept of zero energy house. ...We have been also purchasing things from companies, for example from Naps. We are also a client, so that is benefit for them even they have giving a discount. ...I would say that we brought them [network of the companies] together, but without them we would not be able to build the house. (Kimmo Lylykangas)

It was quite obvious for the Luukku team from the beginning that there has to be solar electricity there, and then starting to search for the solar electricity suppliers in Finland we are quite obvious source. There are few others, but we are only who are making them in an industrial scale and actually doing here in Finland, not just importing everything. ...So, the final outcome is definitely cooperation- they could not have done it, we could not have done it. (Naps Systems)

In this case since companies are delivering the material, for example, we are strongly dependent on them, and if it wouldn't happen as agreed we are in trouble. ...But on the other hand I think partly, since we are independent actor, the university, I think industry is also should be at least

dependent on us because I think we should see more wide perspective because in industry there are a lot of limitations- economical factors and such things. (Pekka Heikkinen)

It is quite obvious; the university has a two way target- in teaching of people how to cooperate in this kind of multi-disciplinary project. ...Without the funding there would not be the results, and without the practical knowledge, and activities taking place at the university there would not be any results. (Ensto)

The companies know that the academics are very dependent on them since they provide material and finance for the project. The academics also know that the cooperation with the industry is extremely important for them and without companies they would not be able to build the house and realize this project. Thus, in this project there is stronger dependence of the academics on the companies. Although, the industry is less dependent on the academy they have many benefits in participating in this cooperation. The academy is interested in the development of multi-scientific teaching, and this project is a good study case. For the companies it is a good opportunity to develop products and to get an additional publicity, where they can show their best products and competence. The academics recognize that the whole project would not be possible to realize without the financing and the support provided by the companies. Among many researchers access to funding is mentioned as a main reason for the universities to cooperate with the companies (see e.g., Dooley & Kirk, 2007; Zhou, 2008; Gomes, et al., 2005; Henderson, et al., 2006; Carayol, 2002; Austin, 2000; Mets, 2009; Abramo, et al., 2009; Santoro & Gopalakrishnan, 2001; Friedman & Silberman, 2003; Stephan, 2001; Lee, 2000; Sáez et al., 2002; Santoro & Chakrabarti, 2002). The financial support provided by the companies has been vital for this project. Moreover, the companies are giving their knowledge, material and developing new solutions that made possible to build an energy efficient house. One of the benefits for the universities to engage into cooperation with the companies is to get an access to technology, experience and complementary capabilities held by industry (Santoro & Gopalakrishnan, 2001; Dooley & Kirk, 2007; Austin, 2000; Abramo, et al., 2009). Therefore, the companies are playing crucial role in the development of this particular project since universities alone would not be able to take the project of such scale. The relationship with the companies is extremely important for the university, e.g. the companies are giving their knowledge, finance, material and collaboratively developing new solutions that made possible to build energy efficient house. In exchange to that, the companies get possibility to develop their products. The companies collaborate with the academics to gain knowledge for product development and to solve specific problems (Drejer & Jørgensen, 2004; Santoro & Chakrabarti, 2002; Baba, 2006; Lee, 2000; Zhou, 2008). In this project the industry is also gaining a great deal of visibility, positive publicity and boosting their image, which is found

by several researchers as one of additional reasons for the companies to collaborate (Gomes, et al., 2005; Austin, 2000). Therefore, in cooperation the academy and the industry can “leverage their strengths with the help of partners” (Pender, 2006?), and access knowledge, complementary capabilities and competence of their partners (Pender, 2006?; Bignoux, 2006, p.616). In other words, the academy and the industry have “a natural strategic fit- the mutuality of interests that is central to creating strong alliances” (Austin, 2000). Having complementary capabilities and bringing them together makes this synergy to achieve more together than they can do separately (Abramo, et al., 2009, p. 503; Austin, 2000; Bignoux, 2006, p. 616; Tretyak & Popov, 2009; Gebrekidan & Awuah, 2002). Therefore, there is clear common interest by both partners to collaborate in this project (Pender, 2006?; Miotti & Sachwald, 2003). The empirical findings also show that both the academics and the industry representatives have good understanding on the needs of their partners. It means that this cooperation has more chances to succeed, i.e. several researchers state that the understanding of the collaboration and the partner is important for successful cooperation (Dooley & Kirk, 2007; Hagen, 2002; Austin, 2000; Bjerregaard, 2009; Ponds, 2008). These issues are discussed further in the following paragraphs.

In this project the academics pursue the goal of developing science namely in the teaching and research:

Solar Decathlon is a unique project. We have a multi-scientific approach to this. So, it has been a very demanding teaching project, which is very unique process. ...There are many aims- from the teaching point of view our aim is to create a base for multi-scientific cooperation in teaching, studying and research. Students need to get acquainted how is the actual work. (Yrsa Cronhjort)
Of course, for the university the main purpose of the existence is to advance their fields of science or technology, and to educate people. (Naps Systems)

In my opinion it is very important to deal with the guys who do actual work, so if we only stick to the university we would have only the theory, but dealing, for example, with economical circumstances or the facts it gives us much... (Pekka Heikkinen)

The goal of academics in this project is in terms of developing multi-scientific teaching, studying and research. Jacob, et al. (2000) and Gomes, et al. (2005) argue that cooperation is beneficial for knowledge creation, production of theories and models. The collaboration is important for the knowledge creation, where partners transfer the knowledge and create new knowledge together (Pender, 2006?). The academics think that the theory should be more grounded to real problems, and the cooperation with the industry helps to implement it and generate new ideas. Thus, the cooperation with the industry is a good opportunity for the academy to gain an access to real

problems and to adapt to additional practical education (Zhou, 2008; Lee, 2000; Jacob, et al., 2000; Drejer & Jørgensen, 2004; Santoro & Gopalakrishnan, 2001; Santoro & Chakrabarti, 2002), and thus to increase the industrial relevance in research and teaching (Henderson, et al., 2006). Therefore, this allows the academy to be more practical and useful for the society and the industry in general (Gomes, et al., 2005). In other words this academy-industry cooperation is beneficial for the universities in sense that they can develop industrial relevance of science, more practical teaching and to gain “valuable perspective and competency that university alone was unable to bring to the education and developmental processes” (Austin, 2000).

Those students who participate in this project are learning and have benefits for their future employment:

Also for the students who have been involved they gained a lot of experience. And now when it is going to get a lot of publicity it is good for them that they have been involved in the project. Maybe they can get some other work after, at least in their CV it would be a good mark. I see that the students who have been doing the kitchen are learning a lot. For the students it is good to have contacts, they might get later work. (Karola Sahi)

Certainly from the university's perspective it is an excellent opportunity for the students to learn how to design innovatively using wood material, because the whole building is built pretty much of the wood. It is really giving them a case rather to base things on a clear and small scale design, and this is a full scale designed building.... I think they will certainly use it in their educational programs when they are getting the results on the functionality of the material and design techniques, etc. They will be able to utilize that in the education of future students, and also provide new design and techniques. (StoraEnso)

...knowledgeable people that might be future workers for us, that is one of the things of course. (Ensto)

The students who participate in this project are learning from the real case. Moreover, the academics can use this project as a study case for the future teaching, i.e. the teachers can expose students to interesting practical problem (Jacob, et al., 2000; Santoro & Chakrabarti, 2002; Santoro & Gopalakrishnan, 2001). Besides that the academy have a good opportunity to “educate experts for the industry” (Gomes, et al., 2005) through practical education (Zhou, 2008; Keithley and Redman, 1997) and preparing “case study material to support teaching” (Henderson, et al., 2006). Some of the students participating in this project have direct contacts with the company's representatives. Thus, the academics believe that the students have an opportunity for training and other benefits for their future employment. The student trainings and the recruitment of the

graduates in the university-company cooperation is widely discussed by many researchers (see e.g., Senker & Senker, 1995; Baba, 2006; Gomes, et al., 2005; Henderson, et al., 2006; Drejer & Jørgensen, 2004; Carayol, 2002; Lee, 2000; Santoro & Chakrabarti, 2002; Drejer & Jørgensen, 2004; Austin, 2000; Mets, 2009; Santoro & Gopalakrishnan, 2001; Stephan, 2001). The industry also recognizes that such projects are good for the students in terms of learning, and especially for increasing the industrial relevance in teaching.

The academics have other reasons to participate in this project besides development of research and teaching students, which is the development of cooperation between the three universities inside of the Aalto University:

...this was a very good opportunity for our wood studio [University of Art and Design] to have a close cooperation with the wood program [Helsinki University of Technology] and this is particularly interesting project. ... For us as a part of Aalto University this is a pilot project of working together with TKK's wood program. (Karola Sahi)

We had an official goals like emphasizing the cooperation between different sciences and also supporting the cooperation between the university and industry. (Pekka Heikkinen)

The project is implemented by the Aalto University, which contains three different universities, and it is a good starting point to develop cooperation practices between these universities. This project is interesting in that it combines three universities from different scientific fields working on the single project. The academics recognize that it is a good opportunity for the universities from different fields to combine their expertise and techniques when working for the same goal, and contributing into the development of Aalto University and multi-scientific teaching.

It is a collaborative university-company R&D project, where the knowledge and research produced by the academia is used by the companies in the development of products:

Isku is involved in the work with the kitchen, we are developing completely wooden based kitchen, framing and everything in wood, and we are testing new development effect of the effex panel kitchen. It is a development work, that is started here and now we are developing further with Stora Enso that products for the kitchen. Also the design of the kitchen is the development project together with the ISKU...there also has been researches on the moisture buffering effects and things like this of this panel and development. Research on the surface treatment of this panels, and now we are trying to develop new product that can be used in kitchen furniture as well. (Yrsa Cronhjort)

...they [university] have taken this material and then innovated it further to maximize the moisture buffering capacity, and at the same time getting this very nice visual aspect. ...one of the really interesting aspects was that the project was trying to focus on the developing moisture buffering as a means to manage the climate inside the building. ...Our effex material has been used as wood material to do that, and the team here developed an innovative profile for the material to maximize the moisture buffering capacity of the wood. I was in the early stages giving some feedback and some ideas of how this might be working or not, and some seminars. ... One of the aims is to get more scientific recognition of some of functionalities of this wood material we provide. ...We wanted to have an opportunity to prove that this can work also on the full house's scale, and what is the real impact of it.... Certainly the expectations are that we will get the scientific evidence of the functionality of our material and the prove that it has a positive benefit when using our material in this type of building, (StoraEnso)

I do not see too big difference; they are as clever as we are. I think it has been working very well and as a two way of transformation of information and creativity. I think it is very good, that if you have an idea you develop it and then you present it to somebody and then you have a feedback and that generates something new, hopefully. ...And of course developing the research in energy efficient and material efficient building. (Pekka Heikkinen)

And we also developed together junior ideas how to increase the productivity of these PV's... (Kimmo Lylykangas)

Then another thing is that it gives us scientifically proven data of the building, because it has been measured and evaluated, and then we will get a third party's opinion and verification of our products. It is important when it comes to the credibility. ...So, they have a real world connection to what is happening in the industry actually. (Ensto)

...And then this innovation minded architects and students are challenging me and as well as other partners all the time with something could you do this, could you do that. Fancy ideas are being developed every minute with them. And they need to be grounded at some point to something that really works and could be done in this scenario. This means that this conflict has been creating something new. (Naps Systems)

The academy and the industry both benefit from this project since they collaboratively test the products, conduct research, and develop new products based on that. This project proved to be beneficial for the industry partners since they could collect scientific evidence, test and develop new products. There are clear benefits for the companies that they can use the knowledge and the research produced by the university at a low costs while developing their products that helps to maintain the competitive advantage (Gomes, et al., 2005; Hagen, 2002; Dooley & Kirk, 2007;

Austin, 2000; Barnes, 2002). Some researchers state that increased productivity of R&D processes enhance the performance of the firm and thus its competitive advantage (Carayol, 2002; Dooley & Kirk, 2007). Such collaborative projects are beneficial for the companies and the universities, where they can share the costs and risks (Caloghirou, et al., 2001; Barnes, 2002; Hagen, 2002; Gebrekidan & Awuah, 2002), exchange the knowledge (Dooley & Kirk, 2007; Henderson, et al., 2006), and test the theories and real products. In the collaboration with the academy the companies gain an access to greater scope of ideas and scientific knowledge than would be possible in-house (Baba, 2006; Levy, et al., 2009; Lee, 2000; Sáez, et al., 2002; Barnes, 2002; Santoro & Chakrabarti, 2002; Nordin, 2006). In some cases the companies have a lack of internal knowledge base for the R&D and are forced to complement their business analysts by delegating some activities to highly skilled researchers (Hagen, 2002; Gomes, et al., 2005; Lam, 2007, p. 996; Dooley & Kirk, 2007). Also the participants have more initiative to cooperate if the project is complex, risky or expensive (Miotti & Sachwald, 2003). In other words, the collaborative research is a great opportunity for the companies to improve technologies, processes and products at lower costs (Zhou, 2008; Santoro & Gopalakrishnan, 2001; Grossman, et al., 2001; Caloghirou, et al., 2001; Lee, 2000; Henderson, et al., 2006; Gray, et al., 2001). Thus, it is beneficial for the industry to outsource “verification activities to their partner university” (Dooley & Kirk, 2007), and to use the scientific research as “a source of knowledge for product development projects” (Drejer & Jørgensen, 2004). There are clear benefits of the “participatory research methods that involve the researcher and the practitioner in a process of continuous dialogue” (Jacob, et al., 2000). For instance, the industry obtains scientific evidence and can test the products. For the academy it is also beneficial since they can complement their academic research (Lee, 2000), gain new research ideas (Gray, et al., 2001), and increase the industrial relevance of science (Henderson, et al., 2006). In other words, it is a mutual learning process where both participants benefit (Jacob, et al., 2000; Gomes, et al., 2005). The academy’s benefit founded in this cooperation is that the prior research can be tested in a real case and the university could receive faster feedback from the companies to develop their research further (Lee, 2000; Dooley & Kirk, 2007; Baba, 2006). This generates the “faster feedback loops” (Dooley & Kirk, 2007), where the research can be tested and verified in shorter time spans, and the results can be forwarded back to the academics for further research. Therefore, both the academics and the industry benefit from the collaborative research in sharing costs and risks, developing the science and the industrial products and technologies.

This project is also a good real case for the companies, where they can test their products and solutions:

ENSTO said that they cannot do this kind of development work without the real case. We need real case, to do project together; so that we have all parts linking together – then we know the results how the house is functioning. (Karola Sahi)

This was suddenly an opportunity to test it in real life, because so far it has been in a laboratory conditions and so to say in a small scale, but this is actually a real case where we can test and prove the benefits of wood as means to remove and release the humidity inside the building. (StoraEnso)

For the companies it is a good chance to gain new ideas, improve existed industrial technologies and to adjust their technology in the real problem. It is also shows that the companies need interesting cases that they can develop their products and processes. Therefore, this project is an excellent real case, where they can build competence in testing and developing products. (Zhou, 2008; Santoro & Gopalakrishnan, 2001; Grossman , et al., 2001; Caloghirou , et al., 2001; Lee, 2000; Barnes, 2002; Dooley & Kirk, 2007). It is important not only for the companies but for all parties to have a real case to develop their areas of expertise. In other words, the real case provides an opportunity for the academy and the industry to test the theories, models or products in reality.

The academy-industry cooperation has a learning effect not only on the universities but also on the companies:

Also an opportunity to learn from the project, to learn the way it has been constructed and gain an idea of how our material can be used in different ways... then it will give us inside of how we can develop our products further. Our product development case is to utilize the learning project....I think it is very important the cooperation, ...it gives us an opportunity to understand especially from the aspect of architecture how our material has being used and how the potential are to use our material in the future (StoraEnso)

...at least now we learned how to make them and we can modify them whenever it needed. (Naps Systems)

We have learned a lot, we have now learned few very essential things, and now we are at the best knowledge, we have most actual information about the eco-efficient building. Of course, we gained a lot of interest from media, from surrounding society, our students learned a lot. ...to learn essential issues of using renewable energy sources, using renewable materials in building, creating new ways of building in wood, and so on. (Pekka Heikkinen)

Mainly the subject of this house: how to develop more ecological solutions in furniture design and learning from the project. It is not cooperation, but to get knowledge by this project. (Karola Sahi)

The academy and the industry's representatives admit that they learned a great deal in this project and are planning to use the knowledge gained in their future activities. In this project the academics gained knowledge and learned essential things, including about energy-efficient wood construction. The companies also recognize that it has a positive effect on their learning and getting new ideas, new perspectives in order to develop products further. In other words, the companies gained an access to knowledge network and they can utilize the knowledge and ideas of the academics in the future (Gomes, et al., 2005; Jacob, , et al., 2000). Thus, this cooperation has been beneficial for the mutual learning and developing (Gomes, et al., 2005; Jacob, et al., 2000; Gebrekidan & Awuah, 2002; Tretyak & Popov, 2009).

This cooperation will be used by the academy and the industry in promotion. For instance, the companies want to use it in the marketing and promotion of their products:

...from the marketing perspective to be able to show the case, the project of how the material has been used, and use it as a case when promoting for our potential industrial clients that our material can be used also for example we have the kitchen that is totally made out of our material, and we can show the furniture manufacturers that you can make kitchens from this material, and all the walls can be used, etc. So, it is an opportunity for quite good marketing and promotion.... Then the building will be moved to Spain we will exploit an opportunity also to invite potential customers and visitors from the Spanish market to visit also the building and show case and the material in the Spanish market... (StoraEnso)

We wanted to be there as their partner, so that we can be proud and utilize the brand advancement or the fact that there is maybe hopefully such winning house or close to winning house, where people go to admire and see, saying "wow, that looks great", and we can say that we did it. (Naps Systems)

For the companies- we are aiming in this project to show all the best possible Finnish techniques, materials, which are available in Finland today. Of course, it is a promoting project for the companies, but also promoting the cooperation between universities and companies. (Yrsa Cronhjort)

In a university's level it is a promotion of the knowledge and the know-how we have, multidisciplinary cooperation. Educational aspect is very important. It is something we are now more ambitious. So, I guess it is profiling us in the international context. [For companies it is...] Publicity and profiling themselves among the most innovative and cutting edge technologies, and making themselves known as something they can supply the newest technology whenever it is needed. (Kimmo Lylykangas)

We get a reference out of this even if it will not be a winner. ...We still have a reference that we are the pioneers in doing it. So, we will have a forerunner or pioneer position in doing it. (Ensto)

The industry representative's states that they need to have this case story to show to the potential customers how their products can be used and what they can do. This is probably one of the biggest benefits for the companies to engage into cooperation with the academy for the promotion and marketing. Although, this issue was not directly stated in the literature, researchers recognize that the academy-industry cooperation has a positive effect on the financial situation of the company. The cooperation helps the companies to generate income and business, expand networks and markets (Jacob, et al., 2000; Gomes, et al., 2005; Austin, 2000). Therefore, the companies have strategic aims when entering into cooperation. Another reason for the companies to participate in this cooperation is the brand promotion, i.e. all companies are getting a lot of publicity out of this cooperation, which they can also utilize in the brand promotion. It is a promoting project for the companies and for the universities, as well as promoting the university-company cooperation. Therefore, the project will have an impact on future relationships between the universities and the companies. The academy is also promoting and profiling itself even in the international level with the help of this project.

In this cooperation both the academy and the companies already got a lot of publicity:

... we expect to get the media coverage for this building. It is already has been on the national television here in Finland, and I am sure they will continue to get coverage. (StoraEnso)

We expect lots of positive publicity, which we already have actually seen. There is a lots of stories in Finnish media- radio, television, papers, magazines. And we expect this also from the broader perspective, especially from European marketplace. It is been there already before the competition, but the competition week is important from that perspective. ...They [the university] also get the publicity and Helsinki University of Technology or especially the architectural department of University of Technology, I think, there is some famousness in them, because there are some named Finnish architects, and they might be able to promote they name... (Naps Systems)

.... It is very unique, plus energy house in Finland. It will give a lot of good knowledge for everybody involved in the project and the publicity later for the companies. (Karola Sahi)

First of all, we want to be recognized in this project through the publicity as a supplier of the energy-saving equipment. (Ensto)

The industry representatives admit that they as well as the academy have an advantage from the positive publicity. It is beneficial for both of them to get numerous amounts of positive publicity to boost their image. This project gives a lot of visibility and prestige to all participants (Abramo , et

al., 2009; Gomes, et al., 2005; Keithley and Redman, 1997; Dooley & Kirk, 2007; Austin, 2000). This is strategically important for the industry since the positive image helps to generate the income in the future. For the academics it can be also a good “marketing tool to attract students, faculty and additional industrial research support” (Friedman & Silberman, 2003). Therefore, such a cooperative project is advantageous for the academy and the industry since they benefit from a large amount of publicity that can boost their image.

One of the aims of the companies is to educate future designers to use their materials:

A great thing is that the international students we have here, and this means that this information and knowledge is transferring around the world, which is only a benefit for wood producing industry, because it means that now young architectures are being trained how to design innovatively using wood... this is an opportunity to influence the future users and designers of buildings using our material. I think we also have a responsibility to assist in education of future users and designers. If we do not actively working with them then they do not have a motivation to work with the material. So, it is a very close connection. (StoraEnso)

...to get fresh ideas and also to get like professional customers' opinion. Because these students are going to be designers... (Karola Sahi)

The information and knowledge transfer is beneficial not only for the development of science, but also for the industry. The companies want to educate young designers to use their materials, which is important for the company's future income. It is beneficial for the companies if young architects start to use their products, i.e. this means that they can again increase their market and future profits. This issue has not been stated in the literature, but again it relates to the economic value of the company (Jacob, et al., 2000; Gomes, et al., 2005; Austin, 2000).

4.2 Challenges in Cooperation for Both Parties

The whole project has been very successful for all participants. Therefore, there are not many challenges identified in this cooperation project. The main challenge for the academics was to make many participants from different fields to work on a single target:

...we have done cooperation together with companies. But this is different, because we are making cooperation with so many participants at the same time; everybody is doing cooperation in its area. (Karola Sahi)

It has been very heavy for both teachers and students, it has been much larger than we expected at the beginning, the cooperation between scientist and chairs has been very challenging, demanding a lot more work than we expected, but it has been a rewarding project. ...For example, we have a lot of students from different sciences, the cooperation between students- how to get them to work together on the single target. The multi-scientific impact- we had a lot of students from different chairs- technicians, marketing, architectures, lightening. ...Different students have different way of working, commitment of students, not everybody is willing to participate at the same extend. (Yrsa Cronhjort)

One of the biggest challenges is the project organization, and I think in this sense we did not success. We have very active core group that has done a lot of work, but I think it could be bigger, and it could be more interdisciplinary in a core team. Now we have architects, it should be more engineers, it should be more representatives of the HSE, and maybe also designers. So, this we could have done better. (Kimmo Lylykangas)

The challenge is gathering people from different areas of expertise. We have wood working specialists, architects, HSE's people, electrician, solar power people. ...It is how to join it together, that is the challenge. I would not say that there is some big problems, but those are normal issues that are being handled easily. (Ensto)

The project is very challenging in terms of teaching and cooperation between participants due to the scale of the project and number of people involved. This project combines many parties from the academy and the industry. Thus, the project is very extensive, and the challenge is how to coordinate it and to make many participants to work for the single purpose. There are many organizational and managerial issues arising in this project, for example how to motivate everyone to work for the same goal, making decisions and handling challenges. The academics also think that this project should be organized better and that all participants should be more active. Therefore, the main challenge arises due to the need to manage the project. It is obvious that weak project management can destroy the cooperation and have a negative impact on the entire project (Gomes, et al., 2005; Jacob, et al., 2000; Senker & Senker, 1995; Abramo , et al., 2009; Austin, 2000). Jacob, et al. (2000) state that there is “a need to shift the focus of attention from discrete projects and the funding arrangements for these to that of building a relationship between the research team and the practitioners with whom they interacted”. Thus, building a relationship, good project management and efficient communication between parties are essential.

Another challenge has been due to the fact that some of the students finished their work and left the team, which created more communication and informational exchange from the academics and the companies:

What cost us some, not difficulties, but extra discussion launch is that there has been students that has done their share, done their thesis and has gone away, so that there is a leaving team, it is not the same team from the start to the end. So, there are new people which need to be talked more with. ...Personally, from the beginning I adopted that ok, it is a university project and this is expected. I would expect that the key people stay there, like Pekka and Kimmo. It was natural from the beginning that students will come and go, and this is supposed to be a student project so that is ok. ...Because there was an understanding from the beginning they are not problems. (Naps Systems)

One company states that they had to have more discussions with new students coming to the project, when other students have finished their work. However, this was not a huge challenge, and the company's representative was ready to accept such conditions. This shows that partners should be better prepared and have a common understanding before starting the project, i.e. some circumstances should be accepted in advance. Thus, the partners should improve the evaluation of each other, encompass a better understanding of the cultural differences and gain a mutual understanding between partners in general. The researchers state that partners should have mutual understanding (Ponds, 2008, p. 80), to have shared understanding about the project (Bjerregaard, 2009, p. 105; Austin, 2000) and the complexities involved (Hagen, 2002), "understand how the collaboration works and the routines in place to facilitate this" (Dooley & Kirk, 2007).

In some cases the decision making can take longer time that could be a challenge for the parties:

... it took a while for them to make a decision to come into this project. It has been influenced from this time area that companies have problems with the financing at the moment. So, it took a little bit more time from ISKU to decide to be in the project, we could start a month earlier. (Karola Sahi)

One thing is may be that all this fancy ideas took from the university time to make an order. At the end of January I had to warn them quite strong that if you want electricity in the house in summer you have to place an order. ...Maybe this tendency of changing goal, because in the industrial projects most often there are quite specific requirement that has to be met. In this project the goal changed its position. It perhaps something that they did not really understand that we could not purchase the parts before we knew what for. Some slowness, some bureaucratic twists that maybe

is expected. But those are also within the expectations; they are natural, and also priced that they are not that bad. (Naps Systems)

One company had to decide about engaging in this project since the whole project is extensive and costly. This means that it is necessary for all parties to evaluate all the costs and benefits of the project before joining. Although this project is costly it obviously has good implications for the publicity and image for all participants since the project is aiming at building the first zero-energy house in Finland. Another company experienced a long decision making process by the academy, because of the tendency of changing the goal and some bureaucracy. However, this issue was solved and it was within the expectations of the company's representative, i.e. it is not stated as a problem. This shows that pre-planning process, negotiations and decision making can take longer time. The partner selection and the planning stage should be better thought-out to reduce uncertainty (Drejer & Jørgensen, 2004; Hagen, 2002). Jacob, et al. (2000) state that organizations can have "time consuming start up negotiations with key actors", therefore partners should be ready to expect this. It is obviously that the academy and the industry have different cultures that should be taken into consideration (Dooley & Kirk, 2007; Jacob, et al., 2000; Senker & Senker, 1995; Gomes, et al., 2005; Drejer & Jørgensen, 2004; Hagen, 2002; Austin, 2000; Hadjimanolis, 2006; Barnes, 2002). Although, the cultural difference is often seen as a barrier for collaboration and for the transfer of knowledge (Bjerregaard, 2009), the partners should be aware of this difference and to accept some conditions. For example, the academy has longer time spans while the industry moves faster (Gomes, et al., 2005; Dooley & Kirk, 2007). The negotiations are also different, and the academy might have more bureaucracy involved (Hadjimanolis, 2006). All of these should be considered in order to lower risks. According to Gomes, et al. (2005) the partners can have "conflicts because of imprecise expectations". Therefore, the academy and the industry should acknowledge the differences and place them within the expectations.

Intellectual property issues are sometimes challenging, for instance, if companies start to produce products which are developed in the project, the rights of the designers (students) can be under question:

Now it is tailored for one house, but if they take it to the production... From the student view it has to be clear the rights of the students- if it is going to be a good invention, then the rights of the students should be taken seriously. Who gets advantage of the invention? The designer should have right on the invention.... It is still a problematic thing. What happens then if they start copy this product? Because of the material it belongs to StoraEnso and they have rights for their

product, but where is kind of limit, the border between different actors in this project? It is important. ...It is not a problem in this case, it is a larger question. (Karola Sahi)

The only disadvantage is that of course what we are doing, what we are developing is totally open for our competitors. So, because it is on a public domain this means that all our main competitors see what we are producing and what we are doing. The only downside is the competitiveness or let's say it is not possible to keep secrets. You have to decide before going to this project what you want to show and what you want to keep secrete, and then you only release the things you want to show in the project, and hold the rest inside. Otherwise your competitors find out what you are doing. ...It is not possible in this particular project related to these products we produce, because it is a public knowledge. We protect anything that we are learning from the project, and then of course we keep it in-house and develop the ideas further. That is the only downside in protecting intellectual property. (StoraEnso)

We decided not to apply any patents or any protection for the ideas, and there is no clear owner for the new innovative ideas. I guess this is pretty much undefined and unclear territory of the project. But also protecting ideas would block the ideas from dissemination and getting used in a broad. We are hoping that they would be used by the construction industry, but do not hoping to benefit ourselves. I think creating innovations would be more and more important for us in the future. But maybe this is something that we could have done better – the strategy how to handle this innovations being created in the project and how to protect them. This time we did not have it and all the innovative ideas we had already are published and shared. (Kimmo Lylykangas)

IPR, leaking out of the team, ok it is not that important, we are not doing anything so inventive that others could not follow anyway. Later, then they see it on the roof they can say “ok, we can copy this”. There is nothing we can do about protecting them. This information could leak out so to say prematurely, but I think in this project it is not that relevant, because it is one of the purposes to disseminate the information. (Naps Systems)

We share the knowledge. I do not think that somebody should hold the knowledge, because if you spread the knowledge then things get working most easily. (Pekka Heikkinen)

The intellectual property issue is one of the challenges arising in cooperation with multiple parties (Mets, 2009; Ponds, 2008; Grossman, et al., 2001; Siegel, et al., 2001; Hadjimanolis, 2006). It is not a problem in this case rather a bigger question how to solve the property rights issue between the company and the university. The collaborative project can be very extensive and it is difficult to decide who owns the ideas. In some cases the intellectual property rights can inhibit companies from partnering with universities in R&D projects (Hall, et al., 2001). Dooley and Kirk (2007) state that “universities fear that industry may steal their discoveries and generate revenue streams

that rightly belong to the university”. It is obvious that challenges like this can be solved through constructive discussions and are not a main barrier for the university-company cooperation. The companies do not see the issue of IP as a problem particularly in this project. Moreover, they think that it is a public knowledge and should be shared. They understand that what they do is open to the competitors and it is important to keep in mind this issue when deciding to cooperate or not. However, the companies are learning in this project and plan to protect the knowledge generated from this cooperation. The academy thinks that knowledge should be disseminated and they do not want to have any patents from the project.

The limitation in company’s production line was another challenge for building customized products for this project:

I think there are still some limitations in their production lines- you know we are anyway based on their production lines- they have certain wide for the cupboards. It is not going to be tailored kitchen. Their way of producing has given us some limitations. So, we had to use certain standardization, standards in the design. (Karola Sahi)

In this project it was not possible to build totally customized furniture for the kitchen since company’s products are limited by the size. Thus, the university and the company had to find new solution to this limitation by means of constructive negotiations. Probably it is not a main barrier in cooperation, but it made an additional challenge in the university-company cooperation in this project. It shows that university and company need to have common understanding (Dooley & Kirk, 2007; Ponds, 2008) of the project and negotiation skills to handle any disagreement (Keithley & Redman, 1997; Hagen, 2002).

The companies have many business projects and in some cases they are de-emphasizing the projects with the academy:

I think that the big problem in cooperation with the companies is that they have basic line running and this are, so to say, extra projects; and if you queue in front it is possible that they move you back here, because this are professional projects. There always will be real projects that they will go first. Companies should have more input in this development. (Karola Sahi)

Of course, when we are dealing with the biggest actors on the industry they have plenty of projects going on and this is...like for us this is priority number one, but for them it is priority number 76 or something like that. That of course, makes our work sometimes a little bit difficult. Of course, in our project has been difficulties and I think they thought the same. (Pekka Heikkinen)

The academics accuse the industry in de-emphasizing the projects with the universities. They think that companies should put more priority on cooperation with the universities. Although this issue seems significant for the academics, it was not mentioned by other researchers in the literature. Like any organization, the companies have many projects and they prioritize them based on the importance, economical value and future benefit. Therefore, the companies can be interested in the projects, which are relevant for the development of their products or processes. Abramo, et al. (2009, p. 503) argue that “collaboration must present significant strategic, economic or financial returns”. Moreover, “the research has to be of sufficient priority for all stakeholders to ensure the necessary resources are available” (Dooley & Kirk, 2007). In other words, the companies should see some benefit from the project in order to participate in it. Also companies are looking for “productive academic results available to be capitalized” (Zhou, 2008), the knowledge should “contribute to the development of the firm” (Drejer & Jørgensen, 2004), and “there is also a demand for more specific knowledge, more directly focused on problem-solving and product design and development (Sáez, et al., 2002). Thus, the academy should provide the knowledge that can be directly applied as well as interesting projects that the companies have personal interest and can benefit from when participating.

The companies want to have better communication. One company was asked to supply more material and to pay additional money for the advertisement:

...we have been asked to supply more and more material than we had been agreed on the certain amount, then we had been getting a questions if we can provide more of certain materials because they liked it so much and they want it more. So, from the budget perspective we actually exceeded our budget in supplying material. We just accepted that as a part of the project. We want to see our material to be used as much as possible, so we just accepted that, but we clearly exceeded our budget. Maybe this could be communicated and discussed better. Let's say handling of the budget that what we as a company has been providing and monitoring it more closely and we could be asked before more ordering. Out of that no problems. ...I was not happy about is that we were advised to if we want an advertisement and marketing of our material during the competition we have to pay additional money for doing that and I already sent the feedback to the organizers saying that this is not so favored because we believe that through the participation in the project and financing, and providing a lot of material we should at least get free advertising and marketing from the building. (StoraEnso)

With somewhat better communication. It is normally a problem. Even we have a lot of things to do, we still expect that the proceedings are communicated. That keeps all of us aboard. (Ensto)

One company has been asked to supply more material than it was agreed beforehand, this caused the company to exceed its budget. Although, the company's representative does not find it as a big problem, they believe this should be discussed better. Another issue is that the company was asked to pay additional money for the advertisement, which they think they should not pay since they sponsor the project. Hopefully, this problem will be solved by efficient communication and mutual understanding, and would not have a negative impact on the future cooperation. Thus, this project was lacking better communication between partners. The communication is assumed to be important for successful collaboration (Austin, 2000; Dooley & Kirk, 2007).

The project is big and risky for both participants:

I think pretty much they hold risks in terms of how the results of the building turn out and how time tables are kept, etc. They hold all risks. The only risk we hold on is that if there is a major failure of the building or it does not work well, there is negative publicity that might come from it. (StoraEnso)

we do have a lot of risks. We can fail in a technical performance. I think one of the risks is that if we are the 20th team after scoring in competition, than it is a failure. We would like to avoid that.... It is a bad message for our supporters, saying that we have not been successful. I would not like to have this position. ... One of the ideas is that we must to begin to evaluate the house here in Finland, before it travels to Madrid. Then, one failure would be safety if somebody will get hurt or injured. We have good safety plan for the house, and we just need to go through it very carefully. I think all the decisions we have done so far have been maximizing the security. We also use professionals to build... The financial risk is of course. ... It is important for them, but if it fails then it is our fault. We would not blame the companies or systems. It is our house and we are responsible for that. (Kimmo Lylykangas)

First of all financial risk, when going in there was quite mutual understanding that they would purchase the system from us, but there was no definite commitment, so we were in a competitive situation after all. ...Second, of course, is the performance risk, which I consider small, because we know what we are doing, but it is there- we can fail. We have made the modules, we tested and looked them and they work good, but still project can fail. For example, they can be broken down in the assembly process and we do not have them, and then the competition house will be send without solar energy system to Madrid. This I consider small. (Naps Systems)

...for example at the moment they are lifting the house and it is the biggest risk...it might break down. And then of course, we have risk on deadline, we have the economical risk and we are

carrying it 100 %, and I do not think that it is shared risk... It might be that we have 100,000 euros minus in this project, so it is a big risk, and nobody helps us with that. (Pekka Heikkinen)

The industry thinks that the academics hold all the risks in this project in terms of the results and timetables. The only risk for the companies is a negative publicity, which might come if the project has a major failure. The risk sharing is a decisive decision in case the risk is big (López-Fernández, et al., 2008; Drejer & Jørgensen, 2004). In that case participants need to evaluate better either to participate in the project or not. It looks like the risks in this project are small for the companies, because they trust their products and the benefits of this project is sufficiently bigger in terms of the publicity. The academy has many risks in this project, which are the failure in the competition, safety risks, technical performance, deadline and the financial risks. In order to avoid this risk they are analyzing and evaluating the house before the competition, and trying to get the highest points in each contest of the competition. They have a good safety plan and are using the assistance of professionals to maximize the security to avoid injury risk. The financial risk is also present. This project has been very risky for the academics, and they carry all risks alone.

Raising money has been challenging in this project:

The challenge was that it was an economic depression at time we had to ask for the support, so it was very difficult for many companies to say yes on our request, but they still did. I think that if the time would be better we could get much more support. ...We have this resource challenge, our team has the smallest budgets out of all. With the biggest budget it would be easiest to fund the project, we could buy whatever we need and to hire professionals to help us, but we have done with the smallest budget. (Kimmo Lylykangas)

In Finland you should put a lot more money in R&D, and in addition to industry's money we need government's money. For example, in our project our budget is 600,000, build not more than 600,000- 700,000 euros, but for example, Germans they do it with 1,6 mil. euros... (Pekka Heikkinen)

The academy needs financial support from the companies as well as from the government, but as this case shows it is not as easy as it desired. Obviously, for the companies it is also an important decisions where to invest their money and what project to prioritize. Although previously in the analysis section one company stated that they were asked for more materials and additional financing for the promotion, the academics state that they needed bigger budget that it would be easier to implement the project. As it has been discussed before the funding is one of the reasons for the academics to cooperate with the industry (see e.g., Gomez, et al., 2005; Zhou, 2008;

Henderson, et al., 2006). Rising money has been a challenge in this project, i.e. the academy had not enough finance to implement the project.

Another issue related to the financing is that the short-term orientation of the funding is a problem for the academic research in general:

One of the challenges for the research in general in Finland is that funding by Tekes and other funding organizations are short-term, but in reality you have a half of the year to start to put this organizations and maybe one to two years of actual work and then you started to wrapping it up as a report, and getting funding for the next project. So, I think this kind of fragmentation of the research is very bad for the research. So, there should be better ways of having research funded long-term, then in short pieces, always changing topics and targets. Good academic research would take from 5 to 10 years, and with the present funding system it is not possible. This has to do with company cooperation as well, whenever you start the project you have to contact them, you have to tell them that we now are trying the new project again, and we need your money, but that could not be long-term targets. (Kimmo Lylykangas)

I think it comes from the nature of the work. In science society you are focused on some problems, and you might be thinking too abstract, the industrial people are thinking quite straightforward some years ahead....They are speaking same thing but industrial people are thinking of things happening today or within a three years, but the science community might be dealing with things that are happening in 20 years. It is not a mistake, it is not a big problem, but they need to find the right fit and at what level... (Ensto)

The academics think that the short-term orientation of the financing whether from the Tekes or from other organizations or the companies is not favored for the academic research since it usually takes much longer time. However, one company states that there is a difference in the nature of work between the academy and the industry, e.g. they look for the specific short-term projects and cannot wait for the results. They also recognize that it is not a problem, but it demands more effort to find the right fit between two sectors. This issue of differences in the time spans and nature of work is also stated by many researchers (Gomes, et al., 2005; Dooley & Kirk, 2007; Austin, 2000; Bjerregaard, 2009; Hadjimanolis, 2006).

The small company's size can impede the collaboration:

We are quite small company, we are about 20 people, so we cannot permanently marry with the university department, but as I said it has been quite investment form us, especially using my time so much in this project. We cannot continuously do things like this. But definitely, considering

Finnish universities there certainly will be projects every year. We do something with the universities all the time. (Naps Systems)

If you have a small company they have so hands on in their daily issues, that they just do not think of using the university as a partner, because it has been regarded as a bit distant, theoretic, not so easy to approach, and the subject that has been handled there let's say can be from the stratosphere, but they are on the surface of earth. These are perceptions, maybe not true, but the average people might think like that. But when you get to know the guys from the university it reopens up that ok they are also some ordinary people, then the real co-operation starts. (Ensto)

The small companies have fewer resources to participate in the cooperation projects with the academy. In the literature review it has been indicated that the larger firms have greater tendency to cooperate with the research institutions (López-Fernández, et al., 2008; Lam, 2007, p997; Santoro & Gopalakrishnan, 2001; Fontana, et al., 2006). Larger firms have “greater technology transfer activities due to their slack resources” (Santoro & Gopalakrishnan, 2001), and therefore they have “a higher probability of benefiting from the academic research” (Fontana, et al., 2006). This project proves that smaller firms are cooperating less with the academy.

Some of the companies decided not to participate in this project:

Although we have been successful on gaining partners, but it has been in some cases much more difficult than I have been expected that some of the partners, I thought they should to participate in this kind of project, were not interested in that at all. I think it was mainly the money. (Pekka Heikkinen)

There were companies that we were hoping to participate, but they were not willing to do so at the end. ...manufacturers of well known Finnish products that we thought we would be presenting in Madrid, but finally we are not. ...I think that the concept of zero-energy house does not bring anything new for their business. That is the problem. So, it would be just promotion of products for them, but no knowledge gained. (Kimmo Lylykangas)

The academy states that some of the companies refused to participate in this project, probably because of the bad economical situation and the problems with the finances, or maybe because the project would not give them any new knowledge only the publicity. As it has been stated previously the R&D projects should be of significant strategic value for the companies and also other participants (Barnes, 2002; Zhou, 2008; Gray, et al., 2001). Therefore, for some companies only gaining the publicity was not enough and thus they did not see the deal in this project.

The communication of the project has been challenging:

Now all the results that we have been focused on the building the house, but we have a lot of communication to do also. We need professionals to do that, and that could be done better.... One risk could be if we fail in communication, and for that we are using now consultants from outside, who plan the communication very carefully. The failure would be if the public opinion is that it is something special that cannot be done in reality or just special and expensive gadgets that could not be in everyday construction then we failed. That we want to avoid. (Kimmo Lylykangas)

One university's representative pointed out that they have been concentrating on building the house, but the communication of the project has been suffering, and therefore they had to use some outside consultants for effective communication. The academy wants the public to think that it is not expensive and it is easy to implement in everyday construction. Thus, the communication of the project to the larger public can be also challenging. This issue was not discussed in the literature.

4.3 Fostering Factors for Both Parties

In this project the participants have been working for the common goal of building the first zero-energy house in Finland with the Finnish products. This has been a good motivation for all participants:

We have to build- for our CO2 emission targets- national target of reduction 80% CO2 emissions until 2050. ...In Germany there are whole towns using solar energy. (Yrsa Cronhjort)

The main target I would say is to make a statement that Finnish know-how of wood construction, energy-efficient construction is competitive wherever in Europe. That we can build this energy-efficient house based on Finnish know-how and products wherever- in Spain, in Finland- wherever in between. (Kimmo Lylykangas)

And then there was certain patriotism, they wanted to collect a team of Finnish makers, collect Finnish sort of we can do this. ...there was certain patriotism, so they were actively looking for Finnish companies capable of doing certain things. (Naps Systems)

First of all since we have a common target, we are more or less committed to supplying this plus energy house and we wish that it is going to be a success story in Madrid. ...Common target that everybody recognize. It is easy to cooperate when you have a common target. The second thing is quite clear, not completely clear, but quite clear division of work. Who is doing what? ...It is better than average so far. I think we succeeded quite well. We have this clear target of what we

are doing, so it is clearly defined problem, clearly defined schedule, and the deliverables are well defined. (Ensto)

It seems that working on an important, common goal unites and motivates participants to work harder. Beugelsdijk, et al. (2008, p. 313) state that “perceived goal interdependence leads to positive interaction”. Understanding that the whole project has deeper meaning, besides basic aims for every partner, makes people interested and committed to the task. Austin (2000) argues that “social purpose partnerships appear to be motivationally fueled by the emotional connection individuals make with the social mission and with their counterparts in the other organization”. This project unites people with different backgrounds to work on a common mission of building the first zero-energy house in Finland with the Finnish products and know-how. These people have in mind the national target of reduction in the CO2 emissions, and compete and compare themselves to other European countries more advanced in this field. The academy wants to display and promote the Finnish know-how, that Finnish companies and architects are capable together to solve even more complicated issues. Therefore, in this project the participants have an emotional connection with the social mission, Finnish know-how and products, i.e. they definitely have patriotism and nationally competing with other European countries in advancing the energy-efficiency. This common goal unites people to work harder, i.e. the Finnish “sisu” (strength of will) is particularly present in this project. Besides that the participants had a clear goal, which only encouraged the cooperation. According to some researchers it is necessary to have clear objectives and the cooperation should remain within them (Senker & Senker, 1995; Dooley & Kirk, 2007; Austin, 2000; Bjerregaard, 2009; Hadjimanolis, 2006).

The energy-efficiency directive made many partners to be interested in this project:

We would build the house anyway, but during the preparation of the house to the competition, they also announced new energy-efficiency directive for the buildings, and good luck for us was that it says that from 2021 on all the new houses should be zero energy houses. So, the good thing was that everybody is interested how to build this type of house here in own market area. For this reason we gain a lot of attention and support. It has been supporting the cooperation with the companies that we are doing now something that has bigger meaning and serves us as a demonstration of future construction. (Kimmo Lylykangas)

The academy’s representative states that this project has an interest since new energy-efficiency directive has a sufficient impact on the construction industry, because in 11 years all new houses should be zero-energy houses. That has a huge influence on the development of the energy-efficiency in Finland in the research and the products. Thus, the subject of the project is a hot-topic

in Finland and gained a lot of interest from many parties. In other words, with a new energy-efficiency directive the policymakers unconsciously made all the participants interested in this project. This social mission (Austin, 2000) and shared goal (Beugelsdijk, et al., 2008; Pender, 2006?; Fang, et al., 2007) motivate the companies and the universities to cooperate.

The whole project is fostered by the fact that the companies are very interested to participate in the project and are taking initiative by themselves, i.e. they are very motivated and committed in this project:

I have been positively surprised- they have been very keen on the project. ...Isku has been very positive- even though we are using many their basic elements, they still try to find new kind of solutions that they can use their normal production, but anyway to do it like a tailored purpose. ...The cooperation with Stora Enso was fruitful as well. They are very interested in this project and want to develop their products, and these effex panel products. ...I am very positively surprised of Isku's attitude to this task. ...so they have been very open minded. We haven't had too much problems with the language either. ... This cooperation has very good picture. They have very good attitude. (Karola Sahi)

I have been following it and giving advice to the Solar Decathlon team, and giving ideas when it needed about the type of products we got, and arranging the raw materials to be delivered to the needed places, and participating in some seminar sessions. Basically just monitoring and following the project. (StoraEnso)

We have had very close cooperation with NAPS, StoraEnso, Enervent, Ensto. ... it has been a very good cooperation with all the companies. ...And they [Naps Systems] have been very flexible, professional, and innovative in their solutions and very happy with the results. ... The network [of companies] has been successful, and they have they own initiative. (Kimmo Lylykangas)

I think they are quite good partners because all of them have been active on the process.... (Pekka Heikkinen)

This shows that companies are very interested in the project and motivated to develop products and solutions even being constrained within their production lines. Such limitations can be solved when cooperating partners have shared understanding and commitment to the project (Henderson, et al., 2006; Hadjimanolis, 2006; Barnes, 2002; Drejer & Jørgensen, 2004; Bjerregaard, 2009; Senker & Senker, 1995). The academics state that the cooperation with the companies has been very productive, e.g. the companies have a good attitude and they putted an effort into this cooperation. As a result the companies are satisfied with the outcome of the cooperation. The effective collaboration is characterized by “the high degree of participation and involvement of the

partners” (Mora-Valentin, 2004), and it “is strongly related to the quality and motivation of the project team” (Meseri & Maital, 2001). Thus, the participants should be actively involved in the project and to be motivated. The industry has their own initiative because they understand that the R&D cooperation with the universities is a good opportunity for the companies to develop their products and to extend production lines. It is important for the development and success of the project that all participants are highly motivated to work together and develop new solutions. Thus, the performance and commitment of all partners are essential (Hagen, 2002).

The academy-industry cooperation can be significantly fostered if all participants can benefit from the project, for instance the industry needs interesting cases, real-life situations and applicable knowledge:

Subject is interesting. ...I do not have any salary from this project, I have more work, teaching, but it so interesting. I do not mind to be working more. (Karola Sahi)

I think certainly one of the key targets of this project was to create Nordic Finnish design of the building, and this again was what attracted us to the project very much, because we wanted to let's say find a reference building and project that develop new appearance and concepts of our material. ...So, we have a lot of experience and small scale projects, and research cases, but nothing on this scale. ... One of our key drivers is to get real life situation for our products. ...The cooperation can be improved by giving us interesting projects, new ideas, suggesting new approaches, and an ability to utilize the knowledge of students, professors from interaction with the industry. At the moment it is like we all the time are giving them seeds what to do, what area to study. The project should be practical that to give a chance to see the material in use. (StoraEnso)

I think the key was in contacting companies that we have something to offer, something that they wanted to be involved with, and at least two companies said that they cannot afford to be outside of the project. If you just go there asking just for money and without anything to offer I think it does not make much sense. ...There are two things that we offer- a lot of publicity and results of the pilot project. Whenever I contacted the company the first thing to tell is that what they can gain, what they can achieve in the project. So, it is important to tell in what kind of media, in what kind of publicity, and another thing was to promote the innovativeness of the project itself. So, to convince them that it is something that has not been done before and their experiences on that would be very valuable for them, without this of course they want just finance the project. ...We are practical enough; we have a lot of publicity by media. (Kimmo Lylykangas)

We found it interesting, of course we saw the deal, and we wanted to make business. When they come with the propose we thought that ok, we can make this. So, why not? But also we found it

interesting, and in what aspects. Because we saw that ok, now in Finland there is a team that wants to build the house which is energy sufficient over the year, and that was interesting. They wanted to do something that is not just putting those on the roof, but something else, something visually interesting. ...Working with this people has been very motivating in this sense that they forced us as an individual company and us as a team of companies really to put our best into this, like thinking challenging, challenging own thinking and they forced us to provide with a new solutions, and to integrate with each other, which is also one of the things that I would expect be beneficial later under all. (Naps Systems)

We noticed now that this project has interest. We have found right project that we do not have to push forward. Industry partners noticed that ok, this is something that they should do, then they joined the project. ...For example, I read from the architectural news that one of the main pioneers of ecological building Bruno Erat was asked which the most interesting project in Finland is at the moment and he mentioned our project. So, I am not the only one who shares same idea. ...I noticed that nobody is interested in the project if they do not see their own value or that they support their own development. (Pekka Heikkinen)

Of course, how you identify the areas of the common interest, how do you know that, where do you get this knowledge, how do you know if you think of the science society the university as a resource of the human resources, as a source of the knowledge, where you get the answers to the specific problems. ...It comes to the ideal university. It could be focused on some specific topic, to have enough scope in this area of expertise that I would need...that I could easily call them on the daily bases and ask for the few questions...So, the knowledge not too wide scoped. (Ensto)

This shows that an interesting empirical problem motivates all participants, namely students, teachers and companies to work on the single project. The participants in this project are motivated by the task and the subject of the project itself. It is the first zero-energy house built in Finland, which has and will have a lot of interest and also publicity. It is also a good study case, which gets an attention and curiosity of all participants. It is obviously that all of the actors have different motivation in this project, for example, the academics are interested in science development and teaching, while the companies are interested in the development of their products. However, this interesting empirical project unites the academy and the industry to work together. The companies are interested to participate in the project if it is in their competence or area of interest and gives them some advantage, for example in the testing or developing products, and if it helps to boost their image and gives them more positive publicity. This was the case in this project, i.e. all companies already got a lot of positive publicity and could test and develop their products. One company has been interested to participate in this project since they got an opportunity to test

products and to use the house built in this project as a reference building. The academics recognize that they have to offer some benefit to the companies, to make them interested to participate in the project. As it was identified in the literature, the R&D project should be of “sufficient priority to all stakeholders” (Dooley & Kirk, 2007) and should provide benefits for all actors. Also it is important that the project is relevant for the needs of the participants and produce applicable results for the industry (Gray et al., 2001; Zhou, 2008). Thus, the research should be strategically important (Barnes, 2002), and “contribute to the development of the firm” (Drejer & Jørgensen, 2004). Therefore, the industry “demand for more specific knowledge, more directly focused on problem-solving and product design and development” (Sáez et al., 2002). The companies want the academics to be more active in giving new ideas and approaches, providing interesting and practical projects, and the knowledge applicable to the real-life situations. One company accuses the academy in general that they are not giving interesting ideas or practical knowledge. However, this was not a case in this project. The industry’s representatives state that this project has been very interesting and challenging their thinking that the companies have been able to develop something new. The academics also recognize that they should offer some benefit for the companies that they are interested to participate in the projects like this. They think that the experience of being in the project in sense of gaining new knowledge, developing products, and also the promotion and the publicity are main benefits for the companies that the academy can offer.

The commitment and trust of all participants is found to be vital for the success of the project:

It [trust and commitment] is vital. Without commitment we are not competing in Madrid. Companies trust is that we build building, competing in Madrid next year, we will be successful there, they will get the visibility that we are promising as they are paying for the project partly. From our side we trust that they are stationary committed and giving us resources, materials, monetary funding. (Yrsa Cronhjort)

I think they always done what they said. Only time table has been longer than they promised. I would not underline that much. They have done everything now....They have a good attitude. (Karola Sahi)

We are trusting 100% of the know-how of these companies. If they told us do this way and we done it that way. So, they have been supporting our designers 100%. I believe they also trust us to use the knowledge on products in a responsible manner. I believe that they trust us to bring their name and know-how in publicity in a good sense whenever it is possible.... companies has been fully

committed, they have done a lot of work. I believe that in reality it worth much more than 500,000 euros- developing these solutions, ideas. (Kimmo Lylykangas)

And then of course, I think we have put a lot of effort on this and then you work hard it lives a mark somewhere, and I think all the participants noticed that we are working on this and this is one of the means to achieve goals. (Pekka Heikkinen)

So, at least quite a bunch of youngsters - students got a chance of life time in joining this project. And I felt this, I have been also involved in the electricity team and I have been heard in this steering group and I have seen the enthusiasm in them. It is seems to me that it is really good project for them. Quite many students can do something to contribute into this building and then feel proud that they have done something, such great thing. ...the spirit of the team it has created a commitment that all of the partners are really committed to make what is needed for this house to become reality. Far beyond what is actually we share the job of the making house into the junk and this is my junk and this is my thing that I have to do. I believe that all of the companies that are providing more than just funding are going far beyond of just making their share in this. (Naps Systems)

The cooperation has been good and also what I have noticed is that students seems to be working extremely well with each other and cooperating quite well, acting very much in a team approach. (StoraEnso)

There is a mutual trust between partners, i.e. the academics trust in the companies' products, while the companies trust that the academics will build the building and bring positive publicity and visibility to them. The academics and the industry's representatives work very hard and there is enthusiasm and the spirit of the team, which probably has a positive influence on others to work as hard. The companies state that students also have been very motivated and working very actively, in a team approach. This indicates that both parties, the academy and the industry, have to be committed and trust each other if they want the project to succeed. The trust and commitment are "the two key elements of relationships" (Hadjikhani & Thilenius, 2009). For successful collaboration partners should build sufficient mutual respect, trust and understanding that they can talk about issues openly (Austin, 2000; Dooley & Kirk, 2007; Hagen, 2002; Drejer & Jørgensen, 2004; Jacob, et al., 2000; Tretyak & Popov, 2009; Beugelsdijk, et al., 2008). In any cooperative project the partners can have some challenges, and therefore they need to have a mutual trust to overcome problems, to be open about obligations and rights if they want to succeed (Ponds, et al., 2007, p. 425). In addition to that, the trust and commitment improves the quality of ongoing relationships and has a good implication for the future cooperation. Thus, the previous successful partnerships can be a good example for the establishing of new partnerships in the future.

Therefore, the trust and the commitment are “the cornerstone of developing a stable relationship” (Santoro & Gopalakrishnan, 2001).

Good interpersonal relations found to be an important element in this project:

...it is also the kind of personal cooperation with the companies- how you get along with people.
(Karola Sahi)

At our wood construction chair we have 10 years experience working together with companies. We have quite a lot of contacts, keeping up contacts is important.(Yrsa Cronhjort)

Every time I come to visit the building or I meet any people involved they are very helpful and ready to show me the building and discuss how it has been going and just good communication.
(StoraEnso)

This distils down to people always. It requires something from the people that was there in this project. Certain openness and encouragement attitude. Of course, especially it requires from the university's people, because they need to collect the team together, and to catalyze the interactions. (Naps Systems)

They [relationships between people] have been very good and reliable and for me it has been an interesting project and I hope for the others also. So, I have enjoyed it.... I have been of course fortunate to have very good partners in the university and other people working on this, very motivated guys. It is not my input, but I have been lucky to find them. (Pekka Heikkinen)

...the personal properties of the people. So, that they are easily approachable, easy going and there is no hierarchy that would disturb the cooperation. (Ensto)

Therefore, both the academics and the industry representatives think that the interpersonal relationships are important and in this project have been extremely positive, i.e. people have good attitude and have been very cooperative in this project. Any cooperation is based on the people and the interpersonal contacts between people involved in the project. If partners want to succeed in the collaboration, they should develop an “effective interaction patterns and team work” (Garrick et al., 2004). The personal contacts and efficient communication are also important for the development of trust between actors (Hadjimanolis, 2006). Bignon (2006, p. 618) state that good personal ties are based on the trust, and are “the bonds that result from successful, mutually rewarding interaction over time”. Thus, having good contacts and relations to other parties is necessary for developing mutual trust and deeper relationships. It is necessary to have frequent interaction and face-to-face contacts in order to build the mutual trust (Ponds, et al., 2007, p.425). Therefore, as Austin (2000) argues “the partnership's staying power derives from the personal relationships that have developed because of individuals' personal interest in and connection”. The

academics admit that having and keeping contacts is necessary, e.g. they can be used for the future cooperation. For instance, Bjerregaard (2009) states that the informal contacts or social networks are important for the establishment of the cooperation. Also, the positive prior experience of cooperation has a good impact on the outcome of the cooperation and establishing new collaborations (Hadjimanolis, 2006; Barnes, 2002; Mora-Valentin, 2004).

The efficient communication and good negotiation skills are the only way to make decisions and to solve conflicts:

...we discuss a lot on all details in this project. ...As usually in design work you just have to raise the problem in early stage enough.(Karola Sahi)

...seminars and collecting plans, going one direction- every week- very active teaching... We have a very large board (12 professors, 20 companies), meetings all the time, decisions on which direction we will go. We have a board; every company is invited to take part in meetings. ...Mostly informal (75%); formal on board meetings. I have a development manager from any company that can e-mail me and ask about building, and I can call them up if I need info. We have key person in every company. Financial decisions are taking place in board meetings. (Yrsa Cronhjort)

I think it has been very good. We have regular updates on the project how it is going. ...They have been very open and providing information, and whenever they knew the research results they made them known to us, and they invite us to the meetings and I attend some time meetings. So, it is, yeah, very open and easy cooperation.... The communication has been very clear and direct. (StoraEnso)

...companies has been pretty active in a board meetings and this has been a way we communicate with them. And then usually we have also informal contacts in technical matters directly to the person who is responsible for technical things in their companies, and it is worked pretty well, they have been always available, we got the solutions very fast, and also all the materials and products has been supplied in time. Nothing to complain. ...There are representatives of different chairs of universities and main sponsors. Companies each have nominated one person to participate in the board meetings. They do not always participate, but they always assist us, and they always get informed on the project. ... They [the companies] encouraged us to have better communication, publicity and we always have easy access to companies through the board members that has been a key person to the company. (Kimmo Lylykangas)

It has been a lots of integration of communication and many meeting with other companies involved and sharing ideas and also I must admit that it is business wise considering this as a single business case, this might be really not business case because I spend far more time on this

than I should have based on the margin that we get, because it has been funny, nice being there. I had really need to work with these things and discuss with the people, and bring it down to what really need to be done and start making it. ...The meetings I have attended have been very constructive, then innovation promoting, challenging people with the new ideas, new requirements. I think all of us having participated in these meetings had a chance of being heard. (Naps Systems)

It don't have to be an official contact and in fact unofficial most often is even better, because then you get something done. (Pekka Heikkinen)

This type of work leads to negotiations and round-table discussions and steering group meetings and design group meetings. (Ensto)

The academics and the companies evaluate the communication in this project as very efficient, constructive, open, clear and direct. They have mostly informal communication, which is found to be more efficient and better. Dooley and Kirk (2007) state that it is necessary to “reduce institutional barriers that impede effective knowledge exchange”. The efficient exchange of the knowledge is reflected in low level of formalization (Bjerregaard, 2009). Thus, it is important to have simple information channels (Drejer & Jørgensen, 2004). However, all the decisions and especially financial matters are discussed in the board meetings. The companies’ representatives are the members of the board, and they attend meetings, which is very positive for having easier access to the partners and for the smooth exchange of the information. Thus, the continuous meetings help everyone to be updated on the project. The communication contains continuous, efficient exchange of information and knowledge, for example, when “companies have pre-publication access to research papers”, have an “access to research labs, meetings, ongoing contact with company scientists” (Dooley & Kirk, 2007). As one company’s representative stated they have been provided information and the results of the research whenever the academics knew them. Thus, the efficient communication and exchange of the knowledge has been a positive feature in this project. The communication is also necessary for building trust between partners (Austin, 2000). Therefore, this project proved that the open and efficient information sharing increase the success of the cooperation (Pender, 2006?; Beugelsdijk, et al., 2008; Fang, et al., 2007).

The academy-industry cooperation is also about adjustments and mutual understanding:

when we are using their components we have to listen to them, we try to adjust the design to their production also. But to the material – it is a pilot project. Certain standards they came from Isku, but in detailing students are doing design. (Karola Sahi)

In this project the academics had to adjust the design of the furniture to the company's production line. Thus, mutual understanding is extremely important especially when organizations face limitations, for example in the production lines. Therefore they need to find some mutually beneficial and acceptable solution. The lack of understanding can be one of the problems in cooperation (Hall et al., 2001). Thus, "shared, tacit understanding about the project" (Bjerregaards, 2009, p.105), and "mutual understanding are important for successful collaboration" (Ponds, 2008, p.80).

The academics have been very open:

I do appreciate the approach that university people do have with their partners that they openly admitted that ok, we do not know about the solar electricity what you can do for us. And then they have challenged our original thinking and asked us with the questions of could it be done this...This kind of questions and challenges, but they have really listened to us, participating companies, when it comes to how it can be really done. (Naps Systems)

One company stated that they appreciate the open-minded attitude of the academics that fostered the cooperation and positive attitude. The academy openly admitted that they do not know anything about the system and they asked for the company to help, while challenging the company with new ideas. Thus, it is good to be very clear and open about the needs (Austin, 2000; Drejer & Jørgensen, 2004). Pender (2006?) state that "clarity in collaborative objectives foster initial trust between partners". Therefore, this openness could create more trust between the academy and the industry.

The academics and the companies make joint decisions that support effective collaboration:

In the development of products decisions are made jointly, because we cannot ask manufacturers to produce something expensive. The incentive must come from the company as well. (Yrsa Cronhjort)

The joint decision-making was necessary for the development of the products in this project. The participants should have joint decision-making since they cannot act independently and need to collaborate when making decisions (Antola, 2009). Thereby the decision-making can be exploited by the partners and have an economic value (Håkansson & Snehota, 1995).

The previously established contacts or cooperative relationships are found to be beneficial for starting new cooperation:

I already had good working relationships with the key people in this project. We already had established working relationships. So, it was very easy just to continue with that in this project. It was not like creating first understanding and trust with each other; we had that. So, it was very easy to step in this project.... I already had an experience of working with them previously. (StoraEnso)

I have been doing a lot of contacting companies. Networks are important, but when again approaching company you have to give something- the benefits for them. (Kimmo Lylykangas)

The academics and the companies have been cooperating before, that is why they did not need to build first understanding and trust as one company's representative believes. The previous positive relationships or interpersonal contacts could have some impact on selecting particular partners to cooperate. It is assumed that past collaborative experience, being particularly positive, had an impact on selection of the partnering and the outcome of the cooperation (Mora-Valentin, 2004; Hadjimanolis, 2006; Barnes, 2002). The academics find that personal networks are important for establishing collaboration with the industry, but showing and giving companies some value in cooperation is more important. In other words, companies' future benefit is more decisive than good established contacts. However, without established contacts it takes more time and effort to build mutual trust and understanding.

The academy-industry cooperation is fostered by the fact that it is easy to find partners:

It could be difficult, but I think now companies are more interested in cooperation. (Karola Sahi)

It is not difficult to find partners to participate. In Finland we have a network, we know professors, and it is not difficult to create cooperation. (StoraEnso)

The companies and the academics state that it is easy to find partners to cooperate. Also the academics think that it could be difficult to find partners before, but now companies have changed their attitude and are more interested in collaboration, and in some cases are taking the initiative by themselves. Probably, the small size of the country makes people familiar to each other and helps to find the partners.

The cooperation is also fostered when partners have mutual interdependence and resources for the R&D:

I think that both parties need to have something to give them. So, we wanted to cooperate with the companies that have advanced technologies and advanced processes and services, and a mind set of doing new things, and if they have these then they also want to cooperate with the universities, because we can do something that they cannot do in their everyday business. If they have these,

some resources for R&D and if they are active in developing new things then they have the initiative to cooperate with us. Sometimes, it is also based on company profile of publicity that they want to profile themselves as something that they cooperate with the universities, which is in most cases general. They want to develop new things. (Kimmo Lylykangas)

The academy thinks that the synergy, which makes partners to complement their resources and capabilities, fosters both the universities and the companies to cooperate. Thus, the partners should have a complementarity of the resources (Fang, et al., 2007). Moreover, those companies engaging into collaboration should have resources for the R&D. Thus, the “absorptive capacity” of the companies and in-house R&D is important for “acquiring external knowledge” (Drejer & Jørgensen, 2004). The company’s own R&D activity positively influence the absorption of the scientific knowledge developed by the research institution (López-Fernández, et al., 2008; Fontana, et al., 2006; Sáez, et al., 2002). Moreover, López-Fernández, et al. (2008) found in their research that “undertaking in-house R&D activity significantly fosters a firm’s propensity to cooperate with the universities”. The academy’s representative states that in some cases the companies want to cooperate only because of publicity or “association with top tier or more prestigious universities for network effect” (Santoro & Chakrabarti, 2002).

The academy-industry cooperation can be improved in general if the academics have better understanding of the industry’s needs and if companies are being more supportive:

I would say that the long-term partnership is something to develop, and for that we need to understand the needs of companies. If we would understand we would be able to give more, but for that in a short project it is not possible. If we have a long term partnerships, let’s say from 5 to 10 years then we would use better time to find about the needs of the company and what kind of research they need, and maybe we would be able to give them the results or demonstration projects to help them. (Kimmo Lylykangas)

Companies should support, that we have real connection between, that we have more information of their materials, for instance. It would help both of us.(Karola Sahi)

The academy hopes to have a longer cooperation with the industry that they could find better about the industry’s needs. Probably the needs of the industry should be better communicated to the academics. The academics think that the industry should be more interested in cooperation and providing more information on their needs and products, that the academics can utilize that in the research and other projects.

4.4 Using the Output in the Future

The future of this project is viewed in terms of developing new and further cooperation:

This is kind of a pilot project and it can lead to further cooperation. This will be a good example project of what we are doing, and for getting next projects. We trying to find more cooperation with the companies, and when we have this example of what we have done it is easy for the companies to get involved together when they know that we have something done. ...Actually we have second bigger project starting next autumn in wood program and wood studio. (Karola Sahi) We can see that we created this and it is interesting for further research projects and cooperation outside SD project. In sense of Aalto University's cooperation it has been a pilot project. ...Of course, it is a promoting project for the companies, but also promoting the cooperation between universities and companies. (Yrsa Cronhjort)

Currently we are establishing networks with the research institutions in Finland, but we are not strong in other countries. (StoraEnso)

I hope that projects like that would emerge, or this will continue after the competition, or from the student project would become industrial project where university still participates somehow. Especially technical university is far in R&D commercialization and industrialization. If this will go into that direction I would appreciate if they will be involved somehow. (Naps Systems)

We will of course use the knowledge and the results on the next projects. So, gaining the knowledge is the main issue. We have a network that we will realize later on. ...We will have, for example, next month the workshop with StoraEnso with other material that they are planning to find the use in different way than in effex material. And then we are, both of them, StoraEnso and Isku are involved in the urban living project that we are starting in autumn. So, this was not first and wouldn't be the last, hopefully. I heard (I am talking now about wood) that they accept that Aalto University will make the difference, so they are waiting quite much from us and when the urban wood project was founded, when the idea has been risen in three big wood companies... They asked us to participate, because they wanted to have some excellence on the project or something like that. I think they are pleased of what we are doing and see this as an important part of their product development. I think they count on Aalto University a lot.... (Pekka Heikkinen)

We are very committed to work with the university together, we have several research projects with all the major universities in Finland and the Aalto is the biggest one ...We try to contribute to the Aalto University's success in certain areas, developing studies, study programs, the content of the programs, and also generate common research agendas, projects. (Ensto)

This cooperative project has been successful for the academy and the industry. Probably because of that both, the universities and the companies, want to cooperate further, and in some cases they already agreed and started new projects together. The companies are ready to cooperate further, which prove that the academy-industry cooperation is beneficial for them. The future benefits of this academy-industry cooperation for the academics are not just in terms of the science development, but also in sustaining current and developing new university-company relationships. This project proves that the successful cooperation is a great opportunity for further partnerships (Henderson, et al., 2006; Austin, 2000). The academics state that this collaboration will be used as an example project for starting future partnerships. Through such projects university increase “portfolio of externally funded projects” (Jacob, et al., 2000) and gets the status of a modern, cooperative institution, which is also positive for the future cooperation. Therefore, this cooperation is “improving dialogue between the academic and industrial world” (Gomes, et al., 2005). It is also a good case for the learning and developing the cooperation practices between three universities within Aalto University. In addition to that, some large Finnish companies want to support the Aalto University and count on it since it can bring some excellence and positive change in the future.

The academics want to develop more cooperation in new projects involving more companies:

More projects, more cooperation, more team-work. I think the cooperation should not happen with one company... We should do work with all the companies together that they could all get an advantage of work. If we collect the best people, then we can have good results at the end. (Karola Sahi)

The academics are looking for more cooperation with many participating companies at the same time. The academics think that the cooperation with the companies could be developed if they have more projects and the synergy with more companies at the same time that all participants could benefit and that could be beneficial for the society as well.

This project also promoted the deeper relationships between the companies:

...there is Ensto, for example, with them we have been dealing a lot. We have been in connection with them otherwise also, but I think this project has promoted our cooperation in a deeper level that will survive after the end of the project also. (Naps Systems)

I am very pleased that StoraEnso and Isku have been doing the cooperation in other things afterwards. Because Isku is interested about Stora's effex material and now they made the prototype on the kitchen cabinets in our house, and it might be a brand that they start to do. Of

course, I am very proud that I have been involved in the process were two companies have found each other and made the cooperation project together. So, that might be the best thing of the whole process, if you think the industry partner cooperation. (Pekka Heikkinen)

This project brought together many companies that have been also working together. It deepened their relationships and it is possibly that in the future these companies will be working further. This indicates that the companies see this project as beneficial since they started to cooperate more with other industry participants. This issue was not discussed by other researchers in the literature.

This project has a bigger impact for the whole society. The academics think that the future of this cooperation should be utilized in the development of the market for energy efficient housing:

Aim of Solar Decathlon is to develop solar house and products, which are working on solar energy, without other need of energy. It is possible even in Finland without any outside energy production. The question is in developing of market opportunity.(Yrsa Cronhjort)

The Luukku house is built in this university-company cooperation, but it should be marketed after the project will finish. The results of the cooperation should be used and produce benefits for all partners. This project definitely has a huge impact on the development of energy-efficient housing market and for the construction industry. Thus, the project has also a social benefit (Austin, 2000).

Companies get visibility with this project, and they have a good opportunity to develop their products:

Now when we have this interior wall system- effex panels- this can be a very good product family – the kitchen- for ISKU. There will be an entire interior made of this effex panels and then you have a kitchen made of the same material. I think it could have a very good capacity in real markets. ...possibly they will get new products in production, new chances. (Karola Sahi)

...if we win the competition companies will get everything they can in sense of media and visibility. (Yrsa Cronhjort)

I hope this will give some model of how to build zero- energy houses as well as connected to wood. (Kimmo Lylykangas)

...then it will give us inside of how we can develop our products further. Our product development case is to utilize the learning project.... From our perspective, our company's perspective we see clearly an opportunity again to market and develop our products to those prefabricated construction systems.... If we get good results we certainly will use them very much in marketing and also as I said in a product development ... We protect anything that we are learning from the project, and then of course we keep it in-house and develop the ideas further. (StoraEnso)

We learned something. We might end up launching new product line based on what we learned. And that would be especially beneficial in the high time. (Naps Systems)

We want to use the measurement results, and we want to use the publicity of this project. We will use the experience of this project to educate our people within the company, and most likely use them to develop some new products. (Ensto)

This project gives companies a lot of visibility, publicity and also it is a good opportunity for them to develop their products. Thus, in such projects the companies can develop and extend their products (Grossman, et al., 2001; Lee, 2000), which could have a good impact on their future profits (Jacob, et al., 2000; Gomes, et al., 2005). It is beneficial for companies to engage in such R&D projects with universities, where they can develop capabilities and products at lower costs compared to industrial partnerships, while also maintaining a competitive advantage (Dooley & Kirk, 2007).

The industry's representatives expect that the solutions and products they developed in this project can have a market potential, i.e. they want to commercialize products developed in this project:

And then we expect, we hope that this modules now that we developed for this will be commercial as such. For example, that somebody start making these buildings or close to these buildings in some industrial scale at least few times a year or something. Or that we could utilize those modules that we developed in this especially in our German grid market. So, name advancement, brand advancement, which would hopefully end up opening new market areas, not necessary geographically but like sub-markets within the existed markets- top designed solar system markets. And then hopefully get these modules on our continuous selection. ...to proceed to some commercial business. (Naps Systems)

The companies plan to commercialize the products they developed in this cooperation. In other words, this cooperation has been fruitful since it possibly will bring them additional profits in the future. Therefore, the academy-industry cooperation helps companies to generate business, expand networks, relationships and markets (Austin, 2000).

In the future the university-company cooperation can be improved, for example if companies have fewer limitations in their production lines:

I hope that company will have a wide view enough to do according to designers, so they would not see much limits of their production. So, that their production line is not limiting decisions too much. (Karola Sahi)

This project was impeded in some extent by the fact that cooperating company was not ready to build kitchen furniture according to designers' idea, and they had to make a new solution. The partners can ensure the strategic fit when carefully analyzing their partners' compatibility, capability and commitment (Hagen, 2002). It is important to invest time in matching needs, capabilities and overlapping values, to clarify the purpose and fit between partners (Austin, 2000). Therefore, it is necessary to ensure that all partners have capabilities to undertake the project, and carefully select partners according to their capabilities so that no challenges arise later in the project.

The project has also a good impact on the student's future employment opportunity:

Maybe they can get some other work after. At least in their CV it would be a good mark. (Karola Sahi)

The academics believe that it is possible that some of the students could be employed (Baba, 2006; Gomez, et al., 2005; Lee, 2000) by some companies participating in this project, especially if students have obtained good results and proved to be highly skilled and educated. In any case, the students got valuable knowledge and experience that they can benefit in the future.

The academics plan to use accumulated knowledge in future teaching of students:

Next students will get knowledge from this project and knowledge of the material. (Karola Sahi)

The knowledge collected from this project will be used in the education of the students. Thus, the university can increase the "industrial relevance in academics research and teaching" (Henderson, et al., 2006).

There has been a change in the academy-industry relation, that companies realized that they need this type of collaborations:

Now we have had some companies who have contacted us that they want to do cooperation. They called and said that they could promote with 5,000-10,000 euro and to give us material like to start to think new product out of this. There have been little changes. I think they start to think that something has to happen, but in this sense has to be really a lot to do... Now in spring we have one day in StoraEnso and they want us to tell what we think of their product. StoraEnso is doing clever thing. ... I think now companies are more interested in cooperation. (Karola Sahi)

The academy-industry cooperation is a necessity for success, for advancing technology. During 1970 or 1980's it was practically forbidden for universities to do anything with the companies, because it was considered as a corruption or something. But then universities opened up early in

the 1990's. I think that this newly opened university-industry cooperation was one of the drivers of the Finnish innovation system success in the 1990's. I considered very important. (Naps Systems)

The academics state that the industry has changed their attitude towards more cooperation with the universities. It is obviously that some changes have happened in the society in the last decades. One company stated that such cooperation is necessary for advancing the technology and economical development in general. Probably, the cleverest companies realized that academics can bring some benefit to their processes and products. This proves that the dialogue between the academy and the industry has improved (Gomes, et al., 2005).

One company's representative sees a business opportunity for the academics:

It can also be that they will also try to create some patent or some type system around that building that they are created, and from that they might be able to commercialize it somehow. (StoraEnso)

The financial risk is of course. Kind of back up is that at the end we are selling the house. (Kimmo Lylykangas)

After the competition the house will be sold, but the academy do not want to make other business opportunities out of this project. Although the academics do not see a business opportunity out of this project, one company stated that the university can commercialize the results of this project.

Presenting the results of cooperation to the companies is a way of promoting the future cooperation:

I think if successful at the end all of companies will think that it was worth participating in this project. We gained a lot, we gave something, but we gained a lot. I think it is our target to make companies to think at the end that ok, we paid some money, but it was worth it, we gained a lot of new things and a lot of publicity. If we do not success in this it will be very difficult to call them ever again, and this is a continuous thing, we need their support every year in the future. ...I have been suggesting and probably will do at the end of the project probably go to the companies and present them results... And the idea is that whenever we contacted them next time, they remember that ok, we did it once, we funded the project, it was good, we gained a lot of information so we can do it again. This kind of continuity is important. (Kimmo Lylykangas)

The academy plans to show the results of the cooperation to their industry partners to remember what they gained in this cooperation. Showing of what has been achieved in the cooperation is a good way to promote future collaboration. Gomez, et al. (2005) argue that the academics should be

more creative in presenting the results of the cooperation. Therefore, this might be a good idea to creatively present the results of the cooperation to the companies.

The academy-industry cooperation is a driving force for the society's innovation system:

It is one of the answers to most important issues. Industry will meet the requirements of the directive for the energy-efficient buildings that they should not have harmful emissions and that the energy consumption should be lowered. This project implements both of these, so it is a very significant case. ...Also the modest and simple houses will follow same development in their own way. (Pekka Heikkinen)

The academy admits that this project in particular has a deeper impact for the society's innovation system. Having new directive on construction, which requires to lower emissions and energy consumption, this project is extremely important for the future. Therefore, both the industry and the academy recognize that in this cooperation they achieved their personal goals, but also it greatly impacted the societal and economic development.

5 CONCLUSIONS

In this chapter the summary and empirical conclusions are presented. Then, the managerial and theoretical implications are suggested. Finally, the limitation of the study and further research avenues are discussed.

5.1 Summary and Empirical Conclusions

This study explores the academy-industry cooperation in the context of the Solar Decathlon competition project in Finland. This project is interesting in that it is a pilot project, which combines three universities from different scientific fields and several companies with different areas of expertise working on the one project. Through the interviews with the academics and the companies' representatives, the following research questions were addressed: 1) Why universities and companies cooperate? 2) What are the challenges in cooperation? 3) What encourage the cooperation? 4) How will the results of current cooperation be used by both parties in the future? This study found that there are clear benefits for both, the universities and the companies, to cooperate. The academy and the industry have a mutual interest and were cooperating in this project for the common goal of building the first zero-energy house in Finland, and thereby contributing to the society's innovation system. In other words, behind this project there is deeper meaning for the society, i.e. the common target of reduction in the CO₂ emissions and recent directive for the construction industry that demand to reduce the emissions level and to lower the energy consumption in new buildings. Although, the main aim for the academy is to contribute to the development of the science in the research and teaching, they also want to promote the Finnish know-how and products. Thus, there is a lot of patriotism in this project that motivates many participants to cooperate and work harder. The main benefits for the academics are an access to financing, material and competence provided by the companies. The aim of the companies in this project is to test their products, to gain scientific knowledge to develop products, and to receive positive publicity. This project is widely covered by the Finnish media since it has a significant meaning for the future.

The project has been very successful and no major challengers have been found throughout this cooperation. This project is very extensive and combines multiple parties with different areas of competence from the academy and the industry, i.e. more than 70 students, many professors and

around 30 companies. Therefore, the main difficulty arose in the project's organization and cooperation between the multiple parties, which the academics admitted they need to improve next time. Another bigger challenge in the academy-industry cooperation in general relates to the intellectual property issues, although it was not a problem in this project. There are many other factors that could impede the collaboration, for instance raising money, motivation of the participants, and the limitation in the company's production line. The academics stated that the industry have a tendency to de-emphasize the projects with the academy to business projects that have more importance for them. Also the universities want the projects to be longer-term oriented, while the companies need practical knowledge in shorter time spans. There have been some companies that decided not to participate in this project probably because it did not bring them any applicable knowledge, only the publicity. The companies' representatives stated that the small firm's size prevent them from partnering due to the limited resources available for collaboration. In general, any cooperation can have some points of friction, but the partners should place more attention to the evaluation of the possible risks and project's preplanning stage in order to find the strategic fit and facilitate the cooperation.

The project has been supported by the common goal of building the first zero-energy house in Finland and promoting the Finnish know-how. In addition to that, the academics state that recent energy-efficiency directive made the companies interested in this project. Thus, this project received much interest and has been an interesting real-case for the companies to test their products and challenge their thinking. These factors motivated many participants, namely students, professors and the companies' representatives to work hard in this project and help to create team-spirit among them. It is found that the trust, mutual understanding and commitment, which have been very high in this cooperation, are very important for successful relationships. The interpersonal relationships and the communication have been very open, frequent and straightforward. The board meetings assisted the smooth exchange of the knowledge and joint-decision making. The industry argues that the cooperation with the academy can be encouraged, if the universities provide interesting cases, practical knowledge and ideas. Meanwhile, the academics state that they want to have long-time relationships with the companies in order to find further about their needs and that the industry should better communicate their needs. It is found that it is quite easy for the academy and the industry to find partners especially having previously established relationships, but it is important to keep in mind that they need to offer some benefit to each other.

This cooperation has a deeper meaning for the whole society in terms of the development of the energy-efficient technologies and wood construction, as well as the development of the academy-industry collaboration. This project will be used by the Aalto University and the companies as a pilot project and will proceed in new cooperation. In addition to that, this project is a good case for the development of the multi-scientific cooperation and teaching within the Aalto University. It definitely has an impact on the teaching that it will have more industrial relevance, and thus also the students will benefit. Those students who participated in this project have better opportunities for their future employment. The companies expect to commercialize the products developed in this project and want to use the results of the cooperation in the marketing, i.e. for the brand promotion and promotion of their products. For instance, they plan to use the Luukku house, which is built in this project as a reference building. Therefore, this project can bring additional profits to the companies. Moreover, this project promoted the deeper cooperation among companies, e.g. some of the companies are planning to conduct projects together in the future.

The academy-industry cooperation was essential for the progress of this project, for instance it was not possible to build the house without the funding, the materials and assistance provided by the companies. However, this cooperation is not only beneficial for the one party, namely the academy, it is a win-win situation, i.e. the industry also gains benefits in terms of the knowledge, development of the products and positive publicity. Now the only thing that the academics should do is present the results of this cooperation to the companies to reinforce achievements in this cooperation. This will be also beneficial in approaching the companies with new projects in the future.

5.2 Managerial Implications

The results of this research can be helpful for the development of future cooperation practices between the academy and the industry. This research provides several important implications for the development of efficient academy-industry collaborations. The companies and the universities can take several initiatives to overcome challenges and to make cooperation easier and effective. Based on the empirical findings of this research, the recommendations are developed and presented below.

It is important to find the areas of the common interest or social mission that the cooperation could be mutually beneficial and increase the motivation and commitment of the parties. Even the

academy and the industry have different reasons to collaborate, they can have common goals, for example like in this project they both have been motivated by the idea of building the first zero-energy house in Finland and promoting Finnish know-how. Moreover, it is beneficial when the project has a deeper meaning or social mission, for instance the contribution to the national targets, ecology or economy. Therefore, the partners should have mutual interdependence of the outcomes.

In the project's preplanning stage the partners should better evaluate each other and ensure the strategic fit and discuss issues of intellectual property rights. It is important to be clear, open and have a mutual understanding from the beginning. During the establishment and development stages, it is recommended to design managerial and organizational mechanisms, for instance less formality, that facilitates a high degree of commitment, trust and efficient communication. The communication can be promoted if the academy and the industry appoint key people or representatives who are members of the board and actively participate in the meetings. The board meetings should be a point where decisions are made and knowledge is smoothly transferred. Altogether, the cooperation is based on people and communication between them. Because of that good interpersonal relations are essential. In addition, all conflicts should be handled at an early stage.

Generally, the academy-industry cooperation can be improved when it offers a benefit to each party, for example the companies want to have real-life cases and applicable knowledge in shorter time. In other words, the scientific knowledge should be in line with the problems of the society. The parties should have a mutual understanding, and thereby the needs of the parties should be communicated better. For instance, the academics should know the needs of the companies. Therefore, it is necessary to improve the dialogue between the academy and the industry, e.g. via better communication of the needs and presentation of the collaboration's results.

5.3 Theoretical Implications

This research examined the academy-industry cooperation and discovered several implications for the researchers. First, this research supports the appropriateness of the theoretical framework built on the literature review. This framework can be applied to analyze other university-company cooperation or the inter-organizational interaction. This study demonstrates that this framework can help develop the academy-industry collaboration, and gives insights into the nature of their needs

and how these can be improved. Second, this study revealed several factors which are not discussed in the literature. For instance, this academy-industry cooperation promoted deeper cooperation between the companies. In the Figure 2 are presented additional factors identified in the analysis of the data. Third, the study focused on the dyadic academy-industry relationships and gathered the view on collaboration from both parties. Previously there has been a lack of such researches. One of the strengths is the study took into account both participants in the academy-industry collaboration. Thus, this study added to the understanding on the academy-industry collaboration and threw light upon this subject.

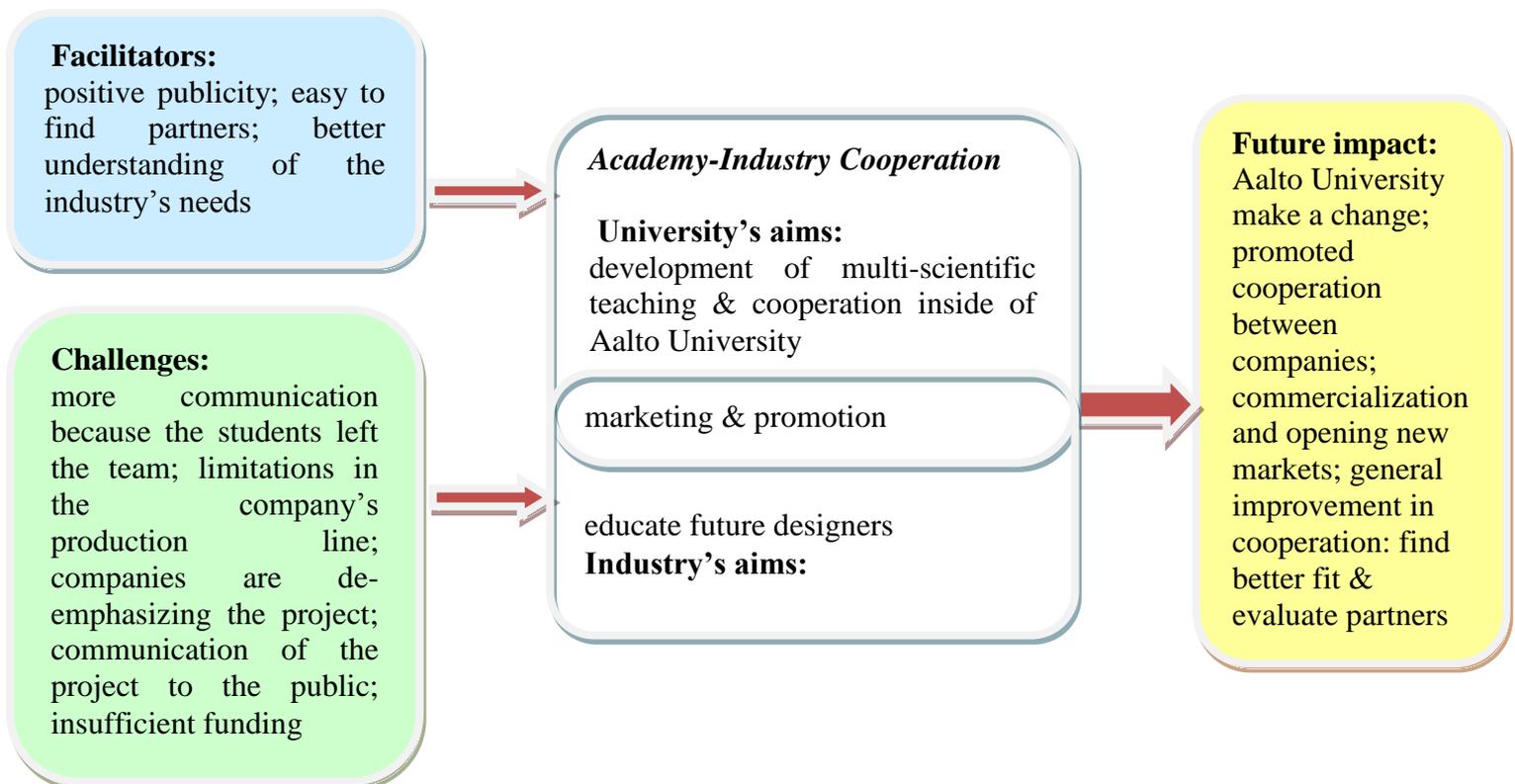


Figure 2: Extended theoretical framework for the academy-industry cooperation

5.4 Limitations of the Study and Further Research

This study is limited to the specific case organizations to explore the cooperation practices in the Solar Decathlon competition project in Finland. This research is limited to the three companies

from the wood and technical industries and two universities. Therefore, only three dyadic relationships have been studied. Due to the nature of the research, all the respondents were self-selected and face-to-face interviewed, which increase the risk of biased opinions. Also the interviewees could give a better view on the cooperation and thus more favorable answers.

The limitations of this study suggest the avenues for the future research. Although the study was conducted in Finland a similar study could be repeated in other cultures and the results could be compared to see if there are significant differences between Finnish and other countries' academy-industry cooperation practices. One future research avenue would be to extend the study to more case companies. Since the study focus on the wood and the technical industries, it would also be possible to study the cooperation practices in other industries, and to see if the results will be similar. Thus, the study may have very different results depending on the business sector and organizations involved in it. Another future research could be to test research findings quantitatively, i.e. it can open up undiscovered information from this qualitative research.

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APPENDICES

Appendix 1: List of interviews

Interviewee and position in the organization	Role in the project	Date	Method
Yrsa Chronjort, Researcher, Helsinki University of Technology	Project coordinator; member of the board	10.11.2009	Face-to-face interview
Karola Sahi, Architect, University of Art and Design	Contact person to Isku; member of the board	11.11.2009	Face-to-face interview
Duncan Mayes, Business Development Director, StoraEnso	Key contact person; member of the board	26.03.2010	Face-to-face interview
Karola Sahi, Architect, University of Art and Design,	Contact person to Isku; member of the board	30.03.2010	Face-to-face interview
Kimmo Lylykangas, Research Manager, Helsinki University of Technology	Contact person to Naps Systems, StoraEnso; member of the board	07.04.2010	Face-to-face interview
Mikko Juntunen, Chief Technical Officer, Naps Systems	Key contact person; member of the board	07.04.2010	Face-to-face interview
Pekka Heikkinen, Professor, Helsinki University of Technology	Contact person to Naps Systems, Ensto, Stora Enso, Isku; member of the board	09.04.2010	Face-to-face interview
Matti Rae, Technology Manager, Ensto	Key contact person; member of the board	26.04.2010	Face-to-face interview

Appendix 2: The interview questions

The purpose of this research is to study the cooperation practices between the Aalto University and Finnish companies participating in the Solar Decathlon Europe 2010 competition project. This research will explore the collaboration reasons, fostering factors and cooperation challenges between the universities and the companies in this project.

Interview questions:

I. Background questions:

1. What is your role in this project?
2. How long have you been involved in this project?
3. What are the names of companies/universities you cooperate with?
4. How have you selected the partner to cooperate with?
5. How many people are involved in this project?
6. Do you have a previous experience in cooperation projects like this?
7. How can you describe the cooperation with your partner in general?
8. What are your main cooperation areas?

II. Detailed questions:

1. What is your aim in this project? / What are your expectations from this project?
2. What are the reasons for your organization to participate in this project?
3. What are the particular benefits for you and your partner in this cooperation?
4. How important is the cooperation between the university and the company?
5. What kind of challenges/ limitations/ problems/ conflicts have you had in this cooperation?
6. What are the barriers for the university-company cooperation?
7. What kind of adaptations / changes / investments have you done for this project?
8. What factors are encouraging the cooperation with your partner?
9. How do you think the academy-industry cooperation can be improved/ developed?

10. How can you describe following concepts regarding the cooperation with your partner: trust, commitment, communication, information sharing, relationships between people or social bonds, interdependence?
11. How the risks and rewards are shared in this project?
12. What kind of results have you achieved in this project?
13. Are you satisfied with the results of the project and with the project in general?
14. How will the results of this cooperation be used by your organization in the future?
15. What kind of impact has this project for the future?