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Open Innovation in technological SMEs

Challenges and implementation

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Abstract

Open innovation as a method to share knowledge and increase creativity and innovation was heavily used in large companies during the past decade. Then it started to spread into SMEs and was adopted in many of those. But for technological SMEs which have fewer resources and higher risks, open innovation was not very common as a method. Because of its various activities and flexibility, open innovation method was described to be helpful for tech-SMEs to assist the growth, competitiveness, and sustainability for them.

This research aimed to discover the best way to adopt and implement open innovation in technological SMEs. Also, to determine the main challenges of that adoption and implementation. A qualitative approach was used to collect the data. Four interviews with experts and employees in different roles were conducted. The collected data was analyzed using content analysis method. That helped to present easy and simple results. The results were also covering different aspects like the impact of cultural diversity in open innovation.

The results of the research stated that more awareness needs to be raised regarding open innovation activities and how beneficial it could be for technological SMEs. The challenges to adopt open innovation were mainly human aspects (skilled workforce and motivation), then comes the competition in the market and the culture of the SME. The inbound open innovation mode was the most preferred for SMEs. Regarding implementation, the best approach was suggested to be implementation team with supervision of senior management. Cultural diversity was agreed to be an enforcement in adopting open innovation and to make the culture ready to accept external ideas and innovations.one of the needed Future research was the evaluation of open innovation process in tech-SMEs.

Keywords/tags (subjects)

Open innovation, technological SMEs, cultural diversity

Miscellaneous (Confidential information)

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1 Introduction

In the current business environment, the technology products have a very short life cycle, so the role of innovation to get the technology to the market fast is more challenging. When companies grow bigger activities become more slowly to be accomplished, because of the many structures and processes the company have, consequently the company will not be capable to take risks any more (Clough , 2014). In that context innovation is now considered as a main factor of the business competitiveness in the market (Weber, 2012; Tan & McAloone, 2006). Development of innovative products is how companies can have a real differentiation from their competitors (Watty, 2013). Meeting new customer requirements, fulfilling some customer wishes that could be unexpressed or current market needs all of this is caused by an innovation that breaks through the market as an idea, product or a process (Schipper & Swets, 2010).

1.1 Why open innovation needed in SMEs

The effectiveness of SMEs is generally affected by the low level of skills in both managerial and technical sides (Rahman & Ramos, 2010). Compared to large firms, SMEs are not that active when it comes to open innovation, caused by the culture, organization, strategy and other characteristics of those companies. Even though studies on open innovation in SMEs are not much comparing to those on large firms, but there are more studies discussing the issue nowadays. Some arguments regarding open innovation in SMEs were raised by researchers suggesting that open innovation can be more beneficial to SMEs than it is to large firms, because of the lower level of bureaucracy, higher ability to take risks and flexibility when reacting to changes in the working environment (Parida, Westerberg, & Frishammar, 2012). Other studies addressed open innovation as possible method to deal with obstacles and increase the profitability of SMEs (Gassmann, Enkel, Chesbrough, 2010). More specifically, the innovation performance of SMEs can be improved well by the wide variety of chances created via open innovation activities.

SMEs usually tend to gain sustainability and competitive advantage relying on their capability to innovate new products and ideas, but still complexity, uncertainty and the high potential risk are badly affecting the success of innovative efforts in SMEs (Griffiths-Hemans & Grover, 2006). Other factors which might decrease the innovative ability and gaining a competitiveness advantage are lacking versatile competence base (Bianchi, Orto, Frattini, & Vercesi, 2010), not enough financial sources and the tendency to not use well organized approaches in innovation (De Toni & Nassimbeni, 2003). The difference between SMEs and large companies is quite clear when discussing the way to utilize and exploit external innovations in the company. Many barriers can be witnessed in the case of SMEs like less resources for R&D, no well-structured innovation processes and low-level development of internal capabilities (Madrid-Guijarro, Garcia & Van Auken, 2009).

SMEs can overcome the challenge of lacking internal resources and competence if they managed to become open innovation professionals by cooperating with all partners in the innovation network (Lichtenthaler, 2008a). interacting with the innovation partners and the advantage of accessing these external resources will help SMEs to empower the development of new technological products and to commercialize them better. Second option is to acquire external innovations and utilize them to the needs of the company. In both cases SMEs will get the ability to compensate its internal technological shortfalls, which are caused by the concentration on specific technologies development. All the external innovations or ideas will be developed and tested internally, hence the innovative activities will be enhanced in terms of quality and speed (van de Vrande, De Jong, Vanhaverbeke, De Rochemont, 2009).

As proved by many recent studies, the adoption of open innovation strategy has raised remarkably during the previous 10 years (Cricelli, et al., 2015). For specialized SMEs, open innovation was claimed to be a valuable method to gain external resources of knowledge and to commercialize the developed products outside the company and its current markets (Bianchi, et al., 2010). But, for such SMEs which are working on specialized products, the most important assets to keep the competitive advantage and the differentiation in its products are the specialized know-how information besides the above-mentioned knowledge and distribution (Parida,

Larsson, Isaksson & Oghazi, 2011). This understanding might produce the conception that open innovation is a risky choice, since it requires the company to share some of its valuable knowledge assets with other companies (Ahn, Minshall & Mortara, 2015). So specialized SMEs needs to make sure that the benefits they will gain from open innovation is more significant than the competitive advantage they might lose because of sharing the deep knowledge with other companies.

When considering industrial or technological SMEs, which require a high level of specialty in R&D, density of the technology and design, it becomes essential to adopt the correct open innovation activities to survive in such business environment (Crema, Verbano & Venturini, 2014). The implementation of open innovation activities in those SMEs will enable them to have products with a high quality as large companies have, since the OI approach can increase the innovativeness and balance the company's abilities with the capabilities of other SMEs in the field (Ketata, Sofka & Grimpe, 2014). It is also important to mention that open innovation activities or model will never replace the work of internal R&D department, since it plays essential role in increasing the absorptive capacity of the SME resulting in enhancing the ability to identify comprehend and utilize he external innovations and ideas (Dahlander & Gann, 2010).

1.2 Motivation for the research

Open Innovation is a phenomenon that has become increasingly important for both practice and theory over the last few years. The reasons are to be found in shorter innovation cycles, industrial research and development's escalating costs as well as in the dearth of resources. Subsequently, the open source phenomenon has attracted innovation researchers and practitioners (Gassmann & Enkel, 2004). And because this field is still new and as Susanne & Pirjo (2013,111) describe it:" So far only little work has been undertaken to explore the actual implementation and use of open innovation and any challenges it may bring about in the broad mass of organizations". Many researches are needed, and more issues have to be clarified, previous researches have addressed the most important future researches in the following.

There still exist many unsolved questions about how companies benefit from open cooperation and how they can nurture these types of creative environments which imply an interesting challenge for both managers and researchers that should be further researched (Helena & Agnes, 2015, p.99). There is yet no holistic model of open innovation that includes the innovation process's determinants and industry specifics, as well as the limits to opening it up (Gassmann, et al., 2010).

Open innovation strategy has benefits for both large firms and SMEs, that is accepted and supported by most researchers in the field (Chesbrough, 2003; Chesbrough, Vanhaverbeke & West, 2006; Lichtenthaler, 2008a).Because, most of the researches targeted large firms, searching for previous studies will lead to the fact that only few researchers worked on SMEs area. Also, most of those studies are case studies with some conceptual researches, so no general results can be based on those studies.

Even its contribution to innovation is growing fast, SMEs didn't have the same coverage and importance as large firms in open innovation researches, with some exceptions like (Lee, Park, Yoon & J.Park, 2010; Parida, Westerberg & Frishammar 2012; van de Vrande, et al., 2009). In addition, SMEs usually tend to focus on external applications of its innovations, and those innovations are related personally and socially to the SME (Ceci & Iubatti, 2012). Although, there were very few studies to examine that relations and how to benefit from those ties to share and commercialize those ideas and innovations. (Brunswicker & Vanhaverbeke, 2014).

The way of implementing open innovation in SMEs is quite different than large firms (Lee, et al., 2010), that's why it not possible to generalize the results of the studies on open innovation in large firms to SMEs. Consequently, we need a specialized researches and investigations to cover this avenue.

During the recent few years more scholars started to examine open innovation in SMEs more specifically and more interesting papers were published regarding the adoption, implementation and performance of open innovation in SMEs (Parida et. al., 2012). Other researches examine the impact of open innovation on SMEs abilities (Huizingh, 2011). But still the phenomenon needs more research and particular aspects and with regards to regional and industrial terms.

The scope of the study was chosen to be technological SMEs in Finland, since those companies have the potential to generate business growth via open innovation, which in turns might help to improve the economic situation and the unemployment issue. In this case tech SMEs will gain its growth and sustainability by using the external knowledge sources and making use of other innovations which are not used by their inventors, collectively that will boost the economic development and enhance growth of business in technological SMEs.

Creating new jobs and developing the economy are some benefits that technological SMEs were found to be providing in Finland. The open innovation business model can help in increasing the growth and sustainability of SMEs, reduce the challenges facing new SMEs trying to enter the market, improve the innovation process by offering the required knowledge sources and partners facilitating the marketing of new products.

The environment of cooperation and partners networking produced by the open innovation platform is supposed to be healthy environment for technological SMEs to overcome the challenges, create radical and innovative solutions, and get professional guidance to grow their business, especially for start-ups. The technological SMEs in Finland are able to be the driving force to assist the growth of the economy and keep the good reputation of Finland as an innovation supportive business environment.

For the personal motivation, I was working as a hardware developer in an engineering company. The company was not using the open innovation strategy. although our company was operating in many countries and we had our own development department. But we missed many opportunities and encountered some losses in customers because other rivals were offering better options. Later, we found out that they had a partnership with other companies in the industry field to provide them new and radical ideas or innovations (in a form of open innovation). The management in our company didn't like the idea and believed that it wasn't suitable for our industry. They said it was risky and we didn’t have enough knowledge to adopt and implement the strategy or to gain its benefits.Hence, this research is a try to show the good way to implement open innovation in industrial companies (especially technological) and what are the most affecting challenges that SMEs will encounter in their new open innovation experience.

1.3 Research questions

As mentioned so far, open innovation as a business mode can play a significant role in facilitating the growth and sustainability of technological SMEs, which in turns will enhance the economic situation, create more jobs and keep the high profile of Finland as an innovation supportive environment.

There have been some studies regarding the topic in general, but to study it on a narrower domain and give more specific details concerning this exact type of SMEs in Finland can be helpful for future researches and for practical purposes alike.

Defining the challenges that will encounters companies if they decided to adopt and implement open innovation strategy, how will they prefer to implement the strategy and the model they might think it will best serve the interest of those companies.

One more thing to care about is the acceptance of the idea that open innovation presents, and if the employees will be comfortable to share their ideas, innovations and marketing knowledge with other partners in the innovation network. And on the contrary is it appealing for employees in technological SMEs to get innovations from external sources and utilize them to serve the company's plans. Many questions and sub questions might be asked here to cover all these sides, but for our study and to get desirable results that we can build on in the future, we have one main question and three sub-questions

How to implement open innovation in Technological SMEs in Finland?

- What are the challenges to adopt open innovation in technological SMEs in Finland?
- What are the suitable modes and models to implement open innovation in technological SMEs in Finland?
- Does the cultural diversity have any impact on the open innovation strategy in these companies?

In this thesis the final goal is to create an understanding of the open innovation strategy in technological SMEs in Finland, the adoption of open innovation as activities and the adoption as business model. There are some open innovation

activities are widely known and practiced by SMEs and other companies, but still they are not recognized as open innovation. Also what is the accepted model to implement open innovation in this kind of companies. There is many methods to implement open innovation in companies, and the chosen methods are usually different depending on the region and the industry of the company, even the business model and the growth level of the company might have an effect on the open innovation strategy that can give the best results. The study also examine the challenges facing technological SMEs in the path of adopting and implementing open innovation, those challenges are related to the culture and the industry and they can be different from one company to another. Cultural diversity is one of the explored factors in this study, its advantages and disadvantages. The acceptance of cultural diversity, and if SMEs are really paying attention to cultural diversity in reality, all these points are discussed and researched in the following chapters.

1.4 Structure of the thesis

To brief the next chapters of the thesis, second chapter is the literature review, you may find the previous studies regarding aspects of the researched phenomenon. Starting with the challenges to adopt and implement open innovation in technological SMEs , then the importance of networking in open innovation environment is covered.

The open innovation ecosystem is an important part to the understanding of open innovation, so it was researched too. Next you can check the studies regarding the impact of cultural diversity on the open innovation strategy and innovation in general. The implementation of open innovation is examined after that, where you can find different modes in open innovation and which are dominating the strategy, then the models to implement open innovation are discussed with focus on the models suitable for SMEs. last in the literature review is the theoretical framework of the study, which we will compare the practical study results according to it finally.

The methodology chapter is the third one. It covers the qualitative research methodology that is adopted to get the research done, the data collection process,

the interviews and the interviewees, and how to analyze the data and finally the verification of the results.

Chapter 4 contain the results of the empirical research, the facts that we gained from the data collection is be presented here in a way to answer the research questions.

Last chapter is the discussion. It shows the implications of the research, the assessment of its results, the limitations and the future research suggestions.

2 Open innovation era in SMEs

This section briefly describes some of the previous studies concerning the implementation of open innovation and the possible adoption challenges in high-tech SMEs. in this chapter you can read about the definition of open innovation, different methods of implementing open innovation and most common challenges facing the adoption or implementation of it. As in every literature about open innovation we can't miss starting by the famous definition of Chesbrough where it was expressed as the knowledge inflows and outflows purposive usage in order to accelerate the internal innovation, and the external marketing of internal innovations. (Chesbrough, 2003a.)

2.1 Challenges of adopting open innovation in tech-SME

For a long time and till now SMEs have been able to survive and even achieve success in both local and international markets, that was possible thanks to the emergence of internet technologies (Schmid, Stanoevska-Slabeva & Tschammer, 2001). But when it comes to adopting open innovation most of those companies faced many struggles (Rahman, 2010). These difficulties facing SMEs when implementing open innovation can be caused by constraints in policy and finance, management challenges and the absorptive capacity which is considered low comparing to bigger companies (Van de Vrande, et al., 2009; Saguy, 2011). Tech-SMEs were experiencing severe obstacles in commercializing their technologies, partnering with intermediaries was one solution to tackle that commercialization issue.

Innovation challenges can differ from one company to another, but in most cases one of the following will be found. Scarcity of skilled manpower and resources, the level of coordination in the company's operative functions, how difficult is the scientific field the company is operating in and ability to get the latest updates in the industry (Abouzeedan, Klofsten, & Hedner, 2013). Even though SMEs are facing many obstacles when practicing open innovation, they still apply its activities extensively (Pullen, Weerd-Nederhof, Groen & Fisscher, 2012). Also, SMEs are reported to have less collaboration with other organizations than bigger companies (Dodourova & Bevis 2014).

Other challenges regarding organizational and sometimes cultural problems when they need to handle more relations with outside companies. As an example of those challenges we can mention R&D outsourcing, customer involvement, external networking and external partners (van de Vrande, et al., 2009). According to Wynarczyk (2013) there are two main internal factors, R&D capacity and structure of management, along with two external factors, activities of open innovation and the firm's capability to gain government grants to develop technologies and for the R&D funding. Those are the key elements that SMEs rely on in terms of international competitiveness. To give a bit more detailed coverage of the subject let's see the challenges facing SMEs which have already been categorized in the literature.

- Human aspects: in today's business environment, demand and supply are determining the continuous changing industry. Regarding innovation related issues, the company may face real struggles caused by expiration of patent periods or the specified measures needed for updating intellectual property rights. Moreover, open innovation can be guided by state-of-the-art innovations, or comprehending human drives in a better way, which enables recognizing new marketing targets. While open innovation may not be guided by scale or process. consequently, there is a critical need for dynamic update of the business models of open innovation in order to be suitable in today's highly competitive markets for SMEs (Jaruzelski & Dehoff, 2008; Rahman, 2010). In all the above-mentioned points the fundamental survival role is granted to skilled workforce. According to a survey study on SMEs in

Portugal the high wage level and scarcity of skilled workforce are the most affecting factors in the human side (Rahman & Ramos, 2013).

- Policy barriers: to spread the adoption of open innovation in SMEs, universities, research labs and big companies can have a huge effect. Furthermore, having a policy that promote sharing knowledge within those partners will have an important role in the procedures to implement open innovation (Van de Vrande, de Jong, Vanhaverbeke & de Rochemont, 2008). The most noticed challenges regarding policy is the high cost of implementing open innovation in SMEs which presents an obstacle to fund such projects or activities. Government regulations in open innovation, financial capacity also play a significant role in this matter (Rahman & Ramos, 2013).
- Competition: in the business environment of today's markets where competition, globalization and transformation are controlling and determining the business or industry nature innovation has become vital to the survival and sustainability. That includes the minor updates of current products, or the commercializing of new and radical innovation into the market (Rahman, 2010). The most affecting factors in terms of competition are the augmentation in product's differentiation processes, seeking market demand and the strategical partnership that needs to be formed by those SMEs (Rahman & Ramos, 2013).
- General barriers: the level of open innovation adoption is affected by four factors related to the business environment. Is the industry manufacturing or service? 'kind of industry', is the company large or SME? 'size of the company', is it a high-tech industry or not? 'density of technology' and does the company target the local or the foreign markets? 'type of targeted market'. In the literature we can find that scarcity of human resources, the lack of information about real benefits of open innovation for SMEs, the coherence issues in the available knowledge regarding open innovation strategies (Abulrub & Lee. 2012). Another general challenge is the decreased customer's purchase power and issues in getting enough finance for companies (Rahman & Ramos, 2013).

2.2 Open innovation in SMEs

In today's fast changing economic environment and more complicated problems facing companies, they strongly need to join their understanding and expertise in order to find better solutions, hence cooperation within field or industry boundaries is now more essential (Kothandaraman & Wilson, 2001).

2.2.1 Open Innovation networking

When firms are using open innovation, there will be a jointly created value by several deals that serve the self-interest of every one of them, those firms can be called value-networks. It's essentially important for the firm innovation to cooperate and form relations with different kinds of enterprises and customers such as competitors, public organizations and academic institutes which represent sources of external inflow knowledge. A good way to boost their innovation ability, firms can gain more skills and knowledge for innovation processes through networking (Gatignon, 2002; Hauser, Tellis & Griffin,2006).

It's fundamental to manage the relations of internal and external networks to bring the open innovation into success (Vanhaverbeke, 2012). In that context we can say that companies form a kind of network or system, so they don't act separately in their targeted markets, so it's a vital success factor of open innovation to cooperate with other companies (Hossain, 2013; Aasen & Amundsen, 2013). We can describe some advantages of establishing an inter-firm linkage between companies. First, they can observe and stay updated about the new developments of technology (Vanhaverbeke, 2006; Van de Vrande, et al., 2006).

Second, the understanding and sharing of external knowledge will be easier through collaboration, which will facilitate the innovation activities inside the organizations. Third, the era when companies were able to produce and commercialize their own products alone is no more, today they need to have relations with other organizations which have the resources required to produce and commercialize new products (Vanhaverbeke, Cloodt, Van de Vrande, 2007).

The ultimate goal of all the effects to cooperate and transfer knowledge between companies is to create a better value for both the customers and the enterprises, so

achievement of a value could be expressed as, is the innovation process going to produce a profit or not? There should be a balance between how capable the organization is to change scientific inventions and new technological breakthroughs into products that can be successfully commercialized, and how valuable those radical ideas and inventions really are? In terms of value creation it is supposed that there will results that could be evaluated of the innovation process like better products with a bigger portfolio and lower costs. In addition, the business performance should evolve, this could be assessed by the market share, competitive position and most importantly the value of customer (Chesbrough & Appleyard, 2007).

Designing a successful innovation network means that every member should participate with a different part of the whole process, primary research, product development, manufacturing and distribution. Since the amount of knowledge shared by all the actors is big, the innovation network always changes its shape, It will be easier for companies to keep their positions in the network by deciding the role and the function they want to contribute with, this strategically positioning could be caused by the low security in the network (Hamrefors, 2009). Taking that in consideration, skills and knowledge that will be shared in the network should be carefully chosen, in the same time other information and knowledge in the company shouldn't be totally exposed to other network members, hence the company must have a security system against unwanted exchange of information (Yström, 2013).

In the innovation field we can mention the following cases for the higher level networking according to Tidd and Bessant (2012).

- Collective learning: networking can also mean sharing experiences and ideas along with its main goal of sharing high-valuable resources.
- Collective affectivity: in today's circumstances it's not possible for smaller companies to have any core competences, only large companies could do that, so networking will enable small companies to use these resources through sharing processes.
- Collective risk taking: sharing risks through innovation network will encourage companies to take risks that it will never take them alone (Tidd & Bessant, 2012).

According to the survey made by (Chesbrough & Brunswicker,2013), a percentage of 78% of the companies participating in the survey were practicing open innovation, there was some difference in the level of using open innovation depending on the industry sector the company is functioning in, high-tech manufacturing and wholesale, trade and retile had the highest results as we can see in the following figure (1)

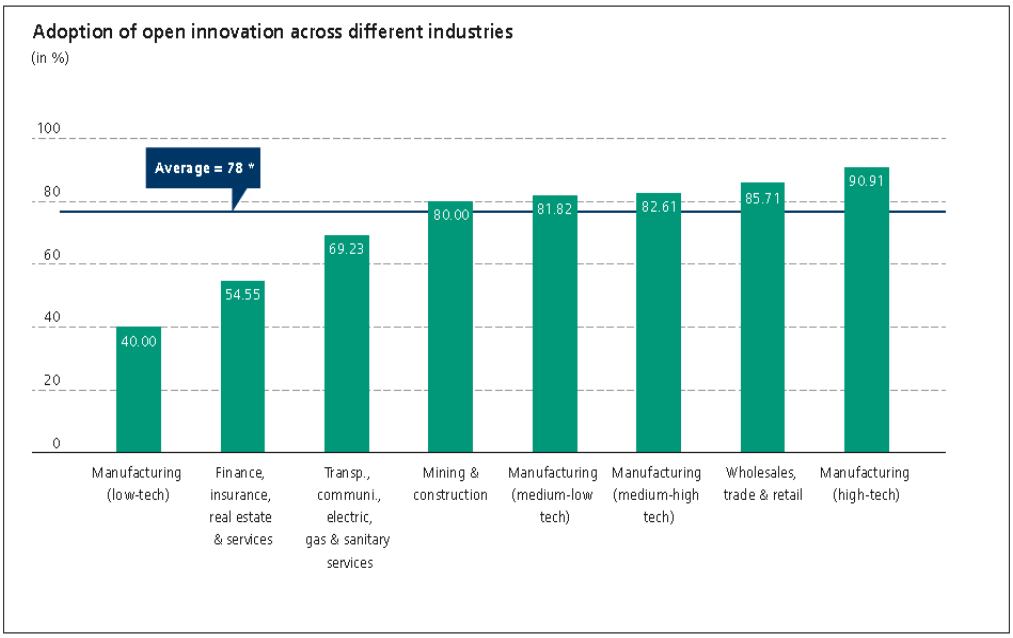

Figure 1. Adoption of open innovation across different industry groups (Chesbrough & Brunswicker,2013), p6.

One of the study case examples we can mention here is (Bigliardi, Dormio & Galati, 2012), three Italian ICT companies were studied, regarding the open innovation approach adopted in those companies, the Cooperation in their networks and its specifications. The study also included the functionality of some departments in the companies like determining the new potential business options with multicultural networks by research centers, integrate external innovations or already working solutions into the company's production process and keeping the atmosphere. For these companies, universities and research centers were the favorable collaboration partners, in addition to suppliers and other value chain members. According to the same study the biggest obstacles for implementing open innovation were the organizational and cultural issues (Bigliardi, et al., 2012).

2.2.2 Open innovation ecosystem

The interest in innovation ecosystem has been growing rapidly as a better technique to avoid defects in structural innovation (Howells & Elder, 2011). In that context, any innovation system will seek creating better relationships between the contributors, which could be done by establishing a comfortable structure to magnetize valuable ideas and investments and shorten the time of getting new innovative products into commercialization process in the international market (Leon, 2013).

According to Adner (2006), the cooperation of research institutes, universities and enterprises as a system is what leads to the innovation as the innovation system theory points out. A basic factor to decide if the process is innovative or not is the technology and knowledge transformation among all contributors, individuals, companies and institutes (Kirner, Spomenka, Rogowski, Slama, Oliver, Spitzley & Wagner, 2007).

Working in cross-functional teams is now important and more favorable than working in separated cells. Because it's not only other enterprises competing with a certain company, also startups which has the ability of quick achievements (Owens & Fernandez, 2014). The connection of different members and required resources in a form of economic system in order to produce innovations and augment growth in a network could be referred to as an innovation ecosystem. The foundation of the system decides the way to manage the relations between the different actors including rules and standards applied in the exact system (Adner, 2006).

We can picture the innovation ecosystem as a group of members who collaborate strategically to guarantee their sustainability in the fast growing and changing economic environment. So, the ecosystem consists of all the business partners who share the idea of selling or buying innovations, from another point of view it determines the environment specifications for all contributors aiming to promote the inventions. Also, we can see the ecosystem as a surrounding globe for the cultures, rules, values, networks and the members interactions in it (Adner & Kapoor, 2010). It should always be kept in mind that coming up with a radical innovation is not enough for it to be successful in the market, the risk of readiness of the ecosystem the innovation belongs to is an important issue to care about, for example the

complementary innovations or legalizations needed for the innovation to work properly and be attractive for the clients (Adner, 2006).

Some concepts related to the innovation ecosystem and they might be mentioned in the literature are clusters, competence block and development block. According to (Traitler, Watzke & Saguy, 2011), in today's business environment the best method to have interchangeable cooperative interaction impact is via forming partnerships or alliances with both resources providers and production entities. That's why it's essential for companies to search for cooperation with companies having harmonious differences to keep their sustainability in the era of international innovation (Traitler, et al., 2011).

The success of innovation ecosystem and the factors that guarantee that, have been discussed in many papers. Xiangjiang (2013) emphasized that the success of innovation ecosystem can be achieved through joining private and public investments with a public policy commitment, which will result in establishing an open environment that embraces innovation, create investments and develop the supportive systems.

The analysis of innovation ecosystem is an important concept to talk about. There are some levels of the analysis, but the main level used is macro-system level in which certain members are delegated some activities and responsibilities by the public authorities as a modified form of the Principal-actor theory. It manages the way system's members act domestically or globally. In this level the property of surrounding circumstances determined by the implementation of government policies and its interchangeable effects with the behavior of pertinent actors, will control the innovation process. The specifications and the advance of regional innovation were studied in many papers so far (Foray & Goenaga, 2013).

The Meso-system level is also suitable to analyze innovation ecosystems showing the advance over time and comparative failure or success. This level focuses on the attitude of groups of institutions having similar interests and working together in long-term partnership, those institutions could be led by an industry or research center. Since the actors are trying to gain knowledge and information from everywhere within the network frame to increase their competitiveness and respond

to the fast development of technology, in that respect the open innovation concept is very suitable. If the focus of the analysis needs to be on how a certain innovation activity evolves, or how a small group of members can execute the organizational policies during a specific time frame to reach a defined target, then there is the Micro-system level analysis to be used.

In the following figure (2) the interactions and relations of the three mentioned analysis levels are illustrated with some examples and clarifications (Leon, 2013).

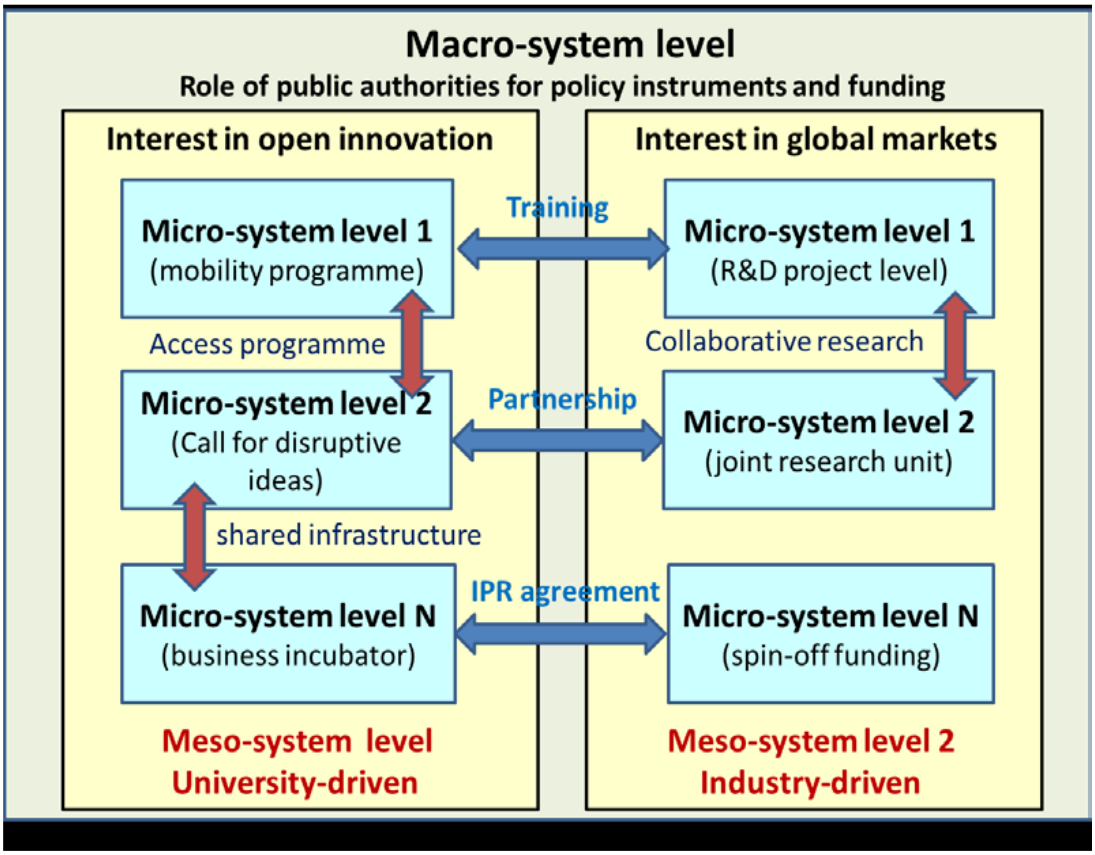

Figure 2. Levels of innovation ecosystem analysis (Leon, 2013). p3

Not all ecosystems are relevant to support innovation, its essential for the researcher or the Idea owner to have a good knowledge of the ecosystem he is functioning in, and the most valuable sections of it, according to Korfmacher (2000) the main factors of the ecosystem would be the intensity of universities and university environment, private sector companies which has an original knowledge and exclusive expertise, the percentage of innovation companies that uses knowledge intensively, finally the inflow and outflow of individuals.

So, after all that information we can summarize in the following lines: the innovation ecosystem can be recognized as open innovation ecosystem if an important number of its activities were considered as open innovation initiatives. It is the division of innovation ecosystem where most of the activities conducted by the actors cloud be described as an open innovation behaviors. Subsequently having a sole open innovation activity will not make the company an open innovation-driven company, there should be a substantial amount of open innovation functions being in progress at the same time in the firm to meet that description (Leon, 2013).

2.3 The impact of cultural diversity

According to Bergman (2009) when employees with different expertise and professional backgrounds team up to solve a problem or get a certain task done, in that case improving the ideas or the innovation process will be better, where everyone can participate and cooperate with others in a collective process of innovation (Bergman, Jantunen & Saksa, 2009).

During the last two decades there were many changes in the workforce globally, resulting in more contrast regarding age, gender, skills and ethnicity of the labor force. The adoption of policies for confronting the problem of population aging, immigration and the globalization process was partly what led to that change in the workforce (Pedersen, Peder, Mariola, Nina, 2008). Diversity was increased in a wide variety of companies, and more debates about how important internationalization and diversification are, can be observed. Strengthening diversity in the business environment adds to the knowledge management and abilities of the company resulting in a better productivity (Parrotta, Dario, and Mariola, 2011).

It is now a common sense that diversity is one of the important sources of innovation. According to a survey done by the European commission, when a company have policies and practices of diversity it will be more innovative (European Commission, 2005). The diversity of certain group or project members is now essential to promote creativity and innovation in that group, because different backgrounds and variety in viewpoints, expertise and understanding could be the generator of creativity (Bezrukova & Uparna, 2009). In accordance to that, it was

found that the presence of foreign workers has a significant positive affect on innovation, since those immigrant workers could enhance innovation based on the high skills and abilities they possess, along with unique ideas and different perspective due to their cultural background (Ozgen, Nijkamp, Poot, 2011).

On the other hand and theoretically speaking, it has been stated that even if a higher level of workers heterogeneity is a real generator of innovation and creative activities, but there could be more situations of misunderstanding, less cooperation and higher conflict chances, which might be leading to reduction of innovation (Basset-Jones, 2005). Very big differences between group members may lead to lower interaction and information sharing, so to save the advantages of creating radical ideas and reduce the bad effects of huge differences. Some searches were made and came up with results that adding proximity enhanced the exchange and sharing information to be 2.5 times more likely to happen in heterogeneous work groups. Proximity will promote the information sharing in the diverse groups but will not totally outdo the interaction patterns and information sharing issues (Ziebro & Northcraft, 2009).

With more diversity in work groups, the team creativity will increase. But at the same time conflicts resulting from that diversity could badly affect the team productivity (Bezrukova & Uparna, 2009). Many factors affect the mobility and the how workers gain knowledge, such as education, age, cultural background, language and their profession (Poot, 2008). The cultural differences are also noticeable even among the same profession workers, could be seen in productivity and the outlook. The presence of a huge number of foreigners all over the world may produce a huge transaction of knowledge, languages and cultures leading to more innovative environments.

Studies regarding the effects on innovativeness of firm's infrastructural and organizational aspects are available in big numbers, whereas it is a relatively new for the economic agenda to include ideas and consider them as valuable as physical assets (Jones & Romer, 2010). There was a big change in the scientific literature during the last decade where the workers, but not the company is considered as the basic source of innovation. The way that foreign workers influence the innovativeness and productivity in both the companies and countries they are

working in is one side this new path is focusing on (Kerr, 2010; Lobo & Strumsky, 2008).

It can be noticed that foreign workers have more chance to be employed in multinational companies, and that innovativeness increases when the firm is bigger. Studies results were clearly confirming that the younger the employees are the more their contribution to innovation is significant, the worker's age ranges 25-34 and 35-44 were the most likely to increase the firm's innovativeness (Ozgen, Nijkamp & Poot, 2011).

2.4 Implementing open innovation

Regarding the implementation process and the strategy of open innovation in SMEs there are two aspects we should consider: (1) when the senior management guide the implementation in an up down method, or a bottom up approach (2) using a centralized way via an implementation team, or decentralized way when companies departments and functions could handle the implementation process. Another dimension which takes a part in implementing open innovation is how to appoint the process responsibilities to organizational sections to be scattered among departments and functions, or centralized to be on a team or specific department (Mortara, Naab, Salcik & Minshall, 2009).

2.4.1 Modes of open innovation

Engaging large number of partners in the process of innovation in the business environment brings new creative ideas and inventions into the institution. This can be named inbound open innovation, with any other case which includes inflows of external knowledge into the firm. Inbound open innovation determines other innovation sources like universities, suppliers and online communities (Christensen, Olesen & Kjaer ,2005), we might extend the definition to include any external expert (West & Bogers, 2010).

On the other hand we have the outbound open innovation which means the knowledge flows outside the firm, in this type the company can make use of the unutilized patents by selling them out, out-licensing to other firms which may need

that intellectual property, and intermediate markets can also be one path of outbound open innovation (Arora, Fosfuri & Gambardella, 2001; Chesbrough, 2007). According to the Open innovation model, it is suggested that exporting the internal innovations and importing external innovations adds to the profitability of the firm (West & Bogers, 2010).

There is a relationship between the adoption of open innovation and certain company's specifications and performance, where the business performance of the company was strongly related to the adoption of open innovation (Drechsler & Natter, 2008). In business environments which has technological unrest and high competitiveness, the company's performance can be positively affected by the outbound open innovation (Lichtenthaler, 2009).

These business environments can make it challenging for organizations to develop depending solely on the innovation created inside of it. Hence, the outbound innovations have a significant importance. The acquisition of technological licenses as an activity of inbound open innovation also had that positive effect in technologically unrested and high competitiveness environments (Lichtenthaler, 2010). Companies are adopting open innovation in variable volumes, and they are utilizing different modes of it. The open innovation process can be driven in two directions to be inbound or outbound open innovation (Lichtenthaler, 2009; West & Bogers, 2010).

Three main original prototypes of the processes were determined as following: inside-out, outside-in and the coupled process which is a combination of the two previous types. Choosing the suitable process depends on the nature of the firm. In most cases companies select one core process and combine some procedures from others (Gassmann & Enkel, 2004). When open innovation activities started to become more common in companies, questions about the role of internal R&D were raised. Some studies found that open innovation is a complement of internal R&D, because spending of R&D departments in organizations adopting open innovation was stable or increased a little (Chesbrough & Crowther, 2006). Other researches such as Lichtenthaler and Ernst (2009) and Lichtenthaler (2008b) came up with a similar result saying that open innovation is a complement rather than a substitute of internal R&D. also according to Vanhaverbeke, et al. (2007), promoting the creativity

in an organization requires the combination of internal and external sources of innovation, and the internal R&D has a fundamental role in the efficient utilization of external innovations.

Some inbound open innovation activities like crowdsourcing platforms, idea contests and using innovation intermediaries such as Innocentive or NineSigma are considered to be very popular nowadays (Enkel, Gassmann & Chesbrough, 2009). And every company will mostly conduct some of these activities (Strategic Direction, 2009). On the other hand, only few organizations are adopting the activities of outbound open innovation (Chesbrough & Crowther, 2006). That can be justified by the lower risk of the inbound activities comparing to the risks of outbound open innovation activities, which may result in losing the possibility of gaining the generated value of the activities.

The possibility of losing the core competences or weakening the market entry barriers may be other threats of outbound open innovation activities. All that led the organizations to adopt inbound open innovation activities in order to reduce the risk (Schroll & Mild, 2011). Chesbrough & Brunswicker (2013) in the report survey demonstrated the classification of inbound and outbound open innovation activities and added the monetary nature of the activities if it's non-pecuniary or pecuniary which we can see in the following figure (3).

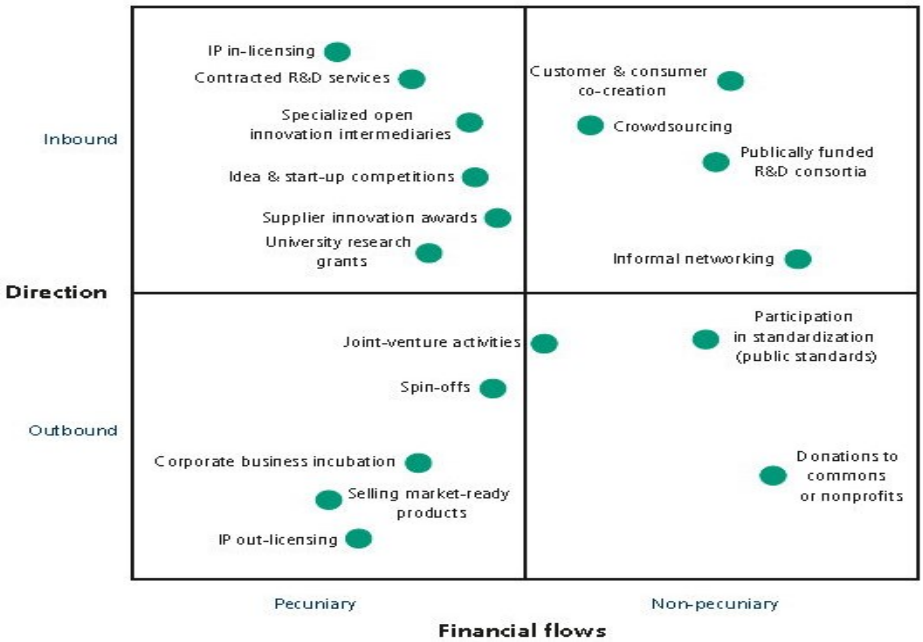

Figure 3. Classification of modes of open innovation (Chesbrough & Brunswicker ,2013. p10).

The previous studies showed that outbound open innovation has a low potential to be adopted or utilized by organizations comparing to inbound open innovation, but still there is some kind of relationship which can be indicated by the fact that adopting inbound open innovation makes it easier to adopt the activities of outbound innovation. So the extent of adopting inbound activities which are the most popular positively affects the possibility to adopt outbound innovation activities (Lichtenthaler & Ernst, 2009).

When a certain company decides to promote its innovativeness by adopting inbound open innovation activities, it is highly expected that the company will utilize the unused innovations and IPs via the outbound activities in a way that reflects the positive effect between both types (Schroll & Mild, 2011). Depending on a recent study regarding open innovation modes, companies tend to increase the knowledge flow into the internal projects 'inbound', rather than commercializing the unused internal innovations. According to the study 35% in average of the projects had inbound components comparing to only 8% included outbound activities (Chesbrough & Brunswicker,2013). the following figure(4) shows the results more clearly.

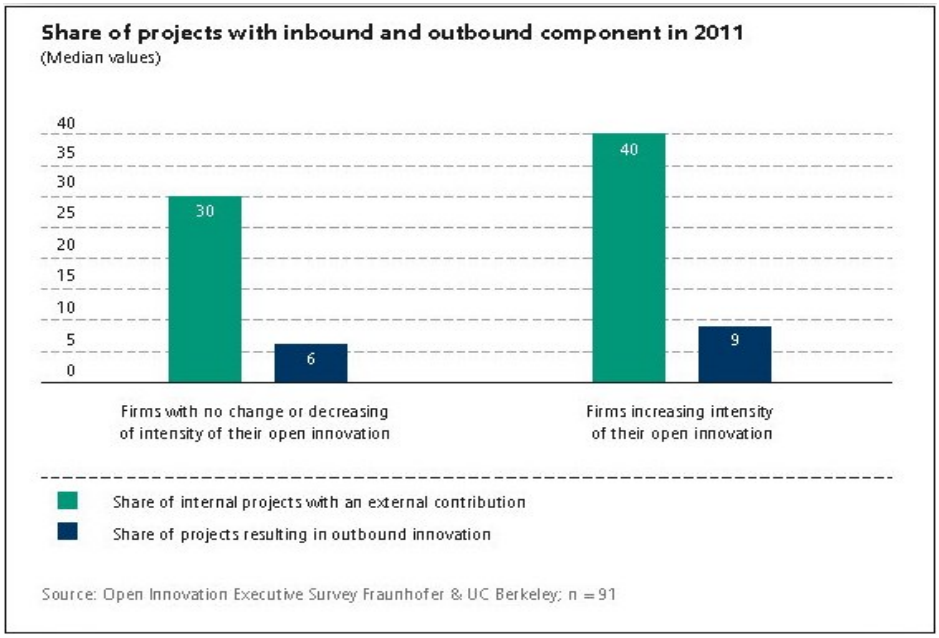

Figure 4. Share of innovation projects with inbound and outbound component (Chesbrough & Brunswicker,2013.p10).

2.4.2 Open innovation implementation models

In the literature of open innovation there are some frameworks which can be described as detailed manual for implementing open innovation.

Starting by the most recent study I could find (Oliveira, Echeveste & Cortimiglia, 2019), it was done regarding SMEs in regional innovation systems which are environments that have better opportunities to implement open innovation in SMEs, in this environment public and private institutions are cooperating, partnering, transferring technology and sharing knowledge among each other (Cooke, 2005; Garcia & Chavez, 2014; Oliveira, Echeveste, Cortimiglia & Gonçalves, 2017).

The framework of open innovation implementation process in SMEs is composed of five stages, it starts by identifying the regional innovation system, second is diagnosing the company, third is the preparation stage, then comes the implementation, and the fifth is the control and monitoring of the implementation (Oliveira, Echeveste & Cortimiglia, 2019). Let's dive a little bit in these five stages to clarify every one of them more closely.

- Identifying regional innovation system, here we try to identify possible stakeholders and the factors affecting implementation process (Oliveira, et al., 2017).to get an assessment of how much stakeholders are informed about open innovation implementation and innovation systems we can apply SWOT matrix.
- Diagnosing the company, in this stage we analyze the open innovation activities implemented by the company and detect the critical success factors of OI implementation in this company, and an evaluation of those factors can help to determine the most affecting factors and if we need to magnify or reduce their impact (Oliveira, et al., 2019).
- Preparation stage, in this stage we need to focus on 4 different activities of open innovation. Level of employees knowledge, the decision to implement open innovation, the plan of implementation and diagnosing the success factors and designing an action plan. The activity of increasing knowledge will assist in accepting the open innovation decision weather it was made for

managerial, marketing, or business model readjustment purposes (Cheng & Huizingh, 2014; Saebi & Foss, 2015).

- Implementation stage, it starts with gathering the implementation team which should include members of the strategical and operational departments .Next this team will examine the portfolio of projects to choose projects that can be developed using open innovation (Bagno, 2016). Then comes the step of selecting suitable partner (Narula, 2004), for market knowledge partnering with other companies is a good option, while high education institutes have more experience in developing technological innovations (Yoon & Song, 2014). Final step in this stage is initiating an open innovation pilot project (Boscherini, Chiaroni, Chiesa, & Frattini, 2010).
- Implementation control and monitoring, in this stage an assessment of the open innovation process outcomes should be done enabling us to examine the performance of management, functional and operational results, and if employees and stakeholders are satisfied with the project (Bagno, et al., 2016).

Another recent study was done regarding the institute of Beijing Genomics which was practicing inside-out open innovation. For implementing this process there are two factors; First is packaging and presenting innovations in transferrable way to enable possible users to utilize it easily, second is to determine the situation profitable for both sides, meaning generating value for the organization selling the innovation and the one buying it (Collins, 2014).

On the other hand there was more than one method to put the outside-in innovations into practice, West & Bogers (2013) presented four steps model to exploit external innovation in the best possible way, it starts with obtaining the innovation which includes the search process followed by filtering and finally acquiring the innovation, then integrating it into the internal innovation system, third is to commercialize it, and last step is managing the interactions between the company and its partners.

Another familiar but a bit older model which was proposed to manage outside-in innovations is the: want, find, get and manage. In this model the founder of it

Slowinski (2005) suggested that to implement the method we need to consider the following issues: the required innovations to fulfill the goals of the company, the procedure we will follow to find those innovations, the phases of the innovation acquiring process like planning and negotiations, the method we will use to control and manage the implementation process of the innovations.

2.4.3 Implementation process and requirements

The requirements of open innovation can also be referred to as enablers and obstacles of implementation. Four enablers were described in previous studies which are: the firm's culture, the implementation procedures, the skills of employees involved in the process and the motivation those employees possess to adopt open innovation activities (Mortara, et al., 2009).

Open innovation culture: one of the main changes required to move from closed to open innovation approach is the cultural changes. Which may in some cases demand employees to do things in an opposite way to the one they were used to. It is essential for moving to the new approach that top management involve directly in the process. In addition cooperating with other companies will be encouraged and needed, which presents a shift in the culture (Mortara, et al., 2009). There are many mechanisms to facilitate the transition process in the culture such as, expanding networks through participating in events, holding training sessions and development programs in which the successful cases of implementing open innovation in projects or functions can be reviewed, encourage the acceptance attitude to the external innovations and ideas in order to overcome the syndrome called "NIH" not invinted here (Ades, et al., 2013).

Open innovation procedure: there are many procedures that may be considered as enablers for open innovation, the internal network will be stronger, and employees' ability to work on various functions will be enhanced by changing the positions of workers inside the organization. In addition to granting the access to their colleagues' contacts and networks, this will enable workers to have a better and more complementary understanding of the business sides. In traditional companies, were changing the organizational structure or culture will be a huge challenge, forming an independent open innovation implementation teams is becoming a very familiar

method. Those teams are usually composed of employees from R&D, marketing, supply chain management and lagal department (Mortara, et al., 2009).

Open innovation skills/capabilities: during the preparation for adopting open innovation in an organization it is fundamental for employees to be trained for the required skills when practicing open innovation. Those skills can be described as the group of personal abilities that make it possible to have access and evaluate both of capabilities and external opportunities. Training programs that we previously mentioned should focus on the following aspects; technical abilities, internal and external business analysis "introspective & extrospective" abilities and interactivity between both of the internal and external. Also having the strategy of job rotation may augment the intercommunication among workers having various skills (Ades, et al., 2013).

Open innovation motivation: according to (Lichtenthaler & Ernst, 2006) workers have real concerns towards any ideas and innovation from an external source, which can be caused by a negative experience they went through, low level of experience, lack of motivation to accept those sources and the reward system that intensively focuses on internal technological developments. The previous lines describe the NIH syndrome that we mentioned before to be one of the real obstacles in the motivation process to adopt and implement open innovation.

One way to overcome this issue is presenting a positive experience in which the employees can feel how much potential and real benefit the outside ideas and inventions can be to the company. In the literature we can find two main types of motivation methods; in regulative methods there is a specific plan already prepared to be followed by the management team, the only concentration is on specialized and narrow goals to be achieved and the development process in this case needs modernized external techniques along with a suitable rationality.

On the other hand, appreciative methods follow a different path by responding to the arising issues, the management here is the tool to balance the company and the situations facing it, the behavior is informed by general common values and the workers in the organization will be the source of the management 'internal motivation' (Mortara, et al., 2009).

Engaging the workers actively in the decision-making process should have a positive effect to motivate them accept the external innovations and ideas. The improvements to the rewarding system by increasing the rewards for integrating an external innovation or idea and implementing it in a beneficial way to the company will be a great help to motivate employees adopting the open innovation processes, in this situation the new approach can move from a threatening to an improvement and positive experience (Ades, et al., 2013).

2.5 Summary of theoretical research

Open innovation in technological SMEs has become a well-known innovation method. More SMEs are adopting this innovation strategy as they get to know the benefits and the gained value in both; sources of ideas and innovations, and paths to commercialize the products and reach new markets. The model of open innovation helps SMEs to utilize the external ideas and innovations to enforce the development of the SME. Open innovation can be used to grow new business as well as to upgrade existing business.

The obstacles that are confronting the adoption and implementation of open innovation were described and categorized, the literature wasn't very clear regarding which are the most affecting factors regarding the context of the study 'technological SMEs in Finland'. Policy, competition, human aspects and some other factors were recognized as challenges to adopt and implement open innovation.

Cultural diversity was very much agreed to be a strong enabler of innovation, and a way to add diversity and uniqueness to the innovation department in any organization. Also, as a source of the important, out the box ideas that may be affected by the cultural differences and foreign expertise.

Inbound open innovation activities are the most common to be applied by SMEs, since they are less risky and seems to be more beneficial to those companies. It was shown in the literature that inbound open innovation is the dominating mode when implementing open innovation. Whereas outbound open innovation activities were less accepted or recognized in SMEs.

In the literature there was many models to implement open innovation in technological SMEs, models that take into consideration the nature of the industry and the size of the company as an SME. Although the main methods were to implement open innovation via senior management, by implementation team, or in a decentralized way where every member takes part in the process.

To develop a theoretical framework is the process of creating theoretical perspective for the researched subject and to determine the main aspects of the research. So, it can be referred to as the theoretical understanding of the phenomenon we are studying (Hirsjarvi, Remes & Sajavaara 2013, p.140-141).

The study will focus on the open innovation strategy in technological SMEs in Finland. It will examine in particular the challenges to adopt and implement the strategy, which modes are more common and accepted by those companies, what models would be better for implementing the strategy and also will explore the impact of cultural diversity on the studied phenomenon.

3 Research methodology

This research aims to add to the understanding of open innovation in Finnish SMEs, the kick-off point of the research was the information gathered from the literature review, regarding the challenges, modes, implementation models and affecting factors. From this point the study will be continued by collecting empirical data and interpretation of those information to illustrate the outcomes and findings.

Research methodology is the process where we collect and analyze the data to enhance our understanding of a certain phenomenon. In other words it’s how we collect and analyze data to get the solution of a certain study problem or to increase the knowledge regarding that issue in general.

We can agree that open innovation in SMEs is relatively not new, but the context of technological SMEs in Finland needs more studies and investigations. In order to explore the researched issues and maybe some implications f the phenomenon, an expolaratory approach was suitable to be applied. Taking into consideration that

open innovation in Finnish SMEs is still in its early stages of adoption, so in this study we will try to analyze theoretical knowledge and empirical data as a combination.

The empirical data was collected via semi-structured interviews with experts in the field of open SMEs business growth, open innovation and employees in a technological SME practicing open innovation activities.

3.1 Research approach

In exploratory research, we explore the research questions with no obligations to conclude any solutions for existing problem. But to add more clarifications to the studied phenomenon, it also helps determining the nature of the issue and more illustration of the problems. this study approach means that as a researcher you should be willing to accept different directions as you go forward in your research.

So, there should be a basic viewpoint of the research and its characteristics, as we have in chapter (2.5), where we explain the research basic assumptions. Then comes the process od data gathering, where only the related and suitable data should be gathered, in a way to help the progress of the research (Routio, 2007). This research approach is usually used to determine what caused the problem, its supposed to have the ability of providing good amount and reasonable information about the researched phenomenon. By collecting the data from both literature review and the empirical study, a conclusion can be served to shed more light on open innovation in technological SMEs in Finland.

By adopting the exploratory research approach we can have rich information regarding open innovation implementation and challenges in technological SMEs, it can also create solutions and shed a light on its possible implications, and more importantly, to describe the benefits of adopting open innovation in such companies. The design of exploratory research has many options depending on the research type and some other factors. The research can be delivered using either primary or secondary design.

In primary research we get the information directly from the field, and it can be done by the researcher (as in this study case) or via third party, and the research will focus on exploring the exact problem by in-depth study. In the primary research we may

use surveys, interviews, focus groups or observation. The other is secondary research where the researcher gathers information from already published primary researches, this can be described to be online research, literature research or case study research. In the case of this study interviews will be used as a primary research, since it supplies in-depth information regarding the studies subject. As a form of qualitative research method, interviews can provide important insights that we can't get from public sources. The interviews were conducted in person and on phone according to the interviewee's preferences, and an open-ended, or semi-structured interviews were designed to give more freedom and the ability to add personal opinions for the interviewees.

3.2 Qualitative research

As a definition this research includes the processes of analysis and interpretation of text data to describe a certain issue meaningfully.

Cresswell (1998) defines it as:

"Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting" (p.15).

The qualitative research can also be described to be characteristic along with being flexible as a process and the higher potential to discover new ideas during the study. Consequently, it will demonstrate the flexibility of the method and its approaches (Uwe Flick, 2009). Using qualitative research method enables the researcher to figure out the sources of the researched issue and provides a basic illustration of the basic theories behind it. And with no doubts it helps to deliver systematic scientific research and to interpret the collected data via the practical research correctly.

Converting any experience, conversation or observations into representable information is a qualitative research activity, In a way that provides easy interpretation of the phenomenon. As described in its structural framework, this method has the ability to extract information from any data other numerical ones

and those specified data sources of quantitative research (Sanders, Lewis & Thornhill, 2009).

Qualitative research can also obtain the motivation, behavior and attitude of participants in the practical study, so we will have access to a detailed description including viewpoints, beliefs and even feelings. In addition, the methods used in his research are known to provide valuable data and give the researcher better sight of the phenomenon to establish the results on real practical knowledge (Lowder, 2009).

For this thesis purpose, qualitative research can serve as best choice to describe open innovation in technological SMEs and to have a clear vision of the implementation modes, activities and challenges. Since our research method is intended to provide a rich description of the studied phenomenon, and interpret the collected data into accessible and useful information to be used in future studies.

3.3 Data collection

Even though qualitative research method has many data collection techniques, the semi-structured interviews was selected for our study. This way of data collection is the most recognized in business related research and it's perfect to study the how and what questions (Eriksson & Kovalainen, 2008). There is no particular number of interviews in qualitative research, but the sufficiency of the conducted ones and how suitable they are for the studied subject (Myers, 2013, p.122-123.).

The interviewees were from different backgrounds in a way that can serve the purpose of the study. From people with educational backgrounds working now in real life companies that uses open innovation activities, to experts working with big number of companies and helping them to survive and grow their business, and finally employees in a company working in management and R&D departments. The variety of the positions and roles of interviewees as experts or hands-on employees was beneficial to get an overall common understanding of the phenomenon. The content of every interview was determining the other one to be chosen, and some questions were modified or changed depending on the position of the interviewee and the discussions in the previous interview. In total 4 interviews were done.

To guarantee the interviewees relevancy to the research, a copy of the questions and an introduction of the research was sent in advance. That increased the opportunity for participants to add more ideas or thoughts outside the theoretical frame of the questions, and to reflect on their own experience and beliefs regarding open innovation in technological SMEs. still the following basic points were discussed in all the interviews:

- The importance of adopting open innovation in technological SMEs.
- Best modes of open innovation for technological SMEs.
- Preferred implementation model they think it suits these companies.
- The possible impact of cultural diversity on innovation performance in technological SMEs.
- Challenges facing those companies in the way of adopting and implementing open innovation.

At first glance, it can be seen that those points were set depending on the theoretical framework in chapter (2.5), some interviews were done face to face, others were done on phone, according to the interviewee's situation and what suits them the best. The length of the interviews was in a range (20 – 50) minutes, some included an extended discussion and many new thoughts while others were just answering the questions precisely. All the interviews were recorded, then transcribed by me. The language of interviews was English, since I wasn't able to use the native Finnish language, and there were two interviewees which are not native Finns.

3.4 Data analysis

Using the correct data analysis method can save the researcher much time and efforts, and it has a vital role in delivering the results in the best way serving the research purposes. There are many methods for data analysis in qualitative research, for this thesis we think that content analysis will be suitable to offer reasonable and correct processing of the collected data during the practical study we did already.

Content analysis is very familiar in today's studies, it can be done in both qualitative and quantitative approaches. Basically, it started as quantitative research analysis,

but then it was heavily used in qualitative researches as well. It can be defined as “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (Hsieh & Shannon, 2005, P.1278).

To understand content analysis in qualitative research, there is some aspects to illustrate its characteristics.

- The primary reason for creating the qualitative content analysis method was to interpret the physical messages clearly and find the reason why they happed.it was first used in psychology and anthropology studies.
- Qualitative content analysis is generally described to be inductive, it basically explores the studies subjects and its themes, with any deductions derived from them.
- In qualitative content analysis the text of the data is chosen on purpose by the researcher to be compatible with the related question (Zhang & Wildemuth, 2009).

The result of the qualitative approach is usually descriptions or typologies, also there will be phrases showing the personal reflection of the studied subject in social means. Which will give better understanding of the text data for the researcher and the reader of the results alike (Berg, 2001).

Qualitative content analysis has a good structure which can provide detailed step by step manual to conduct the analysis. Hence it will facilitate the research’s data management and decrease the required time for the study.

A practical illustration of the steps of the content analysis used in our research can be demonstrated in the following figure:

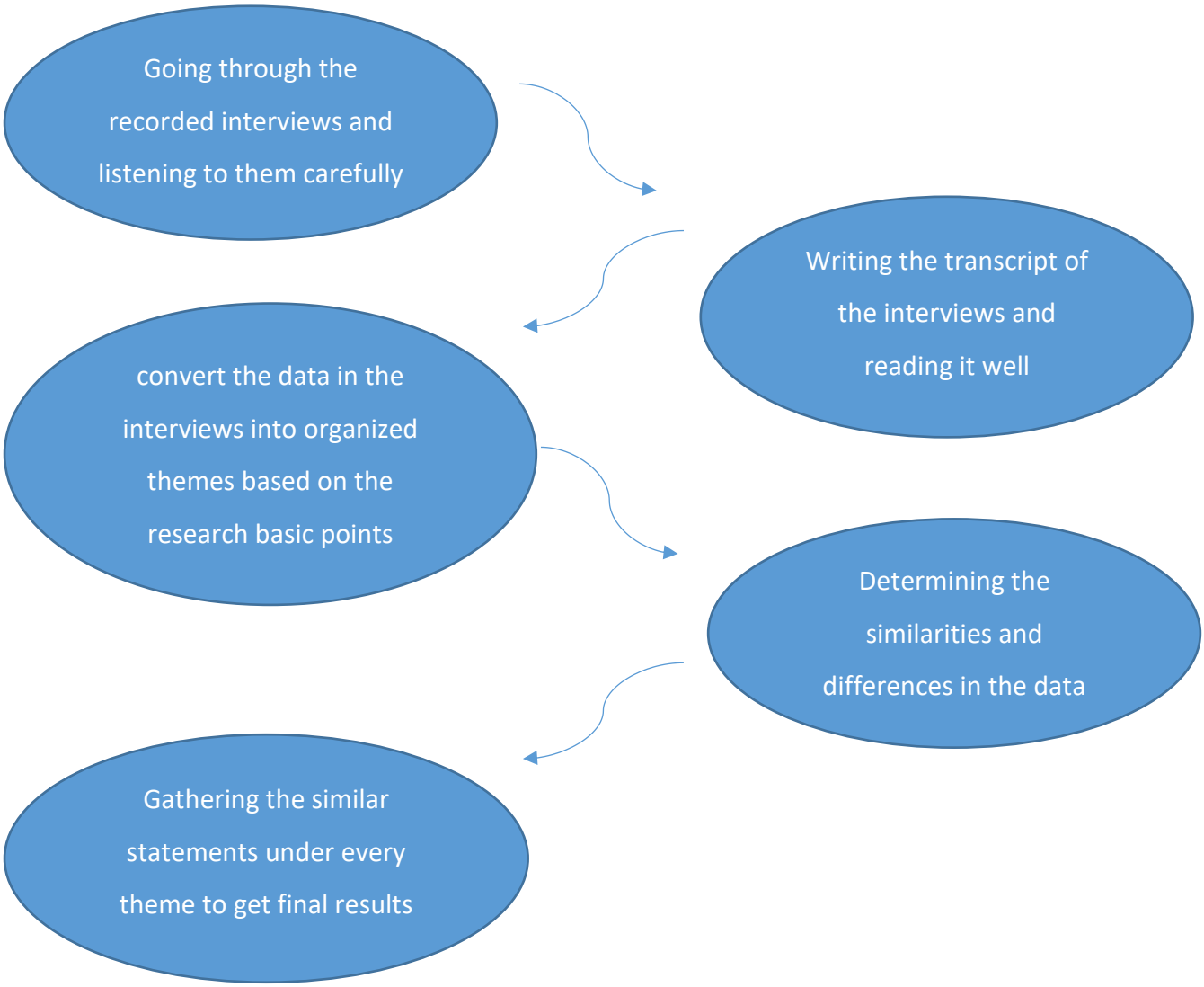

Figure 5. steps of content analysis (based on (Tuomi & Sarajarvi, 2009))

The interviews were transcribed manually word by word, since that is supposed to enhance the overall understanding and familiarize myself better with the collected data. The total data made up to 25 written pages of text. Every interview was transcribed before the next interview is conducted, that helped to change some of the questions or redirect the discussions in different paths depending on the insights and maybe ideas from the previous interview.

To analyze the interviews, three excel pages were created. First page was to determine the analysis basic points and give exact codes to every one of those points. 5 codes were created C1 to C5. Every one of those codes will refer to one of the study points as you can see in table 1

Table 1. Coding the study basic points

Code	Explanation
C1	importance of adopting open innovation in technological SMEs
C2	open innovation modes
C3	preferred open innovation model
C4	cultural diversity impact
C5	challenges facing open innovation in tech SMEs

Second page (data page) contained the parts of interviews where every one of the codes was mentioned in the interview. A column for every code and a row for every interview. In this step the exact words of the interviewees were used under the code. Including the reason behind their opinion, if mentioned, and any ideas that may be suitable to fit in the studied code an example of one row of the table is in table 2.

Table 2. Example of data to organized themes

importance of adopting open innovation in technological SMEs	**open innovation modes**
any company which wants to survive the extremely competitive and rabidly maturing markets in any area, I think would be advised - and I don't think they have to be advised or convinced any more- they know that if they want to survive, let alone the huge companies . In terms of superior products and services delivery. most of them I'm not saying that open innovation is a panacea for everything, okay? It's most likely not. But I think majority of the cases could be useful because it doesn't have to be just open innovation with the customer could be with employees. It could be with the subcontractors or distributors.	So, I would advocate that companies should continue to focus on inbound and especially on trying to find most efficient ways to gather relevant Information with regard to products and services.

In third page of the data analysis excel file (analysis page), there was a deep analysis of the data collected and labeled in the data page. For every one of the previously defined codes there was three columns. One to check how much this code was repeated and agreed in the interviews. Another column to give the reason and the differences in the reason to agree on that code. Finally, the analysis and the comments of the researcher on that code. Below is an example of two codes being analyzed in the form mentioned above in table 3.

Table 3. Analyzing the data codes

Code	how many times to be repeated and agreed	differences in the reason or other aspects (if applicable)	Analysis/comment
C1	repeated and agreed in all 4 interviews	the reason of C1 importance varied from the competitiveness of the business environment, the survival and needing another opinion to grow.	C1 is agreed by all the interviewees, but with some differences in the reason of importance or the impact it might has on the firm
C2	repeated in three interviews and the forth relatively accepting it too	inbound open innovation seems to be less risky and more beneficial to SMEs	C2 resulted in the dominance of inbound open innovation as an open innovation mode in SMEs

Depending on the results we can see in the final page (analysis page), there was some obvious common understanding for some aspects of the studied subject. But the differences in the approach, the meaning and practical aspects varied from one interviewee to another. The position of the employee and the nature of their work also was affecting their viewpoints in some of the study points.

3.5 Verification of results

For business researches, they are usually considered more practical than normal academic studies. Especially if they might be utilized in real life situations. So, the

assessment process of the research's quality is an essential part of the study. Reliability, validity and generalization are the common aspects when conducting quantitative research. But for qualitative research as we have in this study, rigor is the most important concept when it comes to the verification of research.

Like all other studies, this one has many concerns regarding data collection, objectivity, error margin and the bias of the research. it's almost impossible to guarantee that all the collected data is appropriate and sufficient to the research. What we could do is following a well-defined data collection method and doing the best to avoid the researcher bias.

Internal validity applies only to researches aiming to investigate causal relationship. So, it stands for the level of interaction between reasons and resulting effects (Trochim, 2006). In that term, it can also help to prove that a certain study may wipeout other explanations of the same result. This validity pays a great attention of the performance of the study procedures, and how rigor it is. When there is a little chance for the confounding to happen in the study, then it's confidentiality can grow bigger. To give a brief illustration we can describe a study to have cause and effect relation if the cause always comes before the result, changing the cause will change the result, and other explanations of the relationship doesn't have a good possibility. In this study the motivation of employees was always resulting in better acceptance of the open innovation method.

External validity can be described as how much we may expect the results of the study when we apply it under different situations. So, to which extent we can generalize the results of the research, if it was done at different time or with different participants. In the case of this research, we will see in the results and discussion parts that practical results were in most of the addressed issues matching the previous studies conducted in different countries or work fields and environments. That can be a sign that this research results may be generalized and it complies with the external validity terms.

Research reliability in general is the consistency of research results in time terms, and the ability to reproduce same results of the study when using same methodology to process the collected and secondary data used in the research. In the case of the

data that we have it might be difficult to decide that it is totally sufficient to the research or that the data collection techniques of qualitative research have been delivered flawlessly. But the reliability of the research can be granted to some level, because the data analysis was done according to the procedures. So it's highly possible that any future research using same data will come to similar results. The interviews, however might be subjected to the opinion of the interviewee, the personal experience and level of knowledge the participant possess. Hence, conducting same study using same questions, with different interviewees would result in differences in certain aspects of the study. That will depend on the place, time, industry and the chosen participants.

4 Results

The interviewees were representing the diversity to some extent. Two of them were Finnish nationals and another two were foreigners. The level of experience and position also was different from one to another. Having two professionals as experts in the field they operate in, was an advantage to add to the research results. The outcomes in this section will be presented depending on the theoretical framework that was set in section 5-2.

Starting with the challenges to adopt or implement open innovation in technological SMEs. There was some pattern in almost all the interviews to focus on the skilled workforce and the motivation as we can see here in the opinion of one interviewee "organizations consist of people, among other things. And this, you know, those teams, the presence has strengths and weaknesses as individuals and then when combined together, they will still have some stronger and weaker parts. And they really could be case by case, even within the same industry. You may have a collection of individuals who would benefit maybe from better implementation procedures, like more focus on results, tangible results".

Competition also was one of the most important challenges mentioned in the interviews. for many participants the competition against other rivals was preventing from adopting an open model of innovation. it was still obvious that the closed innovation methodology and keeping the innovation inside the company felt more

secure for workers, especially those who are working in the research and development departments. In one response to this question I got this response “Since there are a couple of rivals that are close to equal. This is where you have the situation that whoever comes up with the new idea first will take advantage of it because they're competing of pretty much the same customers anyway. And what comes to mind when I mention the basic product. I think sharing information on production of those would not be a major problem. but what comes to the state-of-the-art stuff, you would never give that”.

Some interviewees tended to prioritize some obstacles/ enablers and give some focus to the most affecting factors depending on their personal experience. Motivation of employees and the working culture were emphasized to have a bigger role as a challenge to adopt open innovation. Assuming that the lack of those two would affect the ability badly. That can be seen in the following line of one answer “I think the firm's culture and motivation of employees are the most important. If you don't have the cultural kind of allows to innovate in the company, so it's not possible to innovate things. So, the culture is a key element, I think. And you need to motivate all this kind of. You need to have motivated employees. I think we need more kind of a culture that you can openly share your idea and get the ideas outside the company. You're not that closed, you’re just opening up for other point of views.”

Other challenges were also pointed out in all of the four interviews. One more challenge was the readiness of the environment to accept and adopt open innovation. The not invented here syndrome was also discussed in some of the interviews. In figure (6) is a diagram of the open innovation enablers or obstacles. Skilled workforce is representing the human aspects in the literature. Culture is one of the general challenges, competition is already considered as main challenge and motivation can be also a general challenge. The values in the diagram are based on how often every challenge was mentioned and considered important by the interviewees.

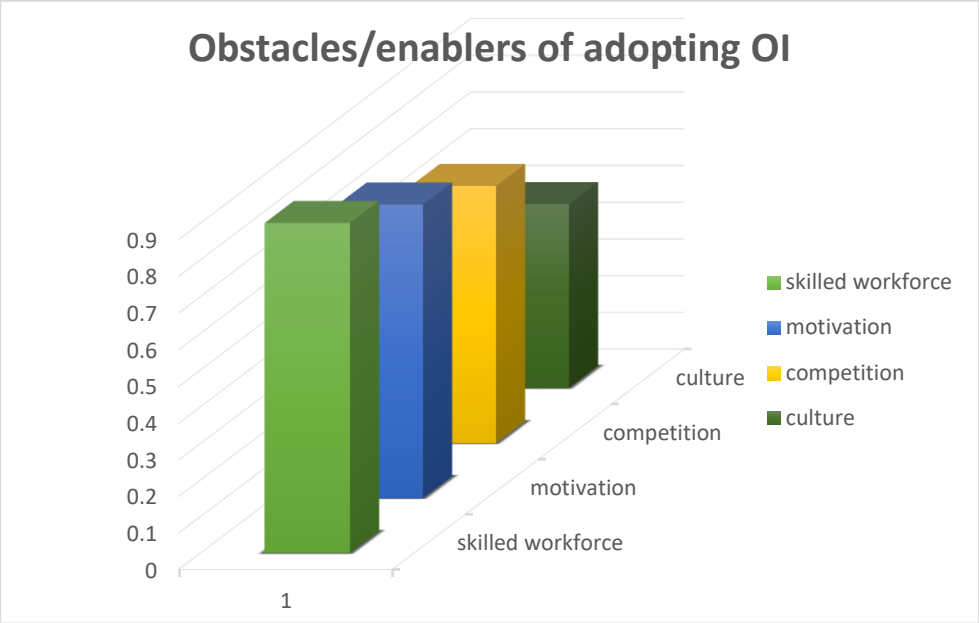

Figure 6. Obstacles/Enablers to adopt pen innovation

Interviews results states that all enablers/obstacles have some role as a challenge to adopt open innovation. And the combination of those challenges is the frame that determines a company's ability to adopt open innovation. Having skilled workers without motivation is not enough. And having skilled workers and motivation will face a real suffering if the culture is not ready or welcoming the transformation into open innovation. So, the ecosystem that helps and enables the adoption of open methodology is essential to guarantee smooth and fast process in adopting open innovation.

Let alone the experts who has been working on an open innovation projects, for normal employees, whether they're working in management or in technical departments. The concept of open innovation was not very clear and two of the interviewees has never heard of it "as the name of open innovation" before which means the awareness of open innovation as innovation and sharing method is not being noticed and it's not given the correct amount of attention. Even though they were practicing some forms of open innovation in the companies they work in. For example here is the response of one of the employees when I asked him about open innovation and what does he know about it "we are not familiar with open innovation as a concept, we just do it the way we do it. Probably without that much conceptualization behind it. But that's the way it works".

The importance to adopt open innovation was almost agreed by all our interviewees. Innovation in general, and open innovation as the form used in the company was described as the way to survive the severe competition between rivals in the market. The connection between innovation and ideas coming from outside the company on one hand, and the future sales and growth of the company was described in the following words “We do it because we get ideas from everywhere, not only from the customers which are working with us. We will get the idea from what else is in the market. This is an industry that is very much R&D based. Actually, most of our future sales come from R&D projects. So. The R&D projects are the driver and the motor of future sales”.

In other opinions, the importance to adopt open innovation was based on the need to have more than one point of view, and the reason behind that is the desire to be one or two steps ahead of other rivals in the industry. And in SMEs it’s not possible to hire too many employees for generating new ideas, then having ideas and innovations from outside the company can be a great help.

Other responses pointed out the importance of open innovation to face the fast growth of the markets. Also described different forms of open innovation which might be applied in companies. Here is what he thinks “any company which wants to survive the extremely competitive and rabidly maturing markets in any area, I think would be advised -and I don’t think they have to be advised or convinced any more- they know that if they want to survive, let alone the huge companies, they need to have some forms of open innovation . I'm not saying that open innovation is a panacea for everything. But I think majority of the cases could be useful because it doesn't have to be just open innovation with the customer, it could be with employees. It could be with the subcontractors or distributors”.

When discussing inbound and outbound innovation modes with participants, all of them have seen or experienced some form of inbound mode. On the other hand, applications of outbound open innovation were not very common in technological SMEs. For example, one interviewee has been personally using a product of another company, after its license has expired. This form of open innovation is widely spread within this industry boundaries. And having the ideas from all our participants

regarding the importance and focusing on inbound open innovation activities is easily noticeable n the results.

Outbound open innovations activities as rarely mentioned or even known even for interviewees with educational backgrounds. They all reacted and mentioned examples for inbound innovation modes. But none of them have done that regarding outbound open innovation. One of the responses explaining why inbound is more important from his viewpoint was this “I would advocate that companies should continue to focus on inbound and especially on trying to find most efficient ways to gather relevant Information with regard to products and services. When it comes to customers. With regards to operations that may include also other stakeholders like employees, subcontractors and so on. And it's no more, I would call them, Data the time needed to be relevant instead of Swimming in the pool of data but has nothing and nothing, just collecting lessons. Some focused target of data to understand how to improve this.”

On the other hand, outbound open innovation was described to be risky and not very popular among SMEs. One interesting opinion stated that, although outbound mode may lower entry barriers for possible future rivals. But it will be a good tool for non-profit organizations which are aiming to spread some know-how knowledge and understanding which are not necessarily commercially oriented. Also some outbound activities, such as spin-offs were described to be not suitable for SMEs in general.

When the discussion came to the open innovation implementation methods, there was some varieties in the responses. But if we would like to give a brief, we could say that all participants agreed on having implementation team to take care of this step. The differences were to make the implementation team responsible for every point of the implementation process, or to give the higher management the role of supervisor. The following figure shows the percentage of both options in our participants opinion.

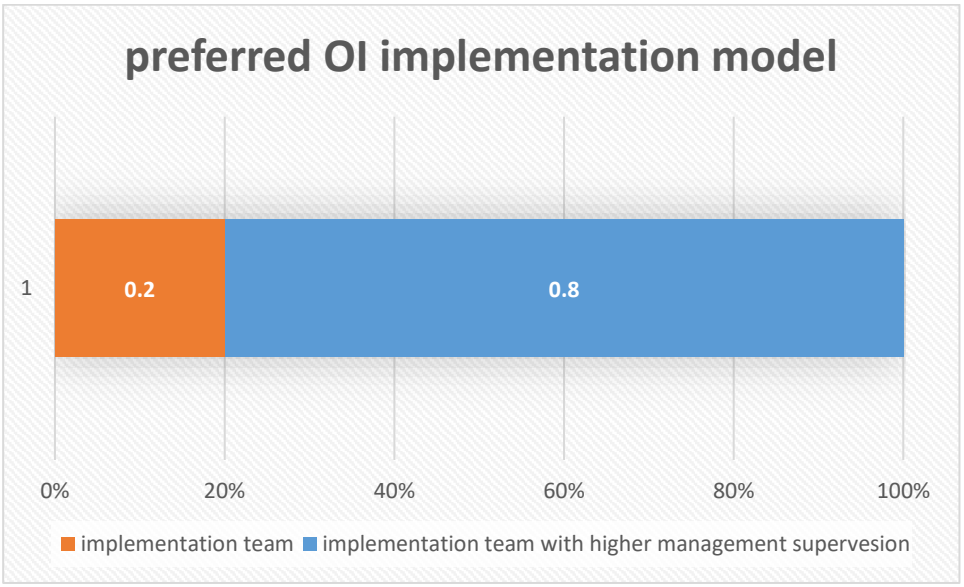

Figure 7. preferred OI implementation model

The Idea of having the implementation team along with some involvement of the higher management team can be seen in this opinion “I think it will be good in in a company, especially at the very beginning, to allow a creative freedom and Autonomy at the lower levels in terms of engaging people within the organization and giving them freedom to engage some target groups, be that customers or others. To make open innovation projects or portfolio projects happening. I would almost say that I think it would be good that some top management would be involved, maybe chief innovation officer, customer engagement, or some Managerial director is directly involved”.

Other point of views was that senior management will help to show the way, create the culture, and determine how to get the job done. Then the implementation team or even everyone in the company, since we are discussing SMEs, can participate in the implementation process. Also, it is worthy to mention that interviewees in practical positions tended to give the R&D employees the ability to choose what to share and t any level. While those in managerial positions suggested that it is the decision of senior management to do that.

The customer engagement in the innovation process was mentioned multiple time throughout the interviews. For example, the customers feedback is a highly preferred source of ideas and even solutions. This was discussed in SMEs providing products directly to customers. And for those working with other companies as

providers. So for SMEs providing one or more services to its clients the feedback is only one step. They should also be committed to follow up with those customers. The company will collect the data gathered in the feedback process to improve certain service or product. Then it will engage customers in the assessment of the service, developing it and creating new ideas or solutions for existing problems.

The impact of cultural diversity was also discussed in the practical study. Ironically, almost every one of the employees was confirming the importance and benefits of cultural diversity, but very small number of foreign workers is found and common in technological SMEs as employees. Cultural diversity can create more creative environment, the group with speaks same language and have same background tend to agree on and take something for granted. Hence, bringing different cultures to work together in same department will generate a richer environment to innovate and accept other ideas or innovations.

Some other aspects, or another way to describe cultural diversity and the importance of it, can be noticed in the following response “I think it's critical you need to have different kinds of people with different backgrounds, in different kinds of skills all the time. That's how people are working or thinking. That's the key things to not have same way of thinking people, they are not creating something new. When people are thinking differently and the culture is that you can openly share idea and openly share your opinion, you can create new things, you can innovate”. Doing projects with employees from different nationalities will provide many approaches for same problem, then there might e many solutions to choose from.

5 Discussion

Open innovation with the different activities it has offers a good solution for SMEs in general to have access to creative ideas or inventions at their initial or concept stage. Then it will be less difficult to continue developing those ideas to reach the wanted final product. By practicing the various activities of open innovation, SMEs will share both risk and benefits with other partners in the innovation network. Also, the issue of lacking internal resources could be fixed when cooperating with innovation partners. The environment has an important role to support the adoption of open

innovation and practicing its activities. The balance of forces in the market could be an enabler or an obstacle for the open innovation process (Wynarczky, 2014).

SMEs had always dealt with the tough market conditions. Also, the economic environment and the fast-changing circumstances in the technology field made it more difficult to sustain the financial health of those companies. Responding to that, the only way to survive was to differentiate from other rivals in the market in products and services. Because SMEs usually don't possess all the required sources to do that, they need to collaborate with various partners outside the company. That partnership will result in better innovation attitude and gaining better position in the highly competitive marketplace. That could show some importance of adoption open innovation in tech-SMEs. That advantage is conditional to the correct management of innovation network in a way that all partners will grasp new opportunities and grow to be SMEs with high profitability (Vanhaverbeke, Vermeersch & Zutter, 2012).

The purpose of this research was to present exploratory study of open innovation in technological SMEs. Many questions still need answers in this area, so this study was a try to fill some of the gaps and to offer a better understanding of open innovation in SMEs.

5.1 Answers of research questions

Some recent studies covered many aspects related to open innovation in many business fields and various organization sizes. But in this research the focus was on technological SMEs, where not many studies happened. So, to contribute to the growth and prosperity of open innovation, those following questions needed to be answered:

How to implement open innovation in Technological SMEs in Finland?

- What are the challenges to adopt open innovation in technological SMEs in Finland?
- What are the suitable modes and models to implement open innovation in technological SMEs in Finland?
- Does the cultural diversity have any impact on the open innovation strategy in these companies?

In this study a qualitative methodology was adopted. After setting up the theoretical framework depending on the previous studies, the data was collected via semi-structured interviews. The interviews purpose was to explore the most suitable way to implement open innovation from the interviewee's viewpoint. Interviews also discovered the preferred modes and models when implementing open innovation, the impact of cultural diversity and the challenges which may be facing that adoption or implementation. The collected data was analyzed using content analysis method, to find similarities.

First, the challenges to adopt open innovation in technological SMEs are not a few. Starting from Human aspects like the availability of skilled workforce, and the way to motivate those workers in order to have the ability and the intention to adopt and implement open innovation activities in the correct form. In addition, overcoming some issues related to the human aspects, such as the not invented here syndrome. That syndrome was noticed in the interviews with employees working in R&D departments, who are usually the basic unit of the open innovation implementation team. Then comes the competition challenge, when SMEs find themselves fighting against other rivals to gain a better market share or even to survive the fierce environment. In that case it might be an obligation rather than an option to collaborate with partners to compensate the low level in internal sources and to improve products and services ahead of other rivals. The culture inside and outside SMEs also have an important role as a challenge to adopt open innovation in tech-SMEs. When big organizations, educational institutes and other important innovation network items are not ready or willing to be part of the collaboration, then the open innovation will not pay back.

Second, the modes of open innovation as described in the literature were inbound, outbound and sometimes a combination of both. In our study the activities of inbound open innovation seemed to be more known and wanted in tech-SMEs. Like using some inventions with license from another company, or even outdated license. Also getting ideas and inventions from universities, research centers and open innovation intermediaries can be described as very welcomed activity of inbound open innovation. On the contrary, outbound open innovation activities didn't grab

the attention of our interviewees. And it didn't seem to be suitable for SMEs. There are plenty models to implement open innovation in companies, but not all suitable for the case of tech-SMEs. In our case interviewees focused on having implementation team to handle the open innovation process. Also, it was preferred to have supervision from senior administration on the implementation procedure and its activities. Almost none of the interviewees liked the up-down method to implement the method. There was kind of general agreement that employees should be involved in the implementation according to the roles they have in the company.

Third, when discussing the cultural diversity, it was obvious that all interviewees agreed that it will add an advantage to the open innovation implementation. Some comments were addressing the situation in Finnish companies, and that adding more employees from different backgrounds would increase the innovation in those SMEs. Integrating the experience and ethical knowledge in one team could produce new and innovational viewpoint to solve problems, or to create new inventions.

5.2 Assessment of the results in the light of earlier literature

In the literature review (chapter 2), the study phenomenon was totally covered. Open innovation in general and previous researches related or connected to the study were mentioned. Moreover, some topics like innovation ecosystem and open innovation networking were also added to give better nderstanding of the research topic in general. By comparing the practical study findings to the literature review, we can find the similarities, differences, and also how this study may contributee to the literature of open innovation in tech-SMEs.

In the literature it was mentioned that innovation challenges can differ from one company to another, but in most cases one of the following will be found. Scarcity of skilled manpower and resources, the level of coordination in the company's operative functions, how difficult is the scientific field the company is operating in and ability to get the latest updates in the industry (Abouzeedan, et al., 2013). The study results confirmed the type of obstacles which may face tech-SMEs while adopting open innovation. Additionally, the research offered some kind of classification for the most affecting challenges. Humas aspects were addressed in the

literature to include scarcity of skilled workforce and high wages (Rahman, H. & Ramos, I. 2013). In our study the lack of manpower with suitable skills was still the most affecting challenge. But, the motivation of employees to adopt open innovation was mentioned as the other factor in human aspects. Competition stood out as one of the main obstacles in the literature. The most affecting factors in terms of competition are the augmentation in product's differentiation processes, seeking market demand and the strategical partnership that needs to be formed by those SMEs (Rahman & Ramos, 2013). Collected data reffered to a similar result concerning competition. It was described to have a huge impact on the adoption and implementation of open innovation in tech-SMEs. General barriers in the literature had many factors determining the business environment of the company. Those factors were kind of industry, size of the company, density of technology and type of targeted market (Abulrub & Lee. 2012). In this study, we found that the culture of the SME, which can be a general challenge too, was important for the adoption of open innovation. It was important to facilitate much easier and smoother implementation of open innovation.

Open innovation modes can include many activities and various ways to specify them in the literature. The literature mentioned that some inbound open innovation activities like crowdsourcing platforms, idea contests and using innovation intermediaries such as Innocentive or NineSigma are considered to be very popular nowadays. And every company will mostly conduct some of these activities (Enkel, et al., 2009). In the research inbound open innovation activities were the most popular in tech-SMEs too. Using licenses from other companies was mentioned more than one time as a familiar inbound open innovation activity. And the risks of outbound activities such as losing the company's core competences and lowering the entry barriers for new possible rivals were also spotted in the practical research as in the previous literature. Something to add is that outbound open innovation activities like spin-offs and selling market ready products were labeled to be completely non-suitable for tech-SMEs. Since companies like these might have only one product (or product family), so there is no option to have any of the two mentioned outbound activities.

Implementation frameworks for open innovation had many options according to the previous studies. One of the discussed methods suggested that framework of open innovation implementation process in SMEs is composed of 5 stages, it starts by identifying the regional innovation system, second is diagnosing the company, third is the preparation stage, then comes the implementation, and the fifth is the control and monitoring of the implementation (Oliveira, et al., 2019). In this research we concedered only the implemeentation phase. Trying to define the most suitable implementation model for tech-SMEs. According to the results, the most preffered way is to have an implementation team with good knowledge of open innovation along with supervision from senior management. This might not be mentioned before to be a good implementation method in the case of tech-SMEs.

Cultural diversity was not precisely attached to open innovation in the literature. Although this study tried to examine the possible impact of it and if it can be enabler to adopt and implement open innovation. Even thought, there was some studies regarding the effect of cultural diversity when implementing open innovation. The diversity of certain group or project members is now essential to promote creativity and innovation in that group, because different backgrounds and variety in viewpoints, expertise and understanding could be the generator of creativity (Bezrukova & Uparna, 2009). In the practical study carried out in this research it was utterly agreed for all participants that diversity of employees is very helpful in terms of accepting new and radical ideas, creating significantly different solutions or viewpoints and the ability to be more flexible to external ideas and innovations. That will ficilitate the acceptance of open innovation and implement it much smoothly.

5.3 Research main implications

The basic aim of this study was to explore the status of open innovation method in technological SMEs. The starting point was to collect previous studies in this field, which were not much. And when the practical study started many facts were discovered and some of them were not expected for tech-SMEs in Finland. The level of awareness concerning open innovation as a business model was very low, even among participants in management roles. There was not enough knowledge regarding the huge benefits of implementing open innovation activities and the

potential of having innovation ecosystem and innovation networks to get the most out of the practiced open innovation activities. In this point it's extremely important to raise the suitable awareness of open innovation among employees in tech-SMEs. This step can help in preparing the company's environment to implement the required open innovation activities as part of the innovation network, and to play the expected role in return as being active and important member of the innovation ecosystem.

Raising the knowledge of open innovation would result in increasing the abilities of employees. Hence there will be more skilled workforce (in terms of open innovation) ready to transfer the market into the open innovation ecosystem. The gained skills could reduce the challenges facing tech-SMEs to implement open innovation. The challenges to adopt open innovation which were mentioned in the practical study varied in some points from the expected depending on the literature. It was noticed that the high wages issue which was described to be one of the most affecting challenges in human aspects during recent studies in other countries. That challenge didn't appear in the interviews or in the discussions regarding the challenges in general. That could be caused by the salary system in Finland, or the nature of the country as technology related jobs are considered common and has huge number of employees. One more thing to point out here, even interviewees liked open innovation and the profitability it might bring to the company, but there was concerns regarding external inventions and ideas. That reflects the "not invited here" syndrome mentioned in the literature. Hence it is important for the team responsible of implementing open innovation to pay extra attention to this phenomenon and reduce the bad effects to the minimum possible level.

An interesting note on implementing open innovation in tech-SMEs was presented in practical research and it is worthy to care about is regarding the specific implementation of open innovation. When implementing open innovation in tech-SMEs almost all participants agreed that implementation team and supervision from senior management is the ideal way. But for employees in R&D department it was critical to know how to decide what to share and what not to share in the innovation network. And it was vital for them that the decision should be made by the implementation team members from R&D department functioning in the open

innovation implementation team. Because they are capable to estimate the importance of every idea or invention, and how beneficial it will be to the company in the long term.

5.4 Limitations of the research

The research was done with objectivity in mind, the results of practical study was not similar to the privious literature in some aspects. In other cases there was some additions or modifications to the old results from different papers. Also the interviewees were not irected towards any answers when conducting the interviews. The way of forming the questions was not adopting any viewpoint preffered by the researcher. The analysis of the data was according to the content analysis method and the results of the analysis should be the same no matter who is doing the analysis. Since the study is explorarity in nature, no assumptions were made in advance. Hence it can be said that it has a good level od objectivity.

The reliability of the results could be prooved by the way the research was completed. the theoretical background was carefully researched. That produced a clear and reasonable framework for the practical study. The research questions addressed the researched phenomenon in the way that will deliver the research results by answering those questions. Data collection method was followd step-by-step to get suitable data from the practical study. Then gathered data were analyzed depending on a well-known method, to generate reliable results. Hence, the researcher believes that same results may be reached by another researcher with considiration to the size of companies as SMEs, field of industry as technology and the country were the study was carried out as Finland.

The limitations in accessing data to complete the research was a huge obstacle. It was so difficult to get interviewees interested and willing to discuss open innovation. Some reasons were the lack of knowledge in the researched topic, or lack of hands-on experience in open innovation method. In addition, some of the interviwees who accepted to do the interview were not sure about the phenomenon we are discussing, and it seemed totally new to them at first. That made it difficult to get in-depth opinions and more specified information which can help more to add

reliability to the results. The number of interviews is not much, only four interviews. Thus, it is difficult to base on these results for generalization of the results. The researcher had to compromise because of the small amount of practical data collected. The implementation of open innovation, for instance was supposed to be discussed in more detailed way. But there was not enough data to achieve that correctly.

5.5 Recommendations for future research

For future researchers interested in open innovation in tech-SMEs, there are some needed researches to complete the study and grant it more generalizable results. First suggestion is a quantitative research on a concedered number of tech-SMEs to investigate the results presented In this study on larger scale. The research may be applied to a number of tech-SMEs in Finland to examin the challenges, implementation modes and models of open innovation. This kind of study will provide a numerical results which could be producing general results regarding the challenges facing open innovation, modes an implementation models of open innovation in tech-SMEs. Second suggestion is to research the assessment of open innovation in tech-SMEs. The evaluation of open innovation still needs many researches to fill the gaps in the assessment proccess for different company sizes and indstry fields. It would be interesting to have some moderrs research on a big scale to specify the possible evaluation methods of open innovation imolementation. And the modifications to that assessment method for various company sizes and business environments. Third suggestion would be open innovation and the growth of SMEs. This study might inspect the role of open innovation activities in the growth of tech-SMEs. The aspects which were positively affected by those activities, and how was it affected, like the engadgment of clients and stakeholders. And the negative effects of those activities (if any) on the company, employees and the business environment in the country.

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