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Tackling the barriers in open innovation practices in emerging markets

An evidence-based framework from Turkey, Russia and India

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TIIVISTELMÄ:
Avoimen innovaation voidaan ennakoida tulevan osa uutta innovaatiohallinnan mallia, joka sisältää sisäänpäin, ulospäin ja yhteistyöhön suuntautuvien toimintojen ohjaamista avoimen innovaatioverkoston välillä. Lisäksi tässä lähestymistavassa korostetaan erilaisten ulkoisten tietoperustojen käytön merkitystä, kun taas tällaisten toimien käsittely tuo esiin haasteita erityisesti samalla, kun useammat toimijat ovat yhteydessä innovaatioverkostoon. Avoimeen innovointiin tähtäävien avointen innovointikumppaneiden keskuudessa voi jossain vaiheessa syntyä haasteita tai esteitä kuten kielteinen asenne, resurssien puute, luottamuksellisen tiedon jakamisen pelko ja kommunikointivaikeudet.

Taloudellisen suhdanteen mahdollisten suuntausten puitteissa, yritykset ovat alkaneet havaita avoimuuden edut ja mahdollisuudet, joka johtuu nykyisen globalisoituneen ja teknologisen ympäristön luonteesta. Lisäksi avoimen innovoinnin kirjallisuus on kattanut hyvin sekä pk-yritysten että suurten yritysten hyödyt ja tuonut esiin erilaisia yksittäisiä haasteita, joita yritykset voivat kohdata. Avoimen innovaation ympärillä olevat negatiiviset aiheet ovat kuitenkin erittäin kartoittamattomia, kun taas tietyissä tutkimuspapereissa keskitytään vain yksittäisiin haasteiseen kuten negatiiseen asenteeseen ja johtonäkymiin.

Tässä tutkivassa paperissa tarkastellaan erilaisia haasteita, joita pk-yritykset ja suuret yritykset kohtaavat sekä ennen avointa innovaatiotoimintaa että sen aikana. Lisäksi kyselyssä keskitytään selvittämään mahdollisia keinoja selviytyä näistä haasteista ja kartoittaa eri yhteistyökumppaneiden välistä onnistumisastetta innovoinnin menestyksen kannalta. Kyselyssä haasteiden osuutta mitataan yhdellätoista mahdollisella haasteella, joita yritykset ovat saattaneet kohdata avoimessa innovaatiotoiminnassaan viimeisen viiden vuoden aikana.

Tutkimustulokset tuovat esiin, että yrityksen koosta tai toimialasta riippumatta yritykset näkevät innovaatiotoiminnassa yleensä arvoa. Kuitenkin, tutkimuksen 196 osallistujan perusteella voidaan korostaa ainutlaatuinen trendi luottamuksellisen tiedon jakamisen pelosta jokaisessa alaryhmässä, sillä se oli yleisimmin kohdattu haaste sekä ennen avointa innovaatiotoimintaa että sen aikana. Tämän ohella, kielteisen asenteen roolia ei voida hylätä, sillä se oli kasvussa kyselyyn vastanneiden keskuudessa. Avoimen innovaatiotoiminnan mahdollisten haasteiden ja esteiden voittamiseksi luotiin kolme erilaista kehystä. Kaiken kaikkiaan tämän teeman ympärillä oleva kirjallisuus ei sisällä riittävästi kehyksiä erilaisten avoimen innovaatiohaasteiden ratkaisemiseen. Tästä näkökulmasta, akateemisen maailman yhteyksiä erilaisiin mahdollisiin haasteisiin on vahvistettava. Lisäksi todetaan, että avoin innovaatiotoiminta asiakkaiden kanssa on samalla suosituin ja menestyksekkäin valinta, kun taas kilpailijoilla on vähiten onnistunein asema muiden sidosryhmien keskuudessa.

AVAINSANAT: Avoin Innovaatio, Kehittyvät Markkinat, Haasteet ja Esteet, Avoimuus, Avoin Innovaatioverkosto, Näyttöön Perustuva Kehys

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ABSTRACT:
Open innovation can be anticipated to be a part of new pattern for the innovation management as it includes controlling inbound, outbound and coupled movements among open innovation network. Furthermore, this approach highlights the role of usage a wide variety of external knowledge bases while handling this kind of activities brings out individual challenges especially when more actors are connected into innovation network. At some stage, challenges or barriers like negative attitude, lack of resources, fear of sharing confidential information and communication difficulties may arise among open innovation actors towards open innovation.

Within the scope of possible trends around the economic cycle, companies have started to notice the benefits and opportunities of openness which is resulted from the nature of current globalized and technological based environment. Additionally, the literature around open innovation has covered well the benefits in both SMEs and large enterprises while bringing out different challenges which companies may face. However, negative topics around open innovation are highly unstudied while certain papers focus only certain challenges like negative attitude and managerial prospects.

This investigative paper examines different challenges which SMEs and large enterprises face both before and during the open innovation activities. Furthermore, the survey focuses on finding out possible ways to overcome these while also mapping the success rate between different collaborators in terms of innovation success. In the survey, the share of challenges faced is measured with eleven possible challenges which companies may have faced in their open innovation activities during the last five years.

The results of research points out that regardless the size of the company or industry, companies tend to see value in innovation activities. However, based on 196 survey participants unique trend on fear of sharing confidential knowledge in every subgroup can be highlighted while it was the most commonly faced challenge both before and during the open innovation activities. Additionally, the role of negative attitude cannot be dismissed while it had increasing trend among the survey respondents. In order to overcome possible challenges and barriers of open innovation activities, three different frameworks were created. In overall, literature around this theme does not consist enough frameworks for coping with variety of open innovation challenges. From this point of view, academia linkage to variety of possible challenges faced needs to be strengthened. Furthermore, it is found that open innovation activities with customers are at the same time the most popular and successful choice while competitors possessed the least successful position among other stakeholders.

KEYWORDS: Open Innovation, Emerging Economy, Challenges and Barriers, Openness, Open Innovation Network, Evidence-based Framework

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Abbreviations

DMAIC	Define, Measure, Analyze, Improve and Control
IP	Intellectual Property
NIH syndrome	Not-Invented-Here Syndrome
OECD	Organisation for Economic Co-operation and Development
OI	Open Innovation
R&D	Research and Development
SME	Small and Medium-sized Enterprise

1 Introduction

In the current multinational, globalized (Patra & Krishna, 2015) and complex technological (Traitler, Watzke & Saguy, 2011) business environment, companies have started to invest more in the research and development (R&D) activities (Gammeltoft, 2006). Additionally, companies have shifted their actions towards being more open (Enkel, Gassmann & Chesbrough, 2009) while the knowledge of benefits and opportunities of external knowledge in order to stay more competitive has increased (Felin & Zenger, 2020). Chesbrough (2003) can be seen as the first creator for the term “open innovation” while Trott and Hartmann (2009) criticize the origin of this action by claiming that companies have had external collaboration activities long before the creation of this term. According to Chesbrough, Vanhaverbeke and West (2014) open innovation is an innovation process where knowledge is shared across the organizational boundaries by using different methods which are in line with the business models of every organization involved.

For innovativeness and market growth, communication between different collaborators like universities, different industries and government has a central role (Patra & Krishna, 2015). In open innovation model, this claim can be highlighted while open innovation activities are tying together a comprehensive scope of different external knowledge sources (West & Gallagher, 2006). Additionally, mainly because of the trend around innovation, companies have started to adopt more the model of openness instead of following old patterns of closed innovation (Hameed & Altaf, 2019). However, adopting the model of open innovation may bring challenges like negative attitude, management constraint and taking advantage of external knowledge (Iqbal & Hameed, 2020). Although company makes structured strategies and meets the requirements for open innovation activities still, it may fail to avoid different challenges and risks (Haase, 2019).

The aim of this research is to provide a comprehensive view of different challenges which companies in emerging economies face while practicing open innovation activities. Object is not just to provide a list of different challenges but find out how often companies

face different open innovation challenges both before and during these activities. Also, support and reasons behind different challenges or barriers are acquired from the existing literature while referring to both classical and new researches. Additionally, three different frameworks for overcoming or handling occurring open innovation challenges is provided which companies may implement in their open innovation model.

1.1 Background of the Thesis

Chesbrough (2003) can be seen as the inventor of open innovation term but Trott and Hartmann (2009) argued whether this type of collaboration is new or not by claiming that openness has always been part of companies' innovation process. However, based on academic attention, the attention towards openness and open innovation in general has increased in business world (Chesbrough & Bogers, 2014). Also, highly globalized and competitive markets are pushing companies towards using more external knowledge (Du Chantenier et al., 2009). After the introduction of open innovation term (Chesbrough, 2003), more research focus have been put on large companies while also research on SMEs is increasing. The reasons why SMEs exploit open innovation activities are usually related to their newness or smallness, mostly because they lack resources (Spithoven, Vanhaverbeke & Roijakkers, 2013).

Literature around innovation like Chesbrough (2003; 2006; 2011) and West, Salter, Vanhaverbeke and Chesbrough (2014) are having too optimistic point of view while dismissing the seriousness of possibly occurring challenges. Moreover, the image around open innovation is shaped to be too positive. Also, Huizingh (2011) claim that more research should be done on the both external and internal environment features which are linked with the performance. Additionally, West and Bogers (2017) bring out that topics like why companies do not continue with open innovation activities and other negative sides of the topic are highly unstudied. Also, literature around open innovation tend to be too specifically focused into one factor while actors in different sectors cannot utilize these results. Therefore, this research is providing an overview of open innovation

in different sectors without limiting research into specific industry based on the size of the company. Furthermore, all company sizes are included into research while creating a framework which companies may implement in their open innovation procedures.

1.2 Research gap and purpose of the research

Earlier research, after the creation of the term “open innovation” (Chesbrough, 2003), focused on large companies and those times it was thought that openness is just part of large companies’ functions (Stanisławski & Lisowska, 2015). Later on, also SMEs have been included to researches while it is argued that SMEs tend to have open innovation activities because they do not have a wide business network or manufacturing opportunities (Ahmed, Halim & Ahmad, 2018). Although literature starts to cover quite well all the areas of open innovation still, there are a few research gaps. For instance, research papers like West and Gallagher (2006) and Abulrub and Lee (2012) are focusing into a specific group of challenges but focus into a wider perspective is missing. Prior literature have focused into certain types of challenges like lack of commitment (Chesbrough & Crowther, 2006; Van de Vrande et al., 2009) and not-invented-here (NIH) syndrome (Chesbrough & Crowther, 2006) while a wider view of challenges faced both before and during open innovation activities lack examination.

This research is limited into emerging economies where as Badir, Frank and Bogers (2020) show, the attention towards open innovation is not in high level mostly due to lack of resources and value capturing. Although especially during the last decades, companies’ growth in emerging economies has been quite significant while it is drawing more attention from advanced economies (Peng, Lebedev, Vlas, Wang & Shay, 2018). Therefore, this research is following the main challenges of open innovation in emerging economies for finding the answer to following research question:

RQ: What are the main challenges of open innovation companies face in emerging economies and how these challenges can be addressed?

In order to better understand the topic of open innovation and to answer the research question, also general aspects of open innovation and innovation in overall will be covered in literature review part. Additionally, this research includes three different objectives in order to better support the process of the research and at the same time find more detailed and comprehensive answers for the research question. The objectives of this research are listed as follows:

1. What are the drivers of failure or difficulties in companies' open innovation system?
2. Does success rate of innovation differ with different external open innovation partners?
3. Which kind of framework should companies follow in order to provide tools to help overcome risks in open innovation activities?

Based on the existing literature, this research has a pair assumptions about different challenges and collaboration. These assumptions along the objectives of the study, are helping to form a guidelines for this research. Moreover, assumptions help to find accurate data from literature while forming a comprehensive survey in order to make it match with the objectives and research question. Additionally, listed assumptions are mostly based on the literature where the importance of different factors or objects are highlighted. The assumptions of the research are listed as follows:

1. Fear of sharing confidential knowledge is a significant barrier and challenge for open innovation (Kazemargi, Cerruti & Appolloni, 2016; Gurca et al., 2021).
2. Open innovation activities with customers leads to the highest rate of success in the terms of innovation (Piller, Ihl & Vossen, 2011).
3. Not-Invented-Here (NIH) syndrome has a crucial role in adapting open innovation activities (Chesbrough & Crowther, 2006).

Assumptions listed above are important and witnessed findings of the topics around open innovation. For instance, Chesbrough and Crowther (2006) point out not-invented-here (NIH) syndrome along commitment problems have a crucial factor in the implementation process and execution of open innovation. Additionally, Kazemargi, Cerruti and Appolloni (2016) point out that some parties may feel that knowledge exploiting can result to lose fundamental knowledge and capability in the business competition. Rouyre and Fernandez (2019) also support this claim while adding that this kind of rising tension should be handled directly in order to avoid the failure of the project. Lastly, Piller, Ihl and Vossen (2011) point out the importance an benefits of customer co-creation where customers are becoming a vital part of innovation process. Support for this claim can be found from Chesbrough (2011), where it is stated that collaboration with customers is an useful way to move towards open innovation practices while getting more information about what customers value the most and what customers need. Additionally, Piller & Ihl (2009) highlight when early customer feedback is taken into account it is reflected in better customer satisfaction and further higher position in competition.

1.3 Research methods

This research was done based on a comprehensive literature review and a survey which was filled by company workers who are working or dealing with open innovation processes. The survey is based mostly on quantitative method where most of the data is collected through question which can be quantified and therefore, analyze is done mostly based on numerical data while taken into account respondents' comments. The target audience for survey were both SMEs and MNEs from Turkey, Russia and India who have had open innovation activities at some capacity during the last five years. This sampling method aims to minimize variation in the study (Guba & Lincoln, 1989) while current situation of open innovation challenges faced in emerging economies is mapped.

Survey was made to correspond the objectives of the research and finding the answer for research question. The data collection process was made between April and May

2021 through the electronic survey which made it easier to obtain data from the case countries. The survey was concluded with Google Forms online survey program and after the data collection all the data were transferred in one Excel file while doing a controlling process for answers. Moreover, out of 236 responses received, 196 answers passed the screening phase which then presents the sample of this study. Also, the sample size is rationally satisfying while all company sizes (SMEs and large enterprises) and case countries were included to the analysis. More detailed information about research methodology is provided in the chapter four.

1.4 Limitations

As every research, also this thesis has specific limitations. The results of the survey are just limited into a sample of companies from Turkey, Russia and India which have had open innovation activities during the last five years. Additionally, this research does not have detailed focus into legal challenges and perspectives because these aspects may vary a lot depending on the country. However, some intellectual property (IP) protection is explored at basic level. Also, this research is leaning more towards technology-based companies because those companies are more likely to have at some capacity open innovation activities. Furthermore, it is hard to draw line between strategic partnerships and knowledge sharing activities as an open innovation action. Also, it can be questioned if all the research results can be directly reflected into every industry due to the sample size of industries. Therefore, in this case, those results can be used more as an example or indicator but other results based on country or enterprise size are more valid.

1.5 Structure of the Thesis

In the figure 1, the outline of the study is presented in linear order. The study consists eight different main chapter. The introduction part provides overview of the research while pointing out the research question and main objectives of the study. After the

introduction, it easier to characterize the idea of the research. Also, the main limits of the study are provided along the purpose of the research.

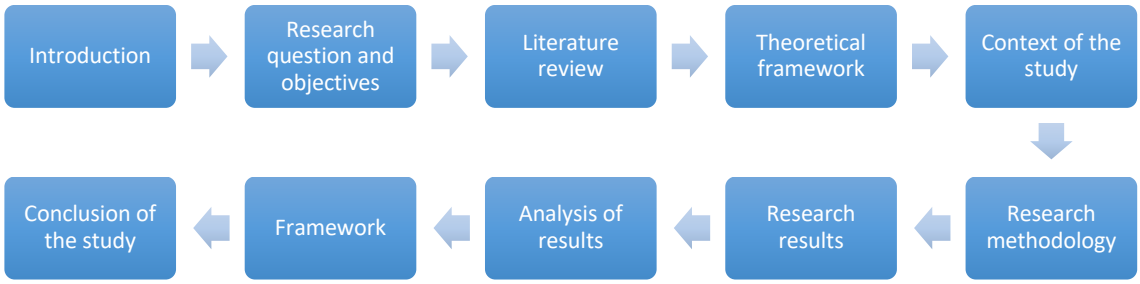

Figure 1. Structure of the research.

The second chapter of the research covers the literature topics around the innovation and open innovation like closed and open innovation, open innovation networks and challenges of open innovation. The third chapter is moving focus into emerging economies where the different aspects of Turkey, Russia and India is compared. Furthermore, overview of open innovation in emerging economies is presented which helps to understand fundamental points of context of the study more detailed. In the fourth chapter of this research, research methodology of the study is defined where methodologies, data collection process and analysis of results is evaluated along the reliability and validity. The fifth chapter presents the results of the survey where analyzing background data, finding out different open innovation challenges and mapping different external open innovation stakeholders is done. The sixth chapter is about getting more detailed look into research results while for instance dividing answers into different groups by country, industry and company size to find out whether specific trends occur between different variables. After detailed analyze of the survey results, chapter seven brings together these results and literature while presenting three different frameworks for overcoming open innovation challenges. Lastly, the research is concluded with conclusion of the study which wraps up main points of the research. Also, main takeaways of the research are presented which collects main answers for the research question and objectives of the study.

2 Literature Review

In the chapter 2, the theoretical literature view of the research will be examined and presented. The literature review is giving a foundation for the research where the challenges of open innovation will be examined. The literature review begins with the background and basic overview of innovation. After that, definition of both closed and open innovation is followed where different aspects are reviewed. Lastly, some example open innovation networks are examined and literature review is concluded with the summary of the theoretical literature around open innovation.

2.1 Background and categories of innovation

Josep Schumpter is often seen as the first economist who highlighted the importance of innovation and also defined five different types of innovation in the 1930s. According to his research, innovation is mainly bringing something new, making changes or developing new source of supply. After those early times, new definitions and clarifications of "innovation" has emerged into academic literature (Rogers, 1998). Kline and Rosenberg (2010) brings out that innovation is not only a new product but also it may be for example a new process, an improvement or a reorganization of something which leads to increased efficiency. Furthermore, within organizations innovation can happen in every level and it does not need to be something radical (O'Sullivan & Dooley, 2008).

Doblin (2015) has created a framework for different types of innovations. With this framework, it is possible to plot and analyze different innovations or competitions. Furthermore, according to this framework innovations can be divided into 10 different dimensions within three categories (Keeley, Walters, Pikkel & Quinn, 2013). The ten types of innovation framework (Doblin, 2015) also state that innovations always happen in one of the determined categories. Configuration innovations are related for company's enterprise or business system and innovations which are categorized as offering focus more on product or service areas. Lastly, experience innovations are dealing with customer

related essentials of the business model which are more noticeable for them via service, brand, channel or engagement of customer (Keeley, Walters, Pikkel & Quinn, 2013).

In overall, innovation can be happened with products, processes and services. Product innovation is when changes are made to product itself that can include adding new functionalities. Process innovation is reflected to process of producing products or ser-vices where even outsourcing of production to improve quality is an innovation. Service innovation is directly related to services which customers use and it does not always involve products into it (O'Sullivan & Dooley, 2008). Furthermore, innovation can be categorized based on the its impact as either radical innovation or incremental innovation (Ettlie, Bridges & O'keefe, 1984; Koberg, Detienne & Heppard, 2003). Here radical innovation makes major impact really quickly for growth and contrariwise incremental innovation has a short-term influence (Koberg, Detienne & Heppard, 2003).

Davila, Epstein and Shelton (2012) have classified innovation types into four categories (figure 2) according to the technology and business model change. In addition to this model, similar approaches are available in the literature where innovations are categorized based on for example problem and domain definition. Satell (2017) introduces innovation matrix which is represented on the right side of the figure 2. With this matrix, companies can find the most suitable innovation strategy for problem solving.

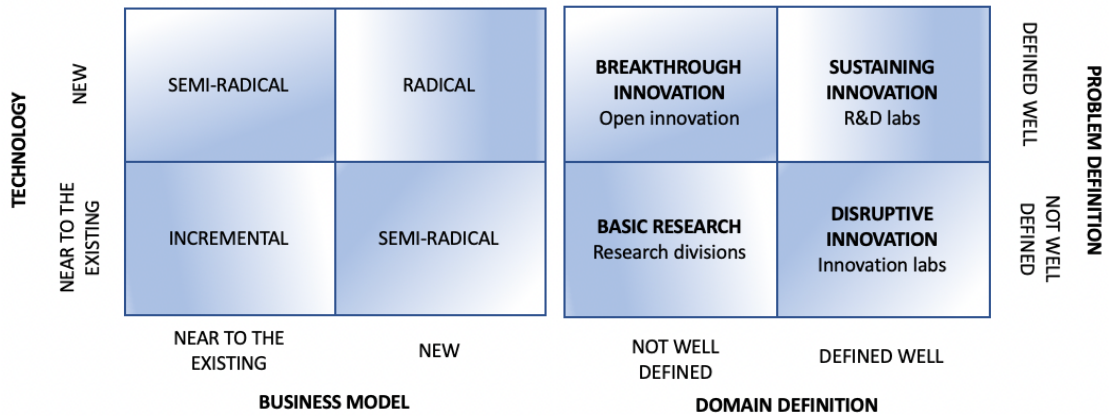

Figure 2. Two innovation matrixes (Left matrix adapted from Davila, Epstein & Shelton, 2012 and the matrix on the right side is adapted from Satell, 2017).

In the Satell's (2017) innovation matrix, breakthrough innovation is categorized when problem is defined well but the place to solve it is not outlined well. Strategy for this kind of innovation can be outsourcing the solving process with offering a price reward. Action like this is considered as open innovation action. Furthermore, innovation activities can be divided into closed and open innovation where open innovation is starting to get more attention both in academic and industrial environment (Marques, 2014).

2.2 Closed innovation

Chesbrough (2003) has described that companies which are creating, developing and commercializing their own innovations are using the closed innovation approach. In this model (figure 3), companies rely on their own internal idea generation and knowledge processing while later these companies do the commercialization and distribution work by themselves. Furthermore, for example because of improved education, globalization, shorter product life cycle and more intense competition has made the approach of closed innovation outdated (Rahman & Ramos, 2010).

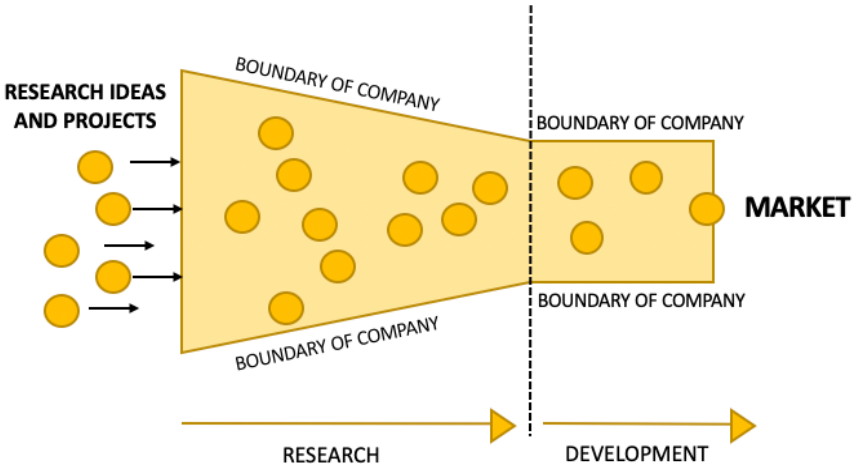

Figure 3. Model of closed innovation (Adapted from Chesbrough, 2003; 2006).

The main characteristics for the closed innovation are company boundaries which means that company does not have any external innovation activities. The flow of process is pretty straightforward where research ideas and project go through the processes of

research, development and commercialization (Chesbrough, 2003). Briefly; the ideas come in only from one entry and exit from another one. Despite being traditional approach for innovation processes, strategy of closed innovation can be at some cases more preferred option for small and medium sized companies (Brem, Nylund & Hitchen, 2017). Transformation from the model of closed innovation to open innovation may bring strategical, organizational and managerial challenges (Hagedoorn & Zobel, 2015).

2.3 Open innovation

After Chesbrough (2003) firstly described the concept of open innovation, it got more attention both in academic and industrial environment. According to Chesbrough (2003; 2006; 2012), in open innovation model (figure 4) companies utilize both own and external sources which can further end up in company's current or new market. This means that in innovation processes the knowledge sharing can be happened with for example customers, competitors and suppliers (Ahmed, Halim & Ahmad, 2018). In addition to this, open innovation activities can lead to better business plan while with the use of external research and development additional value can be achieved (Chesbrough H., 2012).

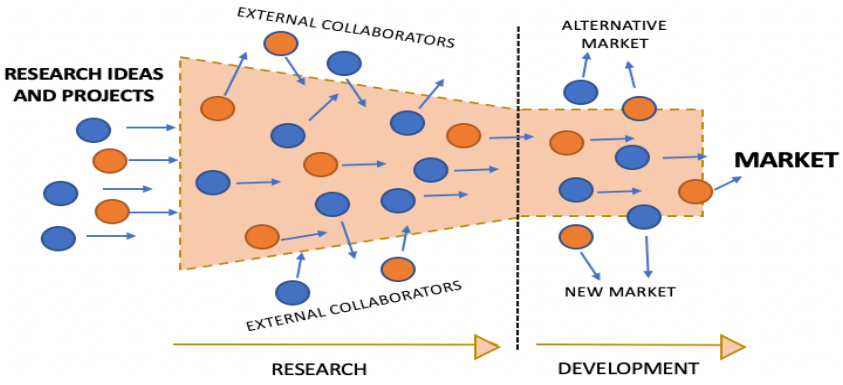

Figure 4. Model of open innovation (Adapted from Chesbrough, 2012).

As presented in figure 4, the biggest difference to closed innovation is the openness of company's boundaries, moreover the two-way boundary between company and its environment. In literature it is pointed out that open innovation model is more common in the sectors where globalization, technology fusion and intensity are part of the industry

(Toma, Secundo & Passiante, 2018). For instance, SMEs tend to have open innovation activities for instance due to lack of business network or manufacturing opportunities and large organizations can benefit from R&D activities (Ahmed, Halim & Ahmad, 2018). Also, companies can benefit from open innovation activities with better resource availability, added knowledge and decreased expenses (Saebi & Foss, 2015). Still, it should be noted that if companies want to make these activities open, they should be ready for handling the concern of the amount of openness (Dahlander, O'Mahony & Gann, 2016).

Based on information flow, open innovation can be divided into outbound and inbound (Gassmann & Enkel, 2004; Piller & West, 2014). Inbound activities include information flow from outside the company into company's innovation activities. Vice versa, outbound activity is when the knowledge and information is exploited externally outside of the company (Chesbrough & Brunswicker, 2013). In addition to these two alternatives, open innovation activity can be the combination of outbound and inbound; coupled process type (Chesbrough & Bogers, 2014). In this process, company may do co-creation with external partners within alliance or co-operation (Zhang, Huang & Hao, 2010). Also, familiar for coupled process is idea generation to markets by jointly generating and commercializing innovations (Mazzola, Bruccoleri & Perrone, 2012).

Table 1. Open innovation subtypes (Adapted from Chesbrough & Bogers, 2014).

		Financial compensation	
		Pecuniary	Nonpecuniary
Direction of open innovation activities	Inside-out Outside-in	In-licensing R&D services under contract Idea competitions	Co-creation with customer Engaging people for processes Informal networking
		Out-licensing Spinoffs Retail of ready products	Joint venture arrangements Standardization Donations to non-profit groups

Furthermore, outbound and inbound innovation activities can be divided into two based on financial compensation (table 1) pecuniary and nonpecuniary. Here companies choose which kind of financial motives they have for the participation of open innovation (Chesbrough & Bogers, 2014). In the case of nonpecuniary financial flow, there is no

straight financial return for the innovation process (Chesbrough & Brunswicker, 2013) and for example, in nonpecuniary outside-in open innovation activity, companies may use external information without offering compensation (Chesbrough & Brunswicker, 2014). Furthermore, in pecuniary outside-in open innovation activity, company is obtaining external information for innovation process with paying the compensation for it (Leitão, Pereira & Brito, 2020).

2.3.1 Openness

In early 2000s, it was still widely thought that pure openness is only practiced within big organizations and smaller companies were closed from this approach. After more research was done on this topic, it was noticed that also SMEs apply openness in their innovation activities (Stanisławski & Lisowska, 2015; Shahzad, 2021a). The initial inspiration for the concept of openness is that company cannot practice innovation operations just inside the company's boundaries without having any contact to external stakeholders (Chesbrough H. W., 2003). This idea can be supported by the fact that in order to be awake of ongoing trends, companies should have interaction with different types of external partners about obtaining both resources and ideas (Dahlander & Gann, 2010; Shahzad, Ali, Takala, Helo & Zaefarian, 2018; Shahzad, 2018). In addition to this, according to Laursen and Salter (2006), studies in evolutionary economics show that company's openness towards external ecosystem may improve the ability to innovate. Furthermore, degree of openness can be divided based on organizational entity. For instance, the degree of openness in corporate funded internal projects is rather closed but in science-to-business it is open. As an example, when radical innovation is pursued with the science-to-business concept, high approach of openness is preferred. (Herzog, 2011, p. 56-57)

Felin and Zenger (2020) state that openness can be expensive especially in competitive environment if companies do not know what they should be open to. Moreover, openness can be really effective if companies do not just waste their resources for scanning the environment. Therefore, the most optimal outcome from openness may be obtained

through targeted search approach. Also, Laursen and Salter (2006) have pointed out that companies which are utilizing open exploration approaches widely and deeply have more in common to be innovative. Still, in their research it is argued that there exists a point where surplus searching approach can become insufficient. Researches of company's openness and performance has shown that there is a noteworthy relationship between these two variables (Ahn, ym., 2016). In their research Ahn et al. (2016) show that in different business sectors openness index is the lowest for manufacturing and highest for service sector. Furthermore, shifting the way of thinking from owning the product or idea to being more open demands re-evaluations of the practices which highlight the creation of value (Chesbrough & Appleyard, 2007).

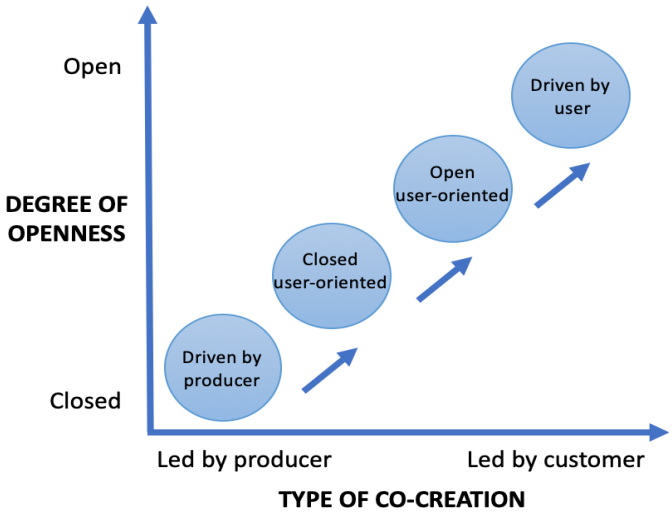

Figure 5. Ladder towards becoming an OI company (Adapted from Westerlund & Leminen, 2011).

Westerlund and Leminen (2011) have made a four-step development approach (figure 5) for company to be operating open. When progressing further in this model, also the user involvement increases. Additionally, important fact is that companies does not need to progress these steps in a usual chronologically order, meaning that they can either begin or stay in any of the step. Open innovation can be also more directed search of solutions for certain problems which makes it more targeted openness (Felin & Zenger, 2020). Furthermore, when exploring the steps of the model represented in figure 5, first step is the least open which makes the development process closed and producer-driven.

When moving towards openness, in closed user-oriented step, co-creation is still led by producer while still, in this step customer is involved more either at the beginning or end of the process. Further in open user-oriented step the co-creation is more led by user and this step can be seen as a big improvement towards being open. Still, in this phase company does not involve users in every point of innovation process but it gives value for user's participation. Lastly, user-driven step is the last step in the model where the process is open and led by user. Here, the idea is that company has a desire for long-standing collaboration and in some cases this can be challenging for company due to openness of practices and measures. (Westerlund & Leminen, 2011)

2.3.2 Inbound open innovation

In the outside-in (inbound) open innovation strategy company is opening its own innovation practices for external inputs (Chesbrough & Bogers, 2014) and this practice can further develop the innovativeness of company (Enkel, Gassmann & Chesbrough, 2009; Gassmann & Enkel, 2004). Furthermore, in inbound method company is exploiting different external sources and it does not need to purely rely on its own R&D activities (Chesbrough & Crowther, 2006). Gassmann & Enkel (2004) brings out the fact that the place of innovation is the not necessarily same place with the exploitation. For instance, in inbound process the locus of the innovation is inside the company but the place of exploitation is outside the company's boundaries. Moreover, inbound innovation can be divided into acquiring and sourcing (Dahlander & Gann, 2010). In the table 2, the comparison between acquiring and sourcing is presented. Acquiring process is involving for example acquiring licensed technology with financial compensation. Similarly, in innovation sourcing companies are using external sources for innovation with nonpecuniary economic compensation (Leitão, Pereira & Brito, 2020). Acquiring external knowledge or innovation is more common for companies which are less innovative but after the acquiring innovation process these companies verge to develop into being more innovative (West & Bogers, 2014).

Table 2. Features of inbound acquiring and sourcing (Adapted from Dahlander & Gann, 2010).

	Inbound - Acquiring	Inbound - Sourcing
Focus	Acquiring ideas and providing input into the creative process through partnerships	Sourcing ideas and information from external operators
Benefit	Having an access to partners' assets and expertise	Availability of extensive range of knowledge
Drawback	Difficulty of sustaining relations with various partners	Hard to select and unite various options
Financial compensation	Pecuniary	Non-pecuniary

In academic and industrial environment, inbound open innovation action has received the most attention (West & Bogers, 2014). Lichtenthaler & Ernst (2009) made a finding that the role of technology aggressiveness can have a negative impact on inbound open innovation results and actions. Moreover, in inbound open innovation activities, when actions are implemented earlier in the process then the chance for greater expense and time savings are higher (Huizingh, 2011).

2.3.3 Outbound open innovation

Chesbrough and Crowther (2006) states that every inbound activity by one company generates mutually outbound action from other company but according to Stanko, Fisher and Bogers (2017) engagement for process does not need to be equal from both of the parties. Outbound open innovation strategy, also known as inside-out strategy, is opening the boundaries of company and letting innovation ideas or knowledge to spread outside the company while taking an advantage of it (Zhang, Huang & Hao, 2010). The advantage of this is not always financial while the financial compensation can be either non-pecuniary or pecuniary. Furthermore, the outbound open innovation processes can be divided into revealing and selling as table 3 represents (Dahlander & Gann, 2010).

Outbound selling open innovation process is highly related to commercializing the invention through out-licensing or selling. The difference to outbound revealing open innovation activity is that instead of taking financial advantage of innovation, company is

spreading internal knowledge to external operators with indirect benefit (Dahlander & Gann, 2010). Furthermore, similar for both of these inbound processes is that locus of innovation is between the company's boundaries but exploitation is happening outside the company's boundaries (Gassmann & Enkel, 2004).

Table 3. Features of outbound selling and revealing (Adapted from Dahlander & Gann, 2010).

	Outbound - Selling	Outbound - Revealing
Focus	Licensing or selling out products with financial compensation	Spreading internal knowledge outside the company
Benefit	When the interests with external partners are mutual, commercialization end up with better results	Promotion of innovations and gaining legitimacy
Drawback	Committing too much on own product while later out-licensing is harder	The risk of sharing confidential resources
Financial compensation	Pecuniary	Non-pecuniary

According to Lichtenthaler & Ernst (2009) research, more aggressiveness on technology is having a positive effect in inside-out open innovation actions. Still, the results of open innovation in this approach are more visible at the end of the process when it can be observed (Chesbrough, 2006). Nevertheless, when thinking from strategic point of view, outbound open innovation activities brings access to new environments and can further boost company's technological status (Lichtenthaler, 2007). However, in the short term of having increased attention to outbound open innovation can result in positive results but in long term it can turn into negative. This is supported with the idea that for outbound, reward is the aim rather than satisfaction of customer (Huizingh, 2011).

2.3.4 Coupled open innovation

The third core open innovation process is called as coupled process which is linking the processes of inbound and outbound. Here, companies are working in alliance with another companies where philosophy of giving and taking has an important role in order to be successful (Gassmann & Enkel, 2004). Basically, this is the first definition for coupled open innovation and later on it has been modified to include companies' co-

development which is happening outside of their boundaries (West, Salter, Vanhaverbeke & Chesbrough, 2014). The definition of coupled open innovation process can be further extended by classifying four dimensions (table 4) of it (Piller & West, 2014).

Table 4. Four dimensions of coupled open innovation (Adapted from Piller & West, 2014).

Dimension	Examples
External collaborators	Companies, alternative organizations and individuals
Analysis of the connection with external collaborator	Dyadic collaboration, network of partners and collaboration with voluntary groups
Impetus for collaboration	Started by upper administration or formed by collaboration with the customer or worker
Locus of innovation	Influencing each other outside the organization or functioning in two directions within each organization

In the early times, focus of coupled open innovation was mostly on companies who acted as external partners but later the sight has been expanded to include actors like non-profit organizations and individuals. In addition to this, co-operating with different actors leads to different ways of managing collaboration between actors (Piller & West, 2014). In overall, the foundation of creating value is based on the network and roles of collaborators (Vanhaverbeke, 2006). Lee et al. (2010) provide three different relationship strategies of open innovation collaboration for SME companies which are customer-provider collaboration, strategic co-operation and inter-firm alliance. Moreover, impetus for collaboration may be either top-down or bottom-up depending where the collaboration forms from (Piller & West, 2014) but if SME company is having a strong joint with a bigger company it may limit their opportunities (Lee, Park, Yoon & Park, 2010). In overall, the locus of innovation in coupled open innovation can be outside the company where innovation is jointly formed or it is generated inside each organization (Piller & West, 2014).

Whilst coupled open innovation practices can include the combination of both inbound and outbound open innovation these practices may be implemented in specific way like for instance as strategic alliance (Chesbrough & Bogers, 2014). Still, coupled open innovation process always requires partnership in some form (Nerone, Junior & Liao, 2014) and for example, collaborative patents are way to decrease expenses and latency

between the beginning and completion of new patent progress (Mazzola, Bruccoleri & Perrone, 2012). Also, in general coupled open innovation process is quite accepted no matter the size of company is but these companies should have considerable resource scheduling methodology or actions (Enkel, Gassmann & Chesbrough, 2009).

2.3.5 Drivers and motives of open innovation

One of the most straightforward value driver of open innovation project is the capability of offering both new products or services for the current client group (Herskovits, Grijalbo & Tafur, 2013). In addition to this, companies can share their issues with individuals and organizations either directly or indirectly who later can find a solution and receive monetary compensation for it (Reed, Storrud-Barnes & Jessup, 2012). Academics emphasize that open innovation and community context is the key for design-driven innovation. When innovation activities are fully open, companies tend to try maximize value of technological or other competencies by combining technology exploration and exploitation (Chesbrough & Crowther, 2006).

According to Chesbrough (2003), benefits of open innovation are for instance; better effectiveness of R&D, risk of not taking advantage of market opportunities is less and capturing opportunity of new products with the comprehensive source of innovations. Similarly, organizations update their own innovation practices in order to reduce time to market of product or services and also taking better advantage of creativity (Van de Vrande, De Jong, Vanhaverbeke & De Rochemont, 2009). However, also the difficulties in the industry drives companies to find substitute strategies and ways to overcome challenges (Singh, Naqshbandi & Jayasingam, 2014).

Studies show that the culture can have an influence on the practices and the same can be seen as opposite where culture is the result of executions and articles (Sivam, Dieguez, Ferreira & Silva, 2019). Still, especially in companies where administrative processes are centralized like often in SMEs, the implementation of open innovation is strongly coming

from the top management (Ahn, Minshall & Mortara, 2017). Moreover, when top management has a positive approach towards open innovation, it can push the implementation process forward quicker and even overcome internal resistance (Huston & Sakkab, 2006). However, implementation of open innovation requires key managerial levers like networks, organizational structures, evaluation processes and knowledge management systems to affect change in the organization along the process (Chiaroni, Chiesa & Frattini, 2011).

Especially with the open source projects, the number of collaborators may be high which then can reflect into reduced costs and more diverse volume of contributors. Due to reduced and shared costs in the development process, it is possible to run more experiments in parallel which then further can reduce the cycles of development (Appleyard & Chesbrough, 2017). Although, in open innovation sharing the knowledge or information is in highlight, it may arise problems of sharing sensitive information (Marques, 2014). In overall, in innovation management the role of openness has increased (Lopes & de Carvalho, 2018) and more companies start to rely on external knowledge and research co-operation (Martinez-Conesa, Soto-Acosta & Carayannis, 2017). In overall, collaboration with customers gives more insight data on needs of market and later on help to eliminate probability of failures in products while providing better base in market (Du, Leten & Vanhaverbeke, 2014).

2.4 Open innovation networks

A network is a form of collaboration which consists people or organizations with series of specific type of ties (Shahzad 2018; Shahzad et al., 2018; Shahzad et al, 2020). These ties form a connection through mutual finishing points which then constitutes paths through indirect links of nodes. In the network, the form of ties generates a specific structure and the nodes in this structure represent different positions in the structure. Still, unlike in groups, the boundary in the network is not always natural and different networks components does not need to be directly connected to each other. Network

which is disconnected is the one where several nodes cannot reach particular ones through any pathway and this is called as a component (Borgatti & Halgin, 2011).

Convay and Steward (2009) points out that the most essential features of network for innovation are size, number of contacts, accessibility, diversity, openness and stability. For large companies it is more common to have high number of partnerships but looking for to make connection with every possible company is not beneficial if the intention is to find new successful partners. Instead, it is more important to utilize certain networking competencies in order to position into well-connected point among the possible partners (Hagedoorn, Roijakkers & Kranenburg, 2006).

In the network, different performers are in the interaction in value network and in this network, they perform different functions with different values and objectives. Furthermore, companies' business models can be divided into four components which are strategic choices, value-creation, value network and value-capturing (Shafer, Smith & Linder, 2005). External operators like volunteers, innovation societies and surrounding complexes are representing increasing foundation of value creation (Chesbrough & Appleyard, 2007). When clients are directly involved in the value creation it helps them to establish a deeper connection with the company which then can be seen as increased customer satisfaction and loyalty (Martinez, 2014). Besides this, in effective open innovation strategy, the value creation and capture are balanced but still some strategies aim for better sustainability by balancing the assets of openness with value capturing (Chesbrough & Appleyard, 2007).

In long term, small and medium sized companies cannot only purely rely on their existing technologies although they tend to turn into networks while operating licensing in order to practice business (Gay, 2014). Nonetheless, SMEs have a vital function in the innovation activities as they provide a basis of economic improvement in every level (Ndou, Vecchio, & Schina, 2011). The size of SMEs obligates them to review their boundaries because they obtain restricted assets and demand to benefit own technologies

externally while their technology is easily becoming outdated due the global competition (Gay, 2014). External collaborators that companies can collaborate with in innovation activities are for example universities, customers, suppliers and competitors (Janeiro, Proença & Conceição Gonçalves, 2013; Saatçıoğlu, 2013).

2.4.1 Customers

The role of customers in open innovation activities can be important based on their roles in innovation generation. From customers, it is possible to collect valuable data (Gassmann, Enkel & Chesbrough, 2010) and further integrate that information for producing specific product or idea (Pille, Schubert, Koch & Moesleim, 2004). Additionally, involving customers in the innovation practices is both cost-efficient and creative but also it may reduce barriers of innovation adoption by users (Antikainen, Mäkipää & Ahonen, 2010). When customer is involved in open innovation process, it inspires to generate new ideas for innovation (Piller, Schubert, Koch & Moesleim, 2004).

In industry the professionalizing of the internal procedures towards better managing of open innovation is more common for companies but still it is closer to be experiment and error than a proficient process (Gassmann, Enkel & Chesbrough, 2010). Customer co-creation reflect this well because customers help companies to have more realistic scene for testing new services in order to capture attitudes and reactions of customer (Wang & Xu, 2018). Additionally, Joshi and Sharma (2004) highlight that due to high failure amount of new products, companies should focus on following customer knowledge development. In some cases this can be challenging due to internal resistance where company is focusing on too much what they sell instead of meeting customers' desires (Martínez-Torres, Rodriguez-Piñero & Toral, 2015). Other reasons for that can be for instance negative changes in customer motivation or lack of process knowledge and therefore, the importance of targeting right target customers in customer integration processes is highlighted (Siakas & Siakas, 2016). One way of pushing customers towards co-

design problem solving is by supporting customer communities and not just single individuals (Piller, Schubert, Koch & Moesleim, 2004).

2.4.2 Suppliers and manufactures

In open innovation system, suppliers are usually involving in network more as an active creative peer creator than just normal supplier under the contract (Remneland-Wikhamn, Ljungberg, Bergquist & Kuschel, 2011). Also, companies are relying more on innovation process collaboration with suppliers and the role of them is increasing. Moreover, some beneficial patents are created by suppliers which has a factor on why collaboration with suppliers may be advantageous (Schiele, 2012). Because open innovation is becoming more familiar among companies, this is further positively affecting on supplier integration (Schiele, 2010).

Like other joint venture actions, innovation collaboration with supplier is important part of business ecosystem. Moreover, new product collaboration with suppliers can decrease the expenses and generate more knowledge (Li & Vanhaverbeke, 2009). More specifically, suppliers have better insight information of the newest technologies that exist in the market (Du, Leten & Vanhaverbeke, 2014). According to Mina, Bascavusoglu-Moreau and Hughes (2014), the activeness of business services in open innovation is higher compared to manufacturers. If company has the required know-how and supplier management competences, they possibly could combine own resources with external momentous resources with a good success by expanding new product development procedures outside the organizational boundaries (Gassmann & Enkel, 2004).

Involving supplier to innovation activities is not always easy because of requirements of complex project management (Li & Vanhaverbeke, 2009). Although, in some cases collaboration with suppliers can be beneficial in terms of costs and development but still positive results are not guaranteed. In some cases, it has been recorded that improved supplier involvement in R&D actions did not end up with better quality or cost savings

(Roijakkers, Bell & Vanhaverbeke, 2014). Additionally, what makes situation even harder is the fact that the amount of greatly innovative suppliers is pretty low. Moreover, these innovative suppliers may have difficulties with choosing just one company to get access to its limited resources in open innovation collaboration (Schiele, 2012).

2.4.3 Universities and public research centers

In the industrial innovation scene, the role of universities has increased due to their research contribution and nowadays more research projects of universities are partially financed by private companies (Ndou, Vecchio & Schina, 2011; Shahzad, 2021a; Shahzad, 2021b). This is because companies started to search innovative solutions with the approach of openness from universities, customers and start-ups (Secchi, 2016). Moreover, R&D collaboration with universities or research centers provides access for both scientific and unpublished information which helps to utilize this on occurring problems (Du, Leten & Vanhaverbeke, 2014).

For other collaborators, universities and research centers can offer non-competitive and simple resources of research (Huang, Chen & Liang, 2018; Shahzad, 2021b). Instead of monetary benefits, as a source of innovation, universities and research centers are in high position as they hold noteworthy potential for research and diversity (Janei-ro, Proença & Conceição Gonçalves, 2013). In overall, universities and research centers provide research, agreement research and advisor services for other collaborators (Perkmann & Walsh, 2007).

Siegel et al. (2003) points out that due to mind-set differences collaboration with universities or research centers can be at some points challenging. Additionally, Roijakkers et al. (2014) bring out the fact that universities and research institutes are leaning more towards process-oriented actions while companies tend to be more results-oriented. Also, universities and research centers differs private sectors by their organizational goals, environment, principles and structure (Boyne, 2002). Furthermore, this can lead

into situation where instead of focusing too much in the results, universities or research centers see more value in research process itself which then can bring out some problematic situations. This is because companies have expectations of getting certain results which then makes them want to use and take competitive advantage of generated innovation results. (Roijakkers, Bell & Vanhaverbeke, 2014)

2.4.4 Competitors

In the early times when closed innovation approach was fundamental base for business, internal R&D was more precious strategic advantage and barrier for competitors to entre different markets (Chesbrough H., 2004; Saatçıoğlu, 2013). Also, research results indicate that companies in service sector tend to have less openness for innovation and large companies are more open for open innovation. Additionally, companies that have a lot competitors in their market, normally lean into closed innovation system (Drechsler & Natter, 2012). Nevertheless, spillovers to competitor in collaboration can be at the same time problematic but also economically reasonable. Company can accept spillovers if it benefits from market growing innovation and whether the return of market share development is lucrative enough (West & Gallagher, 2006; Han, et al., 2012). Still, compared to other co-opetition types, competitors who involve in R&D collaboration tend to possess common objectives and innovation plans (Wu, 2014; Shahzad, 2021a; Shahzad, 2021b).

The research by Enkel and Gassmann (2008) which included 144 companies showed that the share of knowledge source from competitors was 49 percentage which means that almost half of the companies in this research had open innovation collaboration with competitors (Enkel, Gassmann & Chesbrough, 2009). The reason for this why the percentage amount is not higher may possible be the fear of giving own technology away for competitors (Lee, Park, Yoon & Park, 2010). In bigger picture, collaboration with competitors is seen as a business defect which is harming dynamics of competitions and benefits resulting from it (Wu, 2014). However, some researchers emphasize the importance

of collaboration with competitors because it is essential way to stay in global markets (Shahzad, 2021a; Shahzad, 2021b). Nevertheless, co-operation between big companies with strong market control promotes policy worries due to potential of harming innovativeness and customer benefit (Gnyawali & Park, 2011). Furthermore, in competitor aspect, competitors can become threat for openness due to entrance of new competitive and replicative companies into markets (Drechsler & Natter, 2012).

2.5 Challenges and barriers of open innovation

Open innovation concept is broadly utilized in almost every industry including technological and non-technological industries (Chesbrough & Crowther, 2006; Galati, Bigliardi & Petroni, 2016). Because of the differences in industries, also drivers and challenges for open innovation which can be internal or external (Shahzad et al., 2021) in overall may be different (Gassmann & Enkel, 2004; Keupp & Gassmann, 2009). Generally, barriers for open innovation are issues that prevent companies to practice full openness. Moreover, when talking about innovation barriers, it indicates barriers which prevent companies from performing innovation activities. Likewise, barriers for open innovation hinders companies' openness (Dziurski & Sopińska, 2020). Nonetheless, no matter in which sector company is operating still, one of the biggest challenges is to create a new mind-set and culture for supporting the increasing openness (Westerlund & Leminen, 2011).

For start-ups, open innovation can be at the same time rewarding and challenging. Usman and Vanhaverbeke (2017) brings up the important role of CEO or entrepreneur who has an important role in making open innovation collaboration working with large companies. Additionally, Gruber & Henkel (2006) point out small companies face challenges because of their newness and smallness. Challenges related to newness of firm are for instance unfamiliar organizational unit, lack of contacts, lack of experience and new routines of doing things. As well challenges related to smallness are for example limited resources, lack of abilities and narrow market power (Gruber & Henkel, 2006; Demirbağ & Yildirim, 2018).

Open innovation collaboration unites new people to work together and makes companies to face new areas and problems. Management of occupational relationship is foundation for collaboration which consists actions like engaging new colleagues and maintaining relationship (Giannopoulou, Yström & Ollila, 2011). Furthermore, it is well known that between performance and motivation there exists a direct relationship which is reflected to performance of innovation (Iqbal & Hameed, 2020). One negative motivation or psychological phenomenon is not-invented-here (NIH) syndrome. This "syndrome" represents individual's resistance or negative attitude towards external knowledge (Antons & Piller, 2015). Because of this negative attitude, internal R&D workers may tend to ignore external information from outside-in open innovation practices although it may be beneficial (Hannen, ym., 2019). Therefore, overcoming this negative problem is a fundamental task to make open innovation possible. One way for this can be change mindset towards philosophy of "proudly developed elsewhere" but unfortunately this is not a core part of companies' culture (Elmquist, Fredberg & Ollila, 2009). Changing the mindset into positive one towards the open innovation activities is also one of the beginning stages for external engagement (Salter, Criscuolo & Ter Wal, 2014).

Salter, Criscuolo and Ter Wal (2014) presents four individual-level challenges along four different stages of engagement (figure 6) based on a large multinational organization. The first engagement step for open innovation is changing the mindset which is highly related to NIH syndrome and other negative attitudes towards open innovation (Salter, Criscuolo & Ter Wal, 2014). One of the main reason why preventing NIH syndrome is important to root out is because it can spread among the main decision-makers and furthermore have an impact into entire team (Hannen, ym., 2019) The next step for open innovation engagement is forming relationship with new partners but in some cases companies tend to turn towards existing main partners because it is easier to collaborate with the ones who company has worked previously (Salter, Criscuolo & Ter Wal, 2014). Still, company's value chain of operations should consist operations which promotes partnerships as a segment of business model (Demil & Lecocq, 2010).

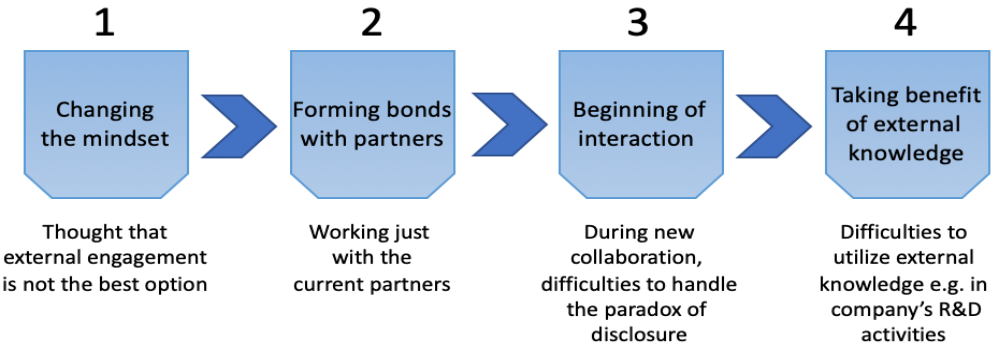

Figure 6. Open innovation engagement stages with individual-level difficulties (Adapted from Salter, Criscuolo & Ter Wal, 2014).

The third stage of open innovation engagement is the beginning of interaction, where per company's normal procedures, company does not want to share information forward, especially to third parties. This is because companies want first to make a confidentiality contract but some parties may feel that certain information needs to be revealed to start a meaningful discussion (Salter, Criscuolo & Ter Wal, 2014). Still, information sharing has a critical role in linking the quality of information and performances of supply chain (Marinagi, Trivellas & Reklitis, 2015). Lastly, the fourth stage of open innovation engagement process is taking benefit of external knowledge (Salter, Criscuolo & Ter Wal, 2014). Managers should identify beneficial external information, concepts or technology which as process is beginning for effective open innovation but companies have to make sure that those can be utilized in company's R&D actions (Wallin & Von Krogh, 2010). Still, it needs to be remembered that not always external information can be directly implemented into existing processes but some efforts may need to be required to align external information to internal (Salter, Criscuolo & Ter Wal, 2014).

Over the time, network information and needs of partner's change as partnership between large companies and start-ups are seen as dynamic relationship (Usman & Vanhaverbeke, 2017). Also, when one partner is more inexperienced commercially compared to other who has complex organization with wide operations, the amount or seriousness of challenges increase (Spender, Corvello, Grimaldi & Rippa, 2017). In a case study from Brazil, company's knowledge flow and technology allocation was happening between the company and partner instead among the partners. Furthermore, this can

become a barrier for sharing experiences and idea generations which further makes developing of the open innovation paradigm more challenging (Fabrício Jr, da Silva, Simões, Galegale & Akabane, 2015).

Research collaboration and R&D outsourcing both contain difficulties to control growing difficulty and management of innovation with the addition of going beyond the usual R&D sector (Van de Vrande, De Jong, Vanhaverbeke & De Rochemont, 2009). In addition to not-invented-here syndrome, one difficulty for company's R&D experts may be admitting the fact that they cannot solve problem which is in their own field of proficiency. This leads to the point where those experts need to define again their own specialized identity from solving the problems to seeking the solution elsewhere (Lifshitz-Assaf, 2017). In addition to unqualified experts in the company (Mon-teiro, Mol & Birkinshaw, 2017) also the scarcity of sufficient management capabilities (Teirlinck & Spithoven, 2013) and non-existence of innovative culture are the factors which can inhibit the introduction of open innovation (Leckel, Veilleux & Dana, 2020). Besides internal challenges also external challenges like customer's lack of responsiveness or information deficiency on the markets can form uncertainty and barriers (Galia & Legros, 2004). After all, different types of risks and barriers are linked with company's depth and width of openness in innovation and the response for those varies based on ownership type, industry and size of the company (Fu, Li, Xiong & Chesbrough, 2014).

2.6 Summary and elaboration of the academic topics around OI

In this chapter, literature review is concluded with main points while creating a theoretical framework (figure 7) which includes different main theoretical aspects of thesis topic. Additionally, this theoretical framework forms a foundation for the both creation of the survey and analysis part. This framework observes open innovation from different challenges and barriers which different sized companies in different industries and countries may face. Also, the aim is to find out what drives companies to fail in open innovation activities; what are the main drivers of failure.

For long period there was a thought that openness is just part of large companies while focus was not on smaller enterprises (Stanisławski & Lisowska, 2015). Though, it is argued that the people in the organization are the ones who determine in overall the openness and culture (Giannopoulou, Yström, Ollila, Fredberg & Elmquist, 2010). For instance NIH syndrome, which is an internal resistance among company's stakeholders against external knowledge and its implementation (Hannen, ym., 2019), is a proof that personnel has a role in implementation process of open innovation activities. Also, overcoming this problem starts from the people in the organization, moreover, from top management (Salter, Criscuolo & Ter Wal, 2014) who should explain through good communication what are the main factors behind the decision-making process.

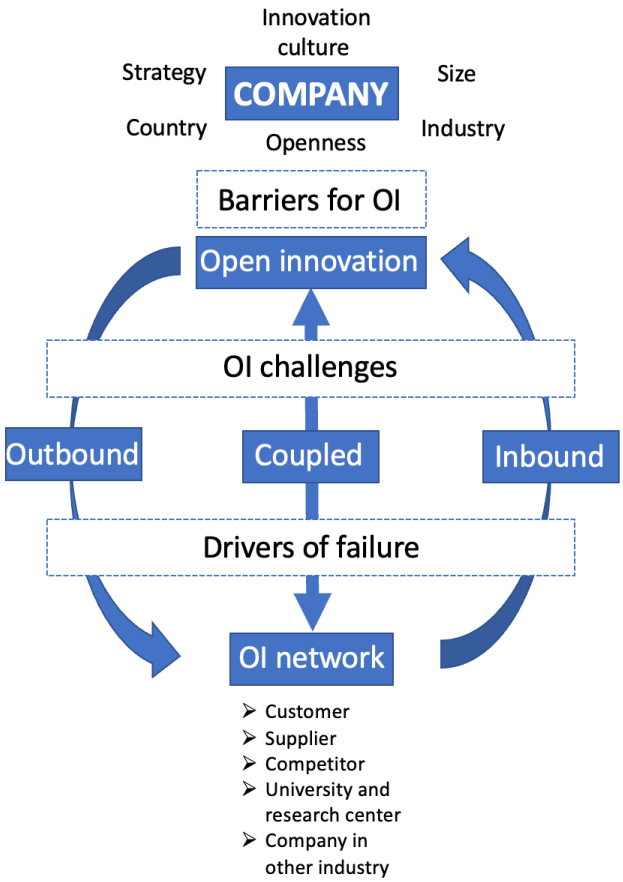

Figure 7. Theoretical framework of the research.

Open innovation can be divided into inbound, outbound or coupled open innovation (Piller & West, 2014). Here knowledge flow can be either inside-out, outside-in or respectively, combination of both of these (Chesbrough & Bogers, 2014). Regardless the

type of open innovation, companies can face different challenges in different phases of open innovation activities where in the worst case, activities may end unsuccessfully. Furthermore, these challenges can emerge as a drivers of failure in open innovation activities where the project can simply face some difficulties or then be completely unsuccessful. Through open innovation companies can achieve even significant benefits like increased R&D effectiveness, value capturing and creating new market opportunities (Chesbrough, 2003). Still, in order to obtain these benefits companies need to think how should they search and identify suitable partners for open innovation activities. For example, Guertler et al. (2015) state that for companies one of the biggest challenge is to first identify and then select fitting open innovation partners.

In overall, regardless the industry or how technology related company's activities are, open innovation is broadly utilized (Chesbrough & Crowther, 2006). It can be stated that innovations can have an improvement in company's business but still one moving towards openness company has to create a new mindset and culture which can become one of the biggest challenge (Westerlund & Leminen, 2011). Also, the role of knowledge sharing barrier cannot be underestimated as companies may fear of sharing confidential knowledge while it can be happened in individual, organizational and inter-organizational level (Crupi, Del Sarto, Di Minin, Phaal & Piccaluga, 2020). In some cases, fear of sharing confidential knowledge or fear that someone will copy the fundamental ideas, can result in the situation where some talented innovators are attracted to join in to projects. However, companies can also benefit from sharing knowledge either freely without any legal exclusions attached to it while companies may also lean in profit-oriented ways where knowledge sharing is more like selective revealing (Henkel, Schöberl & Alexy, 2014). Nevertheless, because of this fear companies may face problems that enough valuable information is not provided which then can become a barrier for ideal collaboration (Bertelllo, Ferraris, De Bernardi & Bertoldi, 2021). However, it can be concluded that based on the industry and size of the company, different risks and barriers are linked straight to the company's depth and width of openness in the regard of innovation (Fu, Li, Xiong & Chesbrough, 2014)

3 Context of the Study

In this chapter, emerging economy is defined alongside with the overall economical view of three emerging economy countries: Turkey, India and Russia. Additionally, the overall view of open innovation in emerging economies is described as an introduction for the research study results. It is worth noting that not every detail is only existing in emerging economy, moreover some details may also prevail in developed economies.

3.1 Emerging economy

During the last decades, companies' growth in emerging economies has drawn more attention, including the information of strategic choices and different point of views of the companies' growth (Peng, Lebedev, Vlas, Wang & Shay, 2018). The term of emerging economy or market refers to countries which possess business or communal activity in the progression of quick growth and industrialization (Guegan, Hassani & Zhao, 2014). Additionally, Hoskisson et al. (2000) defines emerging economy as a country which needs to satisfy two measures; a rapid speed of economic progress and government rules which favor liberalization of economics and the approval of a free-market arrangement.

In emerging economies, economic growth has been quite outstanding during the last decades when reflected in the growth of gross domestic product (Li & Lin, 2019). Additionally, rapidly increasing part of the total research and development of the world is now happening in emerging economies (Wang & Kafouros, 2009). For many companies in emerging economies, innovation is a significant part of the survival and accomplishment in the current business environment (Du, Zheng & Chang, 2020). Emerging economies are making their competitiveness better by obtaining and deploying latest technologies (Wang & Kafouros, 2009).

In World Economic Outlook (April 2021) numbers of annual percent change of volume of trade is published and it can be concluded that the trend of both import and export

annual change for advanced and emerging economies is negative. In a normal conditions small change between annual numbers is normal but the effect of Covid-19 pandemic can be seen in these numbers directly after the year 2019. For both import and export values of advanced economies, the change has been almost exact but the export of emerging economies has taken less impact compared to others. Still, Hevia & Neumeyer (2020) expect that decrease in economic will be harder in emerging economies because they possess less opportunities to work remotely and the financial markets are more shallow where the government do not have enough resources to implement the soothing financial procedures. In other side, Archibugi, Filippetti and Frenz (2013) point out that even during economic crisis, highly innovative companies still kept investing in innovation activities. Still, this research pointed out, as mentioned in the results part, based on financial difficulties of pandemic, some of open innovation activities were not successful or they were stopped.

3.2 Turkey, Russia and India

For better understanding the different circumstances around open innovation activities, moreover challenges which companies face, the overview of case countries financial situation is presented. Turkey is one of the leading economic midpoints connecting Europe and Asia where its location is ideal because of closeness to other emerging economies which further generates exclusive market opportunities (Tatoglu & Demirbag, 2008). Nowadays, Turkey aims to transform the economic structure towards more innovation promoting environment by supporting domestic companies' innovation actions and implementing special mechanisms in the education system (Kleiner-Schäfer & Liefner, 2021). Still from the Organization Co-operation for Economic and Development (OECD) countries Turkey is under the median value when considering capacities and capabilities to innovate. According to OECD (2021) values of gross domestic spending on R&D, Turkey is on the bottom compared to another OECD countries.

Study by Karahan & Karhan (2013) shows that, over the half companies involved in their research had innovation activities at some capacity and most of innovation activities were made for product innovation. Moreover, Turkey has improved its innovation performance but still, compared to European Union countries, Turkey is behind with regard to the number of innovation performance dimensions (Sener & Tunali, 2017). Cornell University, INSEAD and World Intellectual Property Organization's (2020) published The Global Innovation Index rankings and in that ranking Turkey is ranked as 51st being over the median value. Cetindamar and Ulusoy (2007) show that with other companies, Turkish companies have good collaboration relations but still those existing relations does not have a strong impact on the performance of innovation.

Nowadays, the share of global information creation of emerging economies grows and countries such as Russia get often inspired by the experiences of advanced economies and further have a well-defined spatial proximity (Crescenzi & Jaax, 2017). The remarkable change in Russia in the last century had an important step in the economy. From the Soviet command economy to market-driven economical system was a major transition (Alexeev & Weber, 2013: 1-3). The importance and matchless position as a bridge makes Russia a unique case between Asia and Europe. Therefore, the expected economical and innovative development in Russia has been shaping over the years (Sergi, 2019).

As an economical innovative reliability, Russia showed that it lies well below under leading countries and stable around emerging economies. Therefore, focus on potential developments and gains in the industry does not provide excellent levels of innovation activities (EBRD, 2012). However, accelerating the processes and growth in the economy cannot be achieved rapidly in Russia due to the lack of involvement business in funding, governmental motivation, and characteristics of management (Plokhov & Suslova, 2019). Cornell University, INSEAD and World Intellectual Property Organization's (2020) published The Global Innovation Index rankings and in that ranking Russia is ranked as 47th which is over the median value. Though, Russian Federation president weighs that

Russia's important priority is to focus on the development of technology and national science (Sibirskaya, Stroeva, Khokhlova & Oveshnikova, 2014).

After the 1950s, a rapid change in economic developments in India had captured attention from the world. Different numbers of modified techniques in economy policies led profits for India in short term plans (Balasubramanyam, 2019). However, the reform changes that India has faced over the years affected economy to come across difficulties in order to reach the level of developed country status and resulted as remaining in emerging countries (Kanungo, Rowley & Banerjee, 2018). Over the last years, India's investment in the R&D has been increasing but still public expenditure on R&D, which is just a small amount of GDP, has remained constantly around 0,7 percentage (Chattopadhyay, 2020). Still, for the index of readiness for frontier technologies, India is ranked as 43rd, placed in upper-middle score group (UNCTAD, 2021). Additionally, Cornell University, INSEAD and World Intellectual Property Organization's (2020) The Global Innovation Index ranking India is 48th which is over the median value and better than last year's positions. Furthermore, India's innovation ecosystem has made a base for innovativeness while it is the third in the size of start-up economy (Chattopadhyay, 2020).

The policies that were made to overcome the challenges in economy have failed even though they were considered as sustainable. The latest attempts including 'National Manufacturing Policy' of 2011 and 'Make in India' of 2014 are a few examples of governments' performance to stimulate the industry of India (Kanungo, Rowley & Banerjee, 2018, p. 77-78). Consequently, the whole economic experience that India gained has happened under its own philosophy. The complicated, irregular system of India has been self-organized and has failed in the innovated path because of the economic parameters that can occur (Ramani, 2014, p. 381-382).Scholars argue that the country should be more based on innovative activities which help the demanded economic growth of India (Nair, Guldiken, Fainshmidt & Pezeshkan, 2015). However, the recent population rate of skilled people, which is essential for the possible innovation activities, has shown that current increase in educated workforce is not sufficient enough to assist the growth of

India (Kumar & Puranam, 2012: 127-128). Therefore, in order to take better progress on the way of growth, former prime minister Manmohan Singh has declared from 2010 to 2020 as "Innovation Decade of India" (Nair, Guldiken, Fainshmidt & Pezeshkan, 2015).

3.3 Open innovation in emerging economies

The factors which are affecting how organization will adopt open innovation are for instance status in market structure, where does the products and services place on the lifecycle of product and what kind of value capture can be achieved from new technology or product (Ghaston & Scott, 2012). It cannot be hypothetically stated that emerging economies' open innovation knowledge is as valid as developed markets due to the lack of advanced capabilities (Badir, Frank & Bogers, 2020). When one or several designs proof to be better than other in market after the technology maturation, more efforts are done in order to standardize certain technology for the mass markets which can further decrease costs and increase performance (Christensen, Olesen & Kjær, 2005). Therefore, open innovation became so much significant for emerging economies to overcome challenges of transformation (Bogers, Burcharth & Chesbrough, 2019).

In overall, open innovation has been explored in numerous large companies like for instance Intel, Fiat and Sony Mobile but in emerging economies the focus has been more in the patents in generating together with creators from different nations (Thomas, 2018). Still, opportunity from knowledge or technology which company buys from domestic market are normally short-term due to the fact that competitor can simply replicate same technology and take advantage on it (Kafouros & Forsans, 2012). Especially in emerging economies, for companies it is vital to develop and maintain business networks. Moreover, this is due to the fact that for companies, in such a time where uncertainty is highly present, it is hard to own whole wide range of resources to convert ideas into experiences of consumers (Paulose & Nair, 2015). Especially the fact that revolutionizing has emerged almost in every sector changing the ways of producing and marketing does not make exception (Grewal, Hulland, Kopalle & Karahanna, 2020). According to

Chesbrough (2007), market success in the twenty-first century should be done exactly with co-operations of companies because of the higher performance effect.

Theoretical researches which were investigating knowledge levels on Brazilian culture highlighted the connection of culture should get better attention (Bogers, Burcharth & Chesbrough, 2019). Consequently, it shows that one of the characteristics of open innovation activities in emerging economies is that the lack of culture which can be borders for the performance of open innovation (Thomas, 2018). Maintaining a good connection with the industry further helps company to recognize and react for the scarcity in the market (Paulose & Nair, 2015). Hofstede (2001) provides five cultural dimension for every country which shapes the behavior of the citizens. Furthermore, based on these dimensions especially dimension of collectivism versus individualism can provide evidence how people reacts on openness; countries with higher value of collectivism tend to have good thoughts about collaboration actions. Also, developments of society have a widespread effect for research of open innovation. Moreover, the ongoing Covid-19 pandemic has forced companies to form unpredicted partnership (Dahlander, Gann & Wallin, 2021). Similarly, due to effects of globalization, the manufacturing sector has started to spend in open innovation with the hopes of improving efficiency and provide services or products what customers want (Obradović, Vlačić & Dabić, 2021).

If companies want to follow the trends of globalization and open innovation, especially technology based companies need to change their development tactics gradually (Lam, Nguyen, Le & Tran, 2021). Open innovation plays an important role for existing challenges such as resources, set of competencies and skills, cultural-organizational barriers of the emerging markets. However, global collaboration for both knowledge growth and industries' development could be the biggest impact for achievement in new and emerging markets. Moreover, global co-operations supported with open in-novation activities allow challenges to be overcome effectively and creates chains of valuable knowledge repository of worldwide growth.

4 Research Methodology

This chapter of research methodology is acting as a base for the empirical study of the research and also provides information about how the study has been executed. In addition to this, main methods of the study and data gathering ways are going to be described. Furthermore, the questionnaire structure is presented and explained. The research is based on finding the main open innovation challenges which companies face in different sector regardless the size of the company. Additionally, based on survey answers and occurring challenges of open innovation, ways of preventing or overcoming those are presented.

4.1 Data collection and questionnaire

The primary data collection method besides reviewing of the existing literature is the survey. While survey is one the main points of the research (Groves et al., 2011), also reviewing the existing literature brought a lot value. Moreover, the survey is based on quantitative data and most of the data is collected through questions which can be quantified. Open-ended questions can be more accurate in self-explanation while using multiple choice is correlating better with past comprehension of the content. Therefore, open-ended question is used in finding different ways to overcome open innovation challenges while multiple choice questions are used in discovering for instance the share different challenges faced by companies.

For finding answer for research question and fulfilling the objectives of the research, the data collection is done via electronic questionnaire (Appendix 1) created with Google Forms. During the last years the popularity of using online surveys has increased based on cost efficiency while it is the most reviewed among the internet research types (Buchanan & Hvizdak, 2009). The electronic survey data gathering was chosen because it suited the best for obtaining data from different countries while Covid-19 pandemic was restricting opportunities to have empiric study or face-to-face interviews. Furthermore,

electronic surveys are an optimal way to reach people is short time while some persons feel more confident on answering internet-based surveys compared to face-to-dace interviews (Wright, 2005). Proceeding this research with electronic survey made it possible to gather survey responses faster due to time limitation and data gathering was much more accurate. The survey was done with Google Forms online survey program while using online survey form, the respondents identity cannot be recognized based on the any of the answers. The combination of anonymity, form of survey and clearness received lots of positive feedback which then also encouraged participants to participate in survey.

The data for survey was collected between the months of April and May 2021. In overall, survey research can be seen as sort of a cross-sectional study (Olsen & St George, 2004) where the data is collected from different participants during the specific time period. Also, different variables are observed without influencing any of those at any stage. The survey was conducted in English, Turkish and Russian while Turkish and Russian answers were afterwards translated into English. The reason why survey was concluded in different languages was to avoid language barriers (Squires, 2009) and misunderstanding especially when in both Russia and Turkey language barriers may exists.

For the analysis process, all the data was transferred into one Excel file and after that, classification by country, company size and industry was made. From this, the distribution of challenges faced both before and during open innovation activities by subgroups were analyzed while also investigating the most popular open innovation collaborators with the success rate of innovation process. The respondents who filled the survey were people who have been involved in open innovation activities. The reason why survey does not only focus on achieving responds from top management is to get better overview of problems faced (Sanchez, 2007) in different phases or units of open innovation activities. Also, with this approach it may be easier to find out whether for example lack of top management support plays a crucial role in open innovation activities.

The questionnaire started with some essential background screening questions which can be seen as filters for the data (Gaddis, 1998). The question of "Did your company have any open innovation activities at some capacity during the last 5 years" was the limiting question of the research while the respondents who did not have open innovation activities during the last five years were eliminated from the analysis process. The questionnaire was followed by questions regarding to open innovation challenge types and ways to overcome those challenges. This section included open question and also a five point likert scale to keep survey simple. The last section of survey was about open innovation collaboration where the aim was to map different external open innovation partners during the last five years and to find out the success rate of these collaborators.

The survey was not limited by the size of the company or the industry where company operates – the only requirement is that company is operating in a country which is categorized as emerging economy and that it had open innovation activities some capacity during the last five years. Furthermore, this includes inbound, outbound and coupled open innovation activities. Later, countries like Turkey, Russia and India were chosen for the research because they belong in the top seven of emerging economies and these countries have a huge potential in the terms of innovation.

4.2 Evaluation of the research results

The analysis of the results started with checking whether participant had any open innovation activities during the last five years. In total, the response rate was 236 out of 690 persons (34,2%) who were contacted through either email or LinkedIn. Furthermore, final sampling rate out of contacted people after the screening procedures of Turkey is 87 out of 306 (28,4%), Russia 57 out of 181 (31,5%) and India 52 out of 203 (25,6%). From these, amount of valid answers out of people contacted is 196 out of 690 (28,4%) which is in satisfying level especially, while taking into account that much information of possible open innovation activities in companies was not available before contacting potential survey participants.

For analysis process, all the survey data was transferred into same file. This data was analyzed mainly with Microsoft Excel and RStudio. These programs made it possible to analyze numerical data in a systematic way while it was possible to sort answers by different groups and factors. In overall, the results are compared by the size of the company, in which country the company is operating in and by the industry. The categorizing process in relevant groups was done with the Microsoft Excel while distribution calculation were handled both with Microsoft Excel and RStudio. Additionally, all the graphs were created with Microsoft Excel based on the answer quantities. From this, the distribution of challenges faced both before and during open innovation activities by subgroups was analyzed while also investigating the most popular open innovation collaborators with the success rate of innovation outcome.

The results of the research are in overall highly based on the survey results while also support from the existing literature is acquired. The idea behind the research is not just to provide a list of different challenges faced by companies moreover, objective is to find out different trends and also both support and find reasons behind different phenomena from the literature. For instance, while analyzing main challenges faced by different industries also overview of industry from literature is provided in order to support findings. Based on the research results and comments by participants, three different frameworks are developed to overcome open innovation challenges. These frameworks provide more comprehensive result for the research question and helps to meet objectives of the research. Furthermore, frameworks bring value both for literature and industries based on the finding that there does not exists numerous amounts of frameworks which covers overcoming various open innovation challenges in common way.

4.3 Reliability and validity

In quantitative and qualitative research, both reliability and validity are common part of research paradigm while achieving both of these can emerge as a challenging duty for researchers (Lakshmi & Mohideen, 2013). These both can be used in evaluating

research's quality while reliability is describing the consistency and validity is measuring the accuracy (Carlson & Herdman, 2012). In order to maintain validity a general structure for analyses was established by using a questionnaire while reflecting it to the framework of the study. In addition to this, in-depth literature review was performed which laid a base for further quantitative analysis. Moreover, different events or findings were explained by the survey results while discovering support for findings from the literature. However, because answers were collected from the time period of five years, it can be assumed that the share of different challenges faced may change in future. Therefore, this research is providing information of current situation instead of claiming that companies will always face certain problems more than others.

In overall, the results are based on the sources of the survey and literature while through the external validity findings of the research can be generalized to cover specific areas. Therefore, one of the most important criteria in the survey was to ensure that the criteria are linked to the main factors. Thereby, a realistic overview of the open innovation challenges and collaboration in emerging economies based on different categorization was possible to introduce. Also, to increase the objectiveness of the study, the information was being collected from various resources while keeping the survey as clear as possible (Groves et al., 2011).

Total amount of 196 valid responses were collected through the online questionnaire which in overall is quite covering amount for the quantitative research. Therefore, it can be stated that research provided valuable insight (Scheuren, 2004) of the current situation in facing different open innovation challenges. However, adding interviews with both employees and top management would arguable have offered more depth in the research. With interviews, it may have been easier to acquire more detailed information of which different ways companies are using in coping with open innovation challenges while gaining a practical view of implementation of these measurements. Additionally, it can be argued whether respondents put full effort on answering questions in comprehensive way instead of just providing indicative answers. Still, because remarkable

trends were found in the analysis process, it can be stated that answers provided substantial value for the research (Groves et al., 2011).

In this research, three different structured frameworks are presented based on the results of the survey and existing literature around the open innovation. Based on this study, different ways and improvement can be integrated into companies processes who practice open innovation activities. While implementing these frameworks, some of the steps or parts may further be specified and shaped according to company's situation. However, having even more extensive studies on the industry types may result on better transparency and more wider opportunities for analysis.

5 Results of the Study

In this chapter, the results and findings of the survey (appendix 1) are presented. The chapter is organized to follow the structure of the survey. The first part is based on the general info of respondents and whether the company had open innovation activities during the last five years. Also, one of the main ideas is to categorize companies based on emerging economies and by the size of the company. After this part, the section of challenges of open innovation is followed. The purpose of this section is to find out different challenges of open innovation which companies face both before and during the innovation activities. Also, the overall role of innovation in the company is explored. Lastly, survey is concluded with the open innovation collaboration part. The purpose of this section is to map out different external open innovation stakeholders during the last five years. Also, the innovation success rate of different stakeholders is explored.

5.1 Overview of the general and background data

In order to make sure that the data is accurate and as useful as possible, it was important to make sure that participants who took part in the survey were somehow involved to company's open innovation activities. Also, for in-depth understanding of the companies in different industries, it is important to map out companies in different industries who utilize open innovation activities in their businesses. Company names or personal information of respondents are not going to be either shared or published which then further makes it impossible to link individual responses to the respondent.

Companies from 16 different industries took part in the survey (figure 8) where the highest share with eleven percentage of respondents were from software industry. Otherwise the share of respondents in different industries is equal; which was also one of the main targets before obtaining answers. In other words, there is not any industry which noticeably stands out from others based on the amount of respondents.

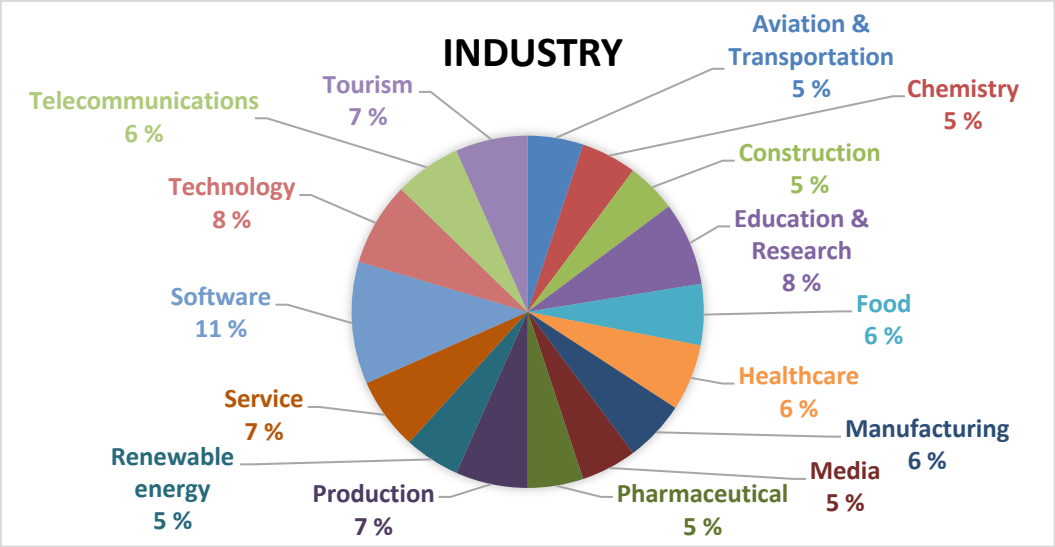

Figure 8. The share of companies in different industries.

In order to answers be relevant for this context of the study, the respondents need to work in the company which is operating in the emerging economy country while valid respondents were from Turkey, Russia and India. The main goal was to have as even share as possible where any of the countries did not have half or over the half of the share. The majority amount of companies who participated in the survey were from Turkey (44%) and the shares of both Russia (29%) and India (27%) are close to be equal.

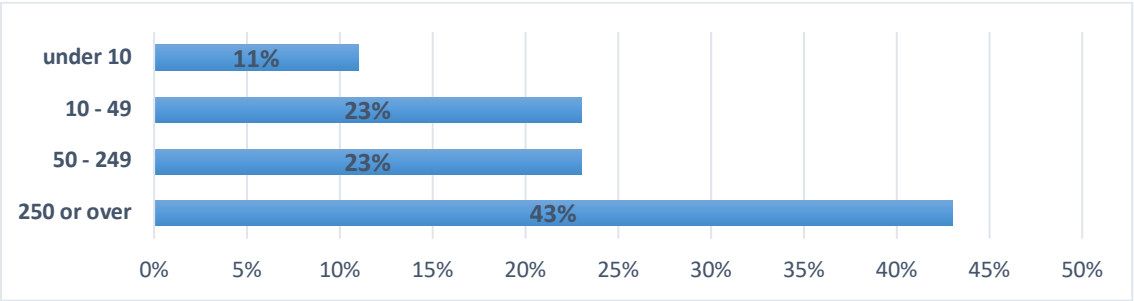

Figure 9. Segmentized share of companies based on the amount of employees.

In the literature, open innovation in different sizes of companies are well explored. Still, some researches are focusing only in either SMEs or just to large companies. This research is not limited only in one size type furthermore, it is focusing on every company sizes. The most of the respondents were from the companies who have 250 or over employee but when categorizing companies into SMEs and large companies based on the

number of employees; the share is quite equal. The detailed share of companies based on the number of employees is presented in the figure 9.

One cost-effective solution for companies is to outsource their R&D and it is also one way to achieve access for more advanced technologies. Still, only 12 out of 196 companies (figure 10) participated in the survey have completely outsourced their R&D activities. For most of the companies, research and development activities exists in their company but this does not mean that some parts of R&D activities are not outsourced.

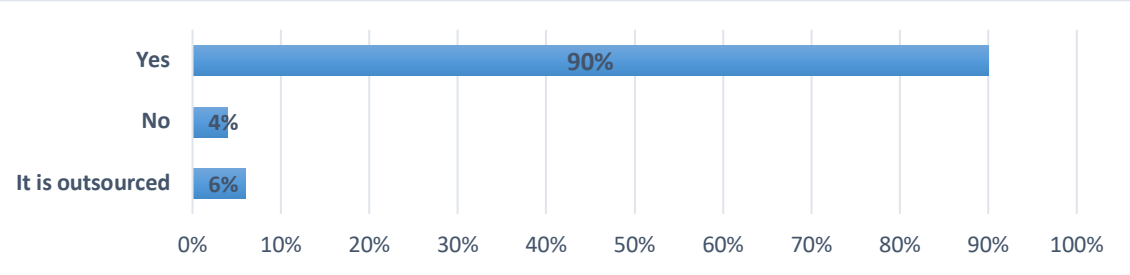

Figure 10. Research and development existence in participants' companies.

The main requirement for participating this research is that company had open innovation activities at some capacity during the last five years. The amount of 18 answers did not have open innovation activities during the last five years so these answers were eliminated from the analysis. From the remaining 196 answers (figure 10), 98 percentage had successfully open innovation activities during the last five years. In addition, some respondents had both successful and unsuccessful open innovation activities and these cases provided important data both about reasons of failure (table 5) and challenges these companies faced.

Table 5. The main reasons of unsuccessful open innovation process by respondents.

Lack of support and trust from top management.
Different difficulties like lack of funding, progress stopped etc. emerged because of Covid pandemic.
A new program was introduced, however no proper training was given on how to use it. This led to a point where many people did not know all the functions and own role.
Solutions were not mature enough especially when worked with quite new startups.
Projects completely stopped due bureaucracy. Still "unsuccessful" innovation projects are considered as a valuable part of the innovation process.

5.2 Open innovation challenges

As reviewed in literature review part, innovations are nowadays crucial part of companies business activities in fast paced and globalized world. Still, there can be a belief that companies operating in high technology industries are only valuing and more relying in innovations. However, Chesbrough and Crowther (2006) belied this claim by proving that open innovation is also practiced by early adopters in industries where technology is not the main attribute. In table 6 below the value of innovation and open innovation in company's activities is presented where the maximum value is five (really important) and minimum value is one (not important). From the table 6, it can be concluded that companies value slightly more innovations in overall in their practices than open innovation based activities.

Table 6. The importance of innovation and open innovation in company's practices.

INNOVATION				
Min value received	**Max value received**	**Average**	**Median**	**Standard deviation**
2	5	4,2	5,0	0,9
OPEN INNOVATION				
Min value received	**Max Value received**	**Average**	**Median**	**Standard deviation**
1	5	3,8	4,0	1,1

From the figure 11 below, it can be concluded that almost half of the respondents face fear of sharing confidential knowledge before the open innovation activities. As already mentioned, open innovation is highly linked with openness which makes it logical that companies are careful or cautious not to share too confidential information to other parties. The second most common challenge which participants faced was the fact that innovation activities takes either or both too much times or resources. This was followed by communication difficulties between different parties while negative attitude and lack of top management support was the least common challenges which companies faced before open innovation activities. Furthermore, in table 7 sample of other challenges which companies faced before the open innovation actions are listed.

Figure 11. Share of challenges companies face before the open innovation activities.

Table 7. Other challenges faced by respondents' companies before the open innovation activities.

Lack of qualified people.
Problems with having or obtaining required licenses.
Lack of support from external supporters, where supports are limited and not enough (financial etc.) and some have only order-based R&D support; including joint projects.
Regulations are not same in different industries.
Problems with global laws in global business.

Finding out the main challenges which companies face during the open innovation activities (figure 12) is also one of the most crucial part of the survey. Interesting was to find out whether the main challenges which companies face the most are the same ones as before the open innovation activities. As seen from figure 12, there are some changes compared to challenges faced before open innovation activities but half of the respondent still face fear of sharing confidential knowledge during the open innovation activities. However, fear of losing own innovation is the most least common challenge faced among participants and lack of top management support is still relatively little encountered challenge. Some companies have in overall doubts of trustworthiness of potential partners which can be seen from the values of fear of sharing confidential knowledge while it has become a driver of failure. Markable is that the share of innovation activities takes

too much time or resources is less among participants but in other hand the challenge of overcoming negative attitude is much higher with unit specific frequency increased by 46 percentage. In the table 8, sample of other main challenges faced during the open innovation activities provided by participants are listed.

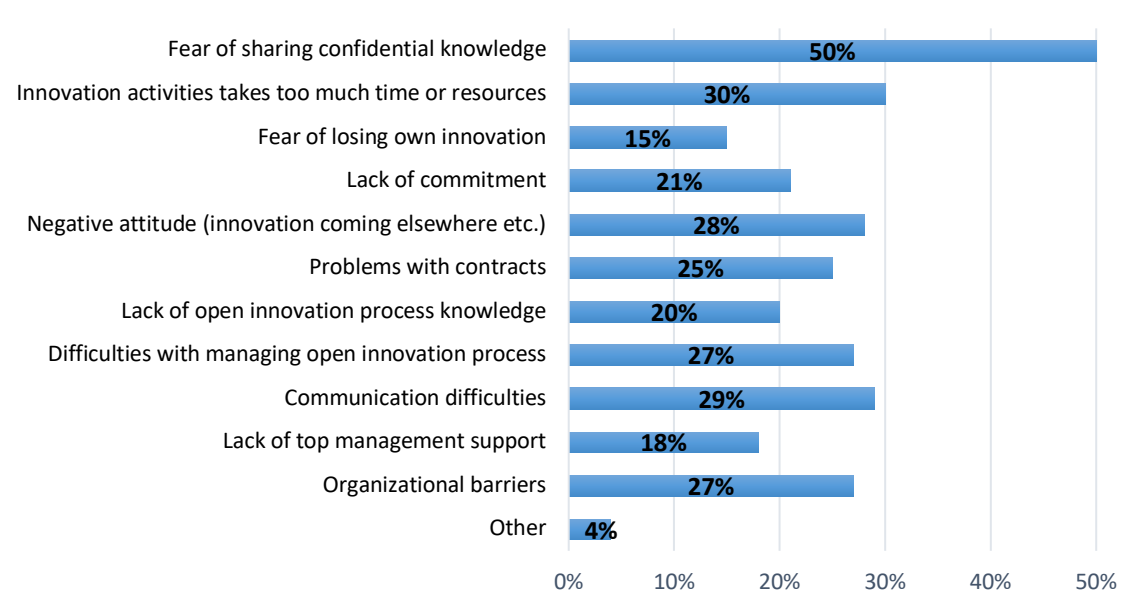

Figure 12. Share of challenges companies faced during open innovation activities.

Table 8. Other challenges faced by respondents' companies during the open innovation activities.

Problems with finding qualified people.
Sometimes target feedback is not represented well enough.
Lack of financial support.
Facing difficulties related to IP protection or censorship of data.
The regulation problems in different industries.

In order to have more wide and overall view of challenges which companies faced during open innovation activities; respondents were asked to rate different challenge types for company's open innovation activities. These challenge types are categorized based on the challenges in figure 11, figure 12 and the challenge types presented in literature in overall. Uncertainty is highly present in the current markets (Bogers, Chesbrough & Strand, 2020) and therefore it is included to this survey as a own challenge type. In overall, uncertainty can be resulted from how combination of different factors are modifying

both customer expectations and probability of future financial returns. Same factors can also be generalized in open innovation projects where not every project lead to innovation or successful result.

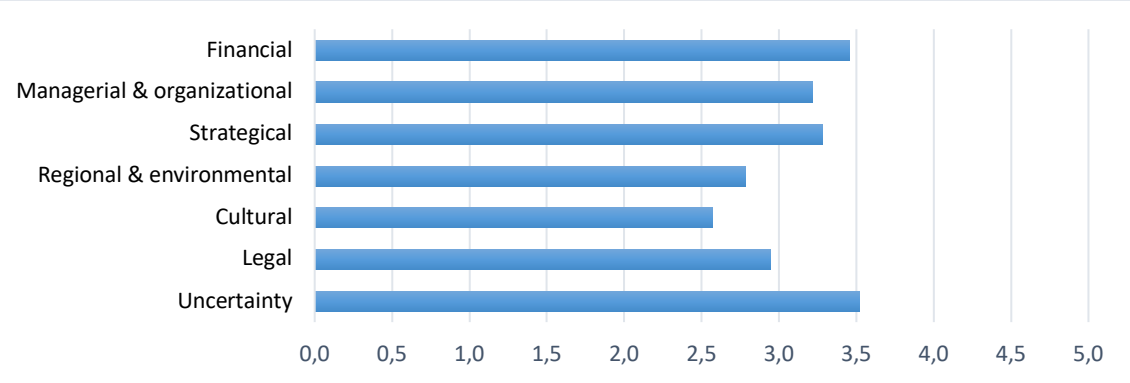

Figure 13. Average of challenge types related by the respondents.

As shown in figure 13, uncertainty is indeed valued as the most risky challenge type for respondents' companies open innovation activities. In the other hand, cultural challenges are seen the least risky challenge type among the respondents for open innovation activities. More detailed share of ranked challenge types are presented in the table 9 below where the rating scale is from the one to five, as one presents not risky at all and value five presents very risky challenge. Same scaling is used in the figure 15. More detailly, when the value of challenge is closer to five it indicates that respondents see certain risk very risky for their actions. Additionally, the share of values from one to five is presented with the percentage share in the table 9.

Table 9. Distribution of rated challenge types by the respondents.

	1	2	3	4	5	Average	Median	Standard deviation
Financial	9,8%	13,9%	21,1%	31,5%	23,7%	3,5	4	1,3
Managerial & Organizational	8,7%	21,4%	26%	27,6%	16,3%	3,2	3	1,2
Strategical	8,7%	15,4%	31,3%	28,2%	16,4%	3,3	3	1,2
Regional & Environmental	18,4%	24,7%	26,9%	20%	10%	2,8	3	1,2
Cultural	27,4%	25,2%	21,6%	14,2%	11,6%	2,6	2	1,3
Legal	16,4%	23,1%	26,7%	17,4%	16,4%	2,9	3	1,3
Uncertainty	6,8%	15,7%	23,1%	27,2%	27,2%	3,5	4	1,2

The last part of this section of survey is about researching different ways how participants' companies overcame the open innovation challenges which they faced. While finding out the main challenges or barriers of open innovation activities, as a counterweight it is also essential to find out ways to overcome those difficulties. Naturally, every difficulty cannot be generalized or direct way to overcome it found but still, common ways or tools to handle those can be provided. In the table 10, the main ways and answers to overcome open innovation challenges by survey participants are presented.

Table 10. Ways to overcome open innovation challenges; provided by survey participants.

Insurance discounts, tax-free and similar supports helped us in a financial way since we are in a zone where technological free area to have company (governmental supports in overall).
Since we are a software company, we've always adopted some forms of open innovation into our operations and business model. For example, we use open source technologies. We have an API. We produce podcasts that teaches others about our product development techniques. Open innovation was in our DNA from the beginning so we never had to tackle any challenges surrounding the concept.
Basic rules were determined for each open innovation activity managed from different sources, and these rules were updated periodically and kept alive.
Organizational changes and top management supports helped us to overcome challenges.
Reward system, comprehensive team work, idea generation and resource addition are the positive effects of success.
We did not work by trying on a brand new innovation project. Rather, we experimented with some modules of projects developed with previous knowledge, or in areas such as the development of a POC. In these trials, subjects such as 1 - learning curve, 2 - problem / bug fixing speed 3 - value of this innovation compared to alternative solutions were evaluated and so gradually these innovations were adapted or eliminated.
Had the employees try it first. Discussed what works and does not, and implemented it after.
Using trial-error method, strategy replication from industry benchmarks, using a single point of failure (SPOF) is a part of a system.
Mindset change, cooperative framework, stakeholder commitment... all these to be developed to get maximum benefit.
They have specific committees, and they have tried to be as transparent as possible, and each person who is involved in the project knows very well what are their tasks. all the appropriate departments (e.g. for legal issues, there is a member from that team seating in one of the committees) are represented to ensure that communication is transparent.

Table 10 presents just a little portion of the main answers for overcoming or avoiding challenges related to open innovation activities. Many of the answers which are not presented in table 10 highlighted the role of top management in changing the mindset

towards accepting openness in everyday business development actions. When top management support and commitment was present also stakeholder commitment was higher. Still, the commitment by itself was not enough for accepting openness as the role of comprehensive communication was highlighted. Moreover, different stakeholders like workers in projects had a better chance to involve in project which then further was seen as a better motivator. Additionally, for instance reward systems and paid trips to other countries to widen and develop skills had highly positive affect. Still, in some cases companies could not see potential benefits and values in open innovation activities which then further hindered open innovation activities. Additionally, this can be seen as one of the potential drivers of failure for open innovation activities. Also, Hofstettter et al. (2021) argue that when companies are seeing other firms' competitive concepts those may just harm the performance instead of stimulating them.

5.3 Open innovation collaboration

Besides mapping open innovation challenges, one of the main aims of this research is to find out main external open innovation collaborators while also exploring the success rate from innovation point of view. Piller, Ihl and Vossen (2011) point out the important role of managing uncertainty in innovation management where customer and market demand information and knowledge of different technological solution possibilities besides customer co-creation in overall are precise competences for identifying occurring chances with right approaches. The importance of customer co-creation has been used as a main pillar for assuming that companies tend to have mostly open innovation collaboration with customers. This assume can be proven to be right as figure 14 presents that roughly three quarters respondents had open innovation collaboration with customer which was followed by suppliers and universities and research centers. Survey participants had least open innovation with competitors as the number covers only one third of all responds. Other external open innovation collaborators according survey respondents are for instance government, consultant companies and other brother companies.

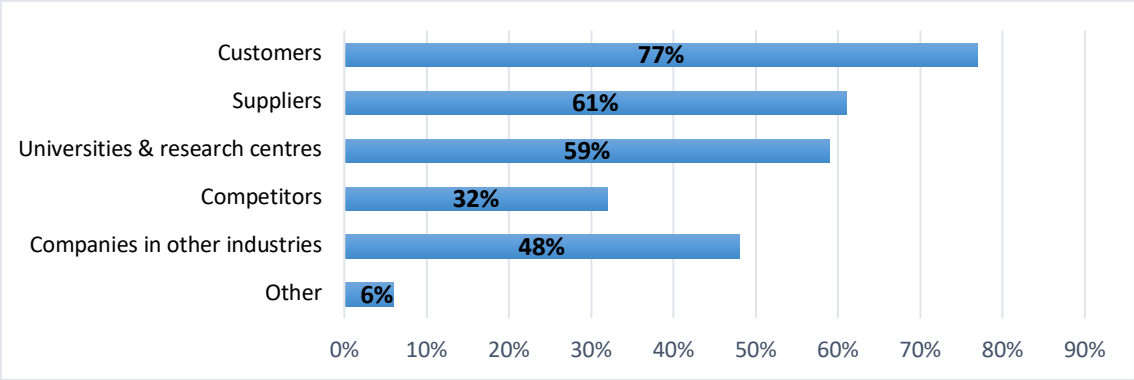

Figure 14. Share of external collaborators in open innovation activities by survey respondents.

When looking more detailed in which area or phase of innovation process has survey participants' companies had open innovation collaboration with external stakeholders two different areas pops up; research and development and idea generation. The share of research and development is 70% while it is not unusual thing that companies rely into open R&D because for example Enkel, Gassmann and Chesbrough (2009) point out that by opening R&D activities, success rate of product and R&D efficiency can be increased. Further, manufacturing, engineering and commercialization were chosen just by about one third of survey respondents. The share of open innovation process areas or phases by survey participants is presented in the figure 15 where percentage amount indicates how many respondents had open innovation collaboration with collaborator in certain area or phase per total number of answers.

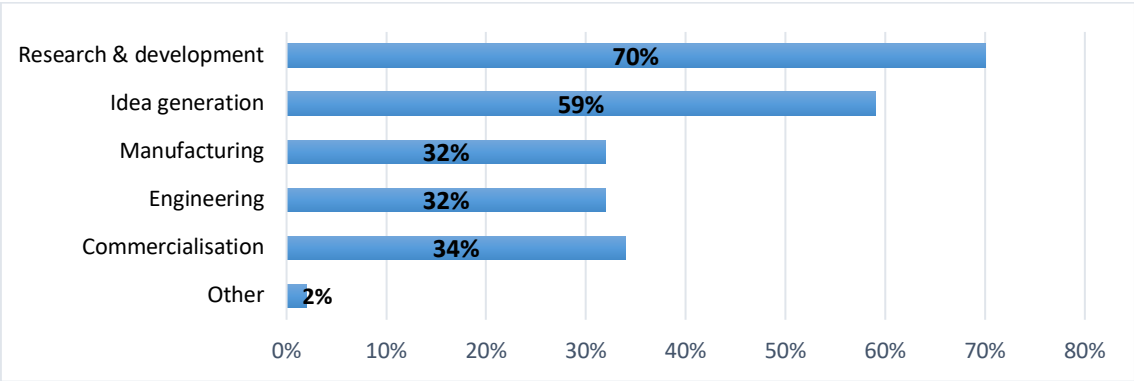

Figure 15. Areas or phases of open innovation process by survey respondents.

One aim of this research is also to find out how successful was open innovation collaboration with different external stakeholders. In this section, it was controlled that number

of external open innovation collaborators presented in the figure 14 matched with this sections amounts. Survey participants were asked to rate from the scaling of one to five how successful was open innovation collaboration with different stakeholders who they had collaboration with. If the participant did not have open innovation collaboration with certain external collaborator; participant was asked to choose option “didn’t have collaboration”. In the figure 16 the average of how satisfied and successful open innovation collaboration with different collaborators was, where closer to number five average is, more successful has open innovation collaboration been among the survey participants.

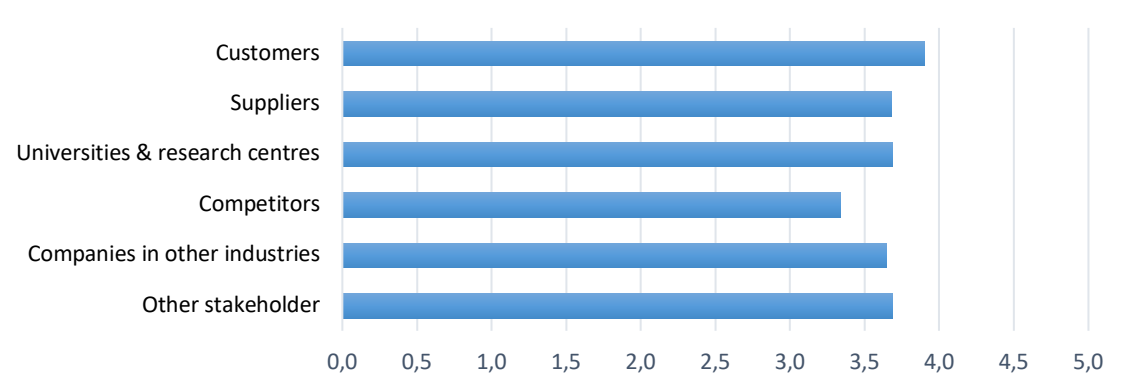

Figure 16. Average of how satisfied and successful has collaboration been by the respondents.

Table 11. Distribution of how satisfied and successful has collaboration been by respondents.

	1	2	3	4	5	Average	Median	Standard deviation
Customer	0,7%	7,9%	23,8%	35,8%	31,8%	3,9	4,0	1,0
Suppliers	1,7%	11,7%	24,4%	41,2%	21%	3,7	4,0	1,0
Universities & research centers	5,2%	8,6%	20,7%	43,1%	22,4%	3,7	4,0	1,1
Competitors	3,2%	24,2%	22,6%	35,5%	14,5%	3,3	3,5	1,1
Companies in other industries	4,2%	9,4%	27,1%	36,4%	22,9%	3,6	4,0	1,1
Other stakeholders	6,7%	8,9%	17,8%	42,2%	24,4%	3,7	4,0	1,1

From figure 16, it can be concluded that in overall, open innovation collaborations have been satisfactorily good but none of the average values reached over the value of four. The most satisfied and successful has open innovation collaboration been with

customers while least successful and satisfied with competitors. In table 11 more detailed distribution of rates given for how satisfied and successful has open innovation collaboration been with different external stakeholders. Some of the companies tend to fail in their open innovation activities die to the fact that they do not understand the real value of different open innovation collaborators which then further can be seen as a driver of failure.

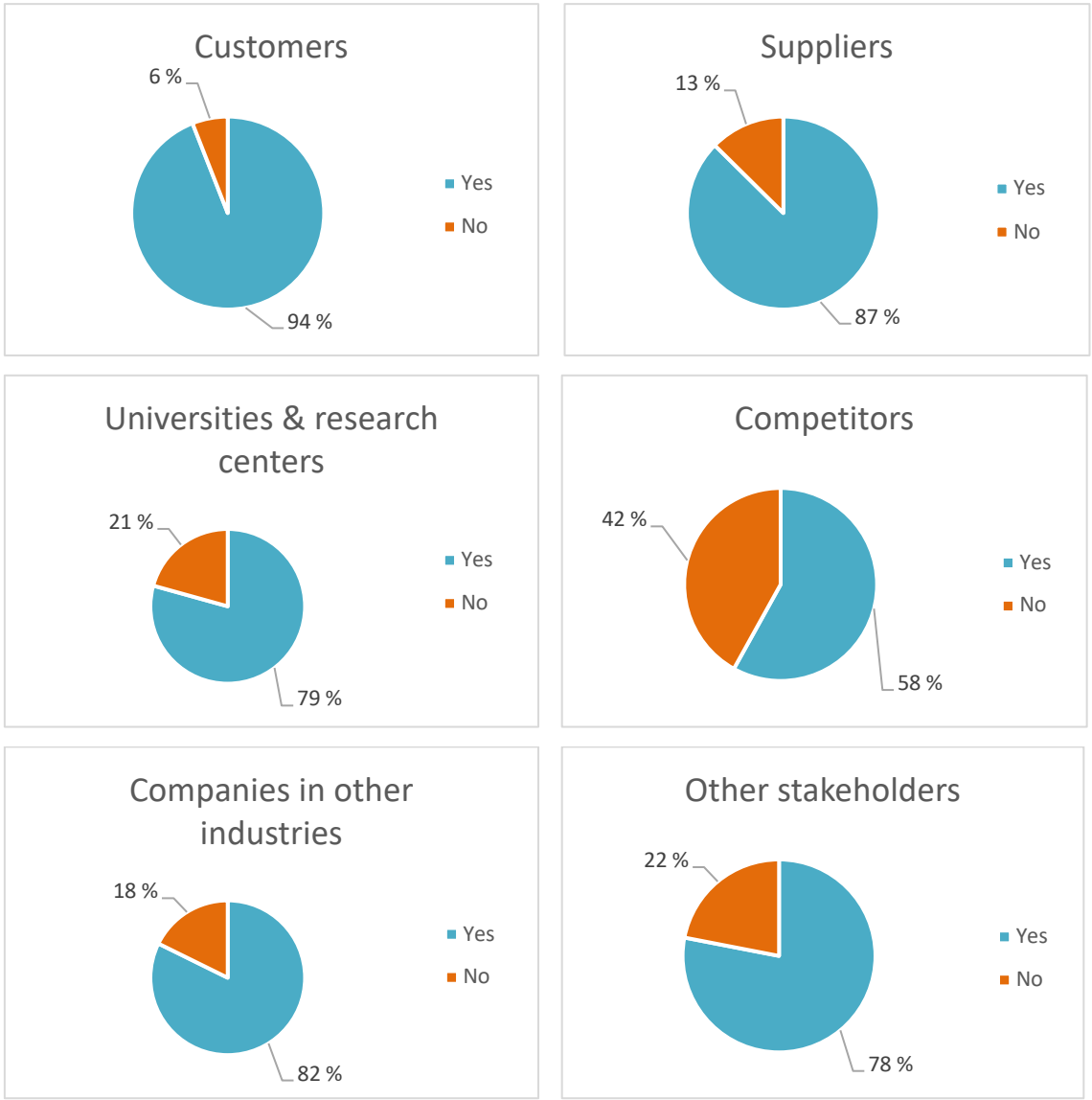

Figure 17. Distribution if collaboration led to innovation with different external stakeholders.

Besides knowing how satisfied and successful has collaboration been with different external open innovation collaborators, it is also important to map out whether the actual

collaboration led to innovation. Collaboration can have an encouraging effect in innovation because every part brings in exclusive collection of skills and knowledge. However, collaboration can be satisfying but still it does not always lead to innovation because of different barriers or challenges related to specific cases. In figure 17, the share whether the collaboration with different open innovation collaborators led to innovation is presented. Here, percentage values are presenting the share of answers which includes only responses if the respondent had collaboration with certain collaborator. Antikainen, Mäkipää and Ahonen (2010) point out that instead of having a narrow focus on a single individual, more wider view for encouraging community creativity is recommended. Further, West and Gallagher (2006) state that these both group and individual dimension perspectives in open innovation theme are still quite unstudied areas.

Chesbrough (2012) highlights that through customization, better customer satisfaction can be achieved while still company has to deal with the gap between customization and standardization for better innovation results. From the figure 17 it can be concluded that collaboration with customers has been the most successful in the terms of creating a new innovation. Here only six percentage of all respondents who had open innovation collaboration with customers did not achieve new innovation at the end or during the collaboration. Additionally, collaboration with customers was the most popular one which was followed by suppliers. This same trend was also visible in whether open innovation collaboration led to innovation among these collaborators; suppliers were the second most successful one. In other hand, competitors were the least successful partner for open innovation activities because among the respondents only little bit over a half of the collaborations ended up with innovation. These results may also reflect to the reason why open innovation collaboration with competitors is not so popular one among other external collaborators. It should also be noted that the numerical amount of respondents who had collaboration with other stakeholders is just 41 where the success rate is little bit over than three quarters but with for example universities and research, the total numerical amount is 116 and the success rate is quite the same as with other stakeholders.

6 Analysis and Discussion of the Main Results

In this chapter, more in-depth analysis is executed for the results while some of the results are already presented and analyzed in results part of this research but some other main takeaways are going to be analyzed in this chapter. All the names and detailed information received from respondents are handled confidentially under the general data protection regulation and therefore, those information are not presented or either analyzed. The main idea of this chapter is to both categorize and summarize survey data into meaningful groupings which follows the guidelines of the research questions and objectives. Each group or significant data set will be analyzed individually which makes it possible to find straight answers for the objectives of the research.

6.1 Distribution of the main challenges faced by different segments

6.1.1 Main challenges by the industries

The amount of the different industries in this research is quite much with almost even share of total respondents. Still, the individual amount of different industries is around ten which makes it invalid to rank all the challenges or barriers for open innovation activations detailly per industry type. However, the most common barrier or challenge per industry type is presented in the table 12 below. It should be noted that, the sample sizes of industries are not significantly remarkable, which means that all the results cannot be directly seen as the only right answer; they are more providing a general view.

From table 12, main percentages of challenges faced which can be taken up are for example related to industries of aviation & transportation, healthcare, manufacturing, production and technology. In these industries the share of certain challenges faced before or during the open innovation activities are quite high, achieving at least the share of two thirds. In aviation and transportation industry, companies seem to face a lot problems relates to communication in both before and during the open innovation activities.

Same trend can be seen in manufacturing industry where companies face the fear of sharing confidential knowledge which can be supported by the nature of industry. In healthcare industry, the fear of sharing confidential information during collaboration is increasing compared to before the activities and the same trend is slightly seen in production industry but in technology industry this trend is much more visible. As figure 11 and 12 shows, it is not surprising that in industry level, many industries face high fear of sharing confidential knowledge as the most common challenge.

Table 12. The most common open innovation challenges by the industry type.

Industry	Before	Share	During	Share
Aviation & Transportation	Communication difficulties	70 %	Communication difficulties	70 %
Chemistry	Difficulties with managing open innovation process	40 %	Fear of sharing confidential knowledge	40 %
Construction	Innovation activities takes too much time or resources	44 %	Innovation activities takes too much time or resources	44 %
Education & Research	Fear of sharing confidential knowledge	53 %	Communication difficulties	40 %
Food	Lack of top management support	55 %	Fear of sharing confidential knowledge	45 %
Healthcare	Fear of sharing confidential knowledge	58 %	Fear of sharing confidential knowledge	67 %
Manufacturing	Fear of sharing confidential knowledge	82 %	Fear of sharing confidential knowledge	82 %
Media	Problems with contracts	50 %	Innovation activities takes too much time or resources	50 %
Pharmaceutical	Fear of sharing confidential knowledge	50 %	Problems with contracts	60 %
Production	Fear of sharing confidential knowledge	60 %	Fear of sharing confidential knowledge	67 %
Renewable energy	Lack of top management support	40 %	Fear of sharing confidential knowledge	50 %
Service	Fear of sharing confidential knowledge	54 %	Fear of sharing confidential knowledge	54 %
Software	Innovation activities takes too much time or resources	59 %	Innovation activities takes too much time or resources	55 %
Technology	Fear of sharing confidential knowledge	47 %	Fear of sharing confidential knowledge	80 %
Telecommunications	Innovation activities takes too much time or resources	58 %	Lack of commitment	50 %
Tourism	Lack of open innovation process knowledge	46 %	Fear of sharing confidential knowledge	46 %

Khosropour, et al. (2015) point out that in aviation industry knowledge is the central of industrial innovation development where based on high role of technology, innovations and technology management possess a high role. Additionally, Gutiérrez-García, Recalde and Alfaro (2020) highlight that for the success of open innovation activities, communication is important because for instance with good communication companies may underline good engagement with different external collaborators. Also, in overall, communication can be seen as a bridge between closed and open innovation because it covers every practice externally and internally. Poor communication can cost businesses a lot and therefore, companies should make sure that communication is supported by right tools, coordination, knowledge and trust.

The chemical industry can be seen as a pilar for numerous industries (Valencia, 2013) and there the role of innovation is crucial in improving and producing new products (Mahdi, Nightingale & Berkhout, 2002). Based on the research by Sieg, Wallin and Von Krogh (2010), three types of managerial challenges in seven different chemical companies were detected which are: assign right internal experts to collaborate with the innovation negotiators, finding the correct problems and finally framing difficulties in a right way so that new solutions are enabled. As table 12 shows, chemical industry face problems like difficulties with managing open innovation process and fear of sharing confidential information. This can be supported by previous statements and the research by Teirlinck and Poelmans (2012) who brings out that in some cases complexity, budget limits and different risks forces companies to think more about the collaboration with external parties which further may bring out more challenges.

Construction industry is highly employed in every country where stakeholders perform different actions (Pinto, Nunes & Ribeiro, 2011) and these stakeholders are connected in numerous stages. Gann (2001) points out that usually companies which are working in high technology based industries tend to invest more in research and development than for instance, construction companies. According to table 12, companies in construction industry face difficulties related to how Innovation activities takes too much time or

resources. Moreover, these companies lack the ability of absorbing research results (Gann, 2001) and it can be challenging to transfer practically knowledge from science to industry (Spithoven, Clarysse & Knockaert, 2010).

In the global scale, the education industry has seen a rise due to the globalization in different sectors and industries (Verger, Lubienski & Steiner-Khamsi, 2016). Collaboration between universities and other companies may lead into pressure of commercialize the results of research (Gassmann, Enkel & Chesbrough, 2010) while university-industry partnership can vary from being small-scaled to large-scaled collaboration (Perkmann & Walsh, 2007). According to this research, universities and research centres face fear of sharing confidential knowledge and communication difficulties. In some cases, universities may be too much process oriented while companies tend to be more results oriented in collaboration. Cervantes and Meissner (2014) highlight that nowadays' trends support knowledge flow from education and research to industries while utilizing open access or collaborative intellectual property.

Growing demands of customers and technology development has led to changes in food industry during the last decades. Also, raw materials and finished goods are handled better because of quick implementation of new technologies (Kumar, Reinitz, Simunovic, Sandeep & Franzon, 2009). Still, due to increasing demands by customers, food industry is forced to open its activities for external resources in introducing both new technologies and products (Sarkar & Costa, 2008). According to this research, companies in food sector face problems related to lack of top management support and fear of sharing confidential knowledge. Because in food sector there is high number of actors and competitors, companies may have problems of implementing open innovation activities while these activities should be coordinated well (Barbara & Galati, 2013). Therefore, companies should establish more linkages that can create more creative strategies and more measures can be put into development of personnel attributions.

Especially during the last decades, healthcare has seen difficulties with achieving both patient satisfaction and cost savings. However, by far healthcare industry has managed to do this and in long run this can be seen by increased market share (Taner, Sezen & Antony, 2007). According to table 12, companies in healthcare industry, as like many other companies in other industries, face fear of sharing confidential knowledge. Still, the research by Bullinger et al. (2012) finds out that practices in open health platform in healthcare has brought exciting results as many participants were active by submitting different challenges and solutions. Also, as a current topic, healthcare open innovation challenge 2020 is aiming to find innovative industrial solutions with the possible prizes for the best successful participants. Still, here another problem is arising; how to attract and engage people to participant. Usually, companies are offering money as a compensation for the best contributions; like healthcare open innovation challenge 2020 is offering $25,000 startup SG grant for the winners in each challenge. However, from participant point of view, problem may be that organization is taking higher profit from the innovation compared to innovator where credit received is not enough. After all, all the different stakeholders in the open innovation ecosystem are co-operating to generate demand-driven innovations and these stakeholders should continue to work openly together to reach common goals of digital health (Pikkarainen, Hyrkäs & Martin, 2020).

The evolution of manufacturing made a recognizable and extraordinary process recently. Therefore, the industries including medicine, computer technologies, mechanical and material sciences along with human and service industries have gained re-markable achievements (Luo, 2014). Innovation has a major role for companies for having sustainable operations in many industries. In the long term run and benefits of companies are succeeded with innovation activities (Harmsen, de Haan & Swinkels, 2018: 20-22). In order to achieve sustainable growth, companies have to find essential technologies internally or externally and in other hand whether they want to commercialize their technology (Noh, 2015). According to this research, fear of sharing confidential knowledge is the most common challenge, obtaining over 80 percent-age of participants in manufacturing industry both before and during the open innovation activities. This makes logical

sense because companies in manufacturing sector aim to gain competitive advantage across the competition where competitors can emulate new successful ways and innovations. Also, in value networks companies require to share different knowledge and resources which is seen as an open system (Fajsia & Morač, 2015).

Media shaped in different forms such as online and digital platforms has been a growing field recently (Kubitschko & Kaun, 2016: 1-3). Therefore, the innovation term had more important and critical position for the media sector. Even daily tasks of a media company involve innovation activities including creation and marketing. Furthermore, another perspective for the relation between media and innovation can be formed because of the key role how the plan of action is done by companies (Küng , 2008: 3-6). In this research, half of the survey participants' companies in media sector face problems with contracts before the open innovation activities while during the activities problems with high amount of time or resources related to innovation activities arise. According to survey participants, companies in media sector tend to collaborate with audience or other media companies while motivation is highly around market-related results. This is also one reason why companies are driven towards making contracts for open innovation activities while addressing problems related to intellectual property. The combination of different resources can lead into improved processes but sometimes newness or smallness of company can be a limiting factor. Also, innovation cost, human and time resources can become a carrier for open innovation which can be highlighted especially with smaller and unexperienced companies.

Companies in the pharmaceutical industry are formed with skills of multitasking and different units of problem solving or production. R&D activities performed previously in the pharmaceutical sector had been internally sourced. It resulted in companies' trust in innovation in order to stay running and develop (Yeung et al., 2020). Therefore, innovation in this industry should have taken into consideration not only in fiscal but also social activities including interactions and networking (Hara, 2003: 198-200). Half of the participants' companies in pharmaceutical industry faced fear of sharing confidential

knowledge before the open innovation activities and sixty percentage problems with contracts during these actions. Many companies in this industry face pressure to answer increasing costs while some of the patents are expiring. In order to improve productivity of research and development, companies need to go beyond their organizational boundaries where protection of intellectual property is important part of the industry.

Industrial Internet of Things, Industry 4.0 and industrial production organisms are shaping production industry (Senvar & Akkartal, 2018). In overall, production sector requires evolving employee capabilities which can further be an important factor for improving and solving difficulties emerging in processes of production (Gudanowska, Alonso & Törmänen, 2018). Similarly to manufacturing industry, survey participants' companies in production industry tend to face fear of sharing confidential knowledge both before and during open innovation activities with slight increase of the share in challenges faced during the activities. However, to be more sustainable, companies are trying to reduce the costs related to transportation and production. For instance, process innovation can be utilized in the production projects but it may require opening up confidential knowledge. Also, it should be remembered that unsuccessful innovation projects should be considered as a valuable part of the innovation process.

The concept of innovation has become significant and developed in renewable energy markets (Elia, Kamidelivand, Rogan & Gallachóir, 2020). Additionally, research for this concept has been made and been explained the dimensions of renewable energy innovation. The dimensions which starting with social factors and ending with market acacceptance indicate that innovation in renewable energy sectors has a challenging process (Wüstenhagen, Wolsink & Bürer, 2007). Therefore, several types of policies are made on innovation activities such as patent applications due to the competitive environment (Johnstone, Haščič;& Popp, 2010). According to this research, survey participants' companies in renewable energy industry face lack of top management support before the open innovation activities and during these activities fear of sharing confidential knowledge. Companies should decide different conditions and

recommendations to determine the extent of assets which are used for open innovation activities. Additionally, because of the nature of the industry, companies should collaborate in order to increase the ability of developing new ideas and this should be the seen as a major solution point for occurring problems.

Development and growth in the service industry have been conceptualized around innovation in recent years (Howells, 2011: 68-69). The change in the service sector has different results and aspects during innovation activities. Limitless borders of innovations of service indicate that the existing dimensions such as marketing, distribution, organization development could be concluded with new challenges (Den Hertog & Bilderbeek, 1999). In this research, the share of half of the participants' companies operating service industry face fear of sharing confidential knowledge. Still, being familiar with the problems is key for solutions in this industry because a new concept can sometimes be related to existing other markets while another cannot be. As a result of this, the application of innovation activities are significant and research by Hameed, Nisar and Wu (2021) points that companies' open innovation implementation increases both business and service innovation performance in a positive way.

Just like production industry, Industry 4.0 is also affecting on software industry and the industry is developing rapidly. Still, during the industry 3.0 the amount of new research and development partnership was quite low in software industry (Cloodt, Hagedoorn & Roijakkers, 2010). However, especially nowadays software industry is more open where companies may choose open source software licenses which are a good way to spread the product while capturing value (Chesbrough & Appleyard, 2007). According to table 13, companies in software industry feel that Innovation activities take too much time or resources which then further forms as a challenge. Yet, the nature of software industry is pushing companies towards collaboration and knowledge search while open source software is a good example of open innovation activities opportunities. Benefits for open source software are for instance low costs and flexibility but still on the other hand as a drawback lack of capability and user support may arise (Morgan & Finnegan, 2010). Still,

companies should not just purely focus on inbound open innovation but rather also moving focus into outbound open innovation in order to increase the demand of different products.

Technology industry has had a lot of changes during the last years, where for example, internet of things have connected enormous number of devices to the web. Also, in high-technology industries companies are forming strategic alliances with high activity. Moreover, in this industry companies which form technology alliances tend to innovate at a greater rate which be simply due to company's commitment which is reflected through the willingness for collaboration (Stuart, 2000). However, this research indicates that survey participants' companies in technology industry tend to face fear of sharing confidential knowledge. Also remarkable is that the share of this challenge among the companies working in technology industry is increasing significantly during the open innovation activities. This makes logical sense due to the how industry is characterized. In this industry companies are aiming to find competitive advantage by implementing better technological solutions while competitors aim to implement trending technologies.

The transition and characterization stages of the telecommunication industry have been shaped under pressure. Accomplishing hard and complex parts and meeting up the promises on the businesses have brought up the change in development (Grishunin & Suloeva, 2015). Therefore, innovation has been always an era in this sector and has been made with purposes that follow the development and uninterrupted procedures (Yami & Nemeh, 2014). There have been various reasons why the telecommunication industry is an exciting area for innovation activities. The latest demand in change for growth and the fast evolution of the industry are the key factors for addressing different reasons for the attractiveness of the telecommunication industry (Clò, Florio & Rentocchini, 2020). According to table 12, half of the respondents' companies operating in telecommunications industry feel that before the open innovation activities these activities takes too much time or resources which can be seen as an obstacle for open innovation. However, during the open innovation activities the share of that problem reduces but problems

with commitment occur. Nevertheless, companies in many industries are moved towards introducing innovations into business strategy (Bigliardi, Dormio & Galati, 2012). Bigliardi, Dormio and Galati (2012) highlight that open innovation processes can be managed by different ways based on for instance the roles or the task forces.

The tourism sector has had economic and social effects on the regional zones. Therefore, a concept that can grow around innovation activities, particularly with creative ones, has grown in recent years. The innovative activities such as marketing, service and technological services show the variety of complex methods of the tourism industry. However, positive results of innovative approaches are proofs of interactions of tourism services in the economy (Ratten, Braga, Álvarez-García & del Rio-Rama, 2020: 1-4). According to table 12, companies in tourism sector face lack of open innovation process knowledge before the open innovation activities and fear of sharing confidential knowledge during these activities. Due to the fast-growing market of tourism, companies should stay in the race not only by developing in the size of the economy but also by bringing innovative ideas (Alsos, Eide & Madsen, 2014: 1-3). The new business models of the tourism sector have been modified in ways of being accessible and more attractive in order to develop. Therefore, innovation activities allow society to have benefits and good feedbacks in return for the companies' profit and growth (Velikova & Cohen, 2019: 45-46). For instance, companies in tourism sector could utilize more the social big data in order to promote openness which then further can support sustainable tourism activities which is also supported by as Del Vecchio et al (2018).

6.1.2 Main challenges by the countries

The majority of participants' companies were from Turkey while the share of participants from Russia and India is quite equal. These three countries were chosen because of their innovation potential, economical size and future objectives. Research by Cetindamar and Ulusoy (2008) show that companies in Turkey tend to have collaboration with each other but still these partnerships have only minimal impact on the performance of innovating.

In overall, emerging economies are attracting multinational companies and here India is not making exception where India is having credible research laboratories maintained by governments. Yet, these government research laboratories are not having significant role with the foreign companies while especially the bond between academia and industries should be supported (Patra & Krishna, 2015). Like other Western Europe countries, also Russia has started to have more focus and resources for building competitive economy on the basis of innovations and knowledge (Savitskaya & Torkkeli, 2011). Due to history and characterizes of Russian markets, open innovation is not widely utilized. However, Podmentina, Savitskaya and Väätänen (2012) point out that companies who are utilizing outbound and inbound open innovation in their activities, tend to have greater productivity and growth.

Table 13. Distribution of challenges by survey respondents in Turkey.

TURKEY	BEFORE	DURING	TREND
FEAR OF SHARING CONFIDENTIAL KNOWLEDGE	48,3 %	48,3 %	Same
INNOVATION ACTIVITIES TAKES TOO MUCH TIME OR RESOURCES	42,5 %	47,1 %	More
FEAR OF LOSING OWN INNOVATION	13,8 %	19,5 %	More
LACK OF COMMITMENT	13,8 %	5,7 %	Less
NEGATIVE ATTITUDE (INNOVATION COMING ELSEWHERE ETC.)	24,1 %	12,6 %	Less
PROBLEMS WITH CONTRACTS	23,0 %	24,1 %	More
LACK OF OPEN INNOVATION PROCESS KNOWLEDGE	17,2 %	31,0 %	More
DIFFICULTIES WITH MANAGING OPEN INNOVATION PROCESS	26,4 %	33,3 %	More
COMMUNICATION DIFFICULTIES	32,2 %	29,9 %	Less
LACK OF TOP MANAGEMENT SUPPORT	12,6 %	6,9 %	Less
ORGANIZATIONAL BARRIERS	28,7 %	20,7 %	Less
OTHER	5,7 %	10,3 %	More

Tables 13, 14 and 15 show the distribution of challenges presented in survey from the companies operating in Turkey, Russia and India. Like presented in figure 11 and 12 also in individual country level, challenges of “fear of sharing confidential knowledge” and “innovation activities takes too much time or resources” were the top challenges or barriers faced both before and during open innovation activities. Markable is that especially the fear of sharing confidential knowledge is not decreasing from the starting point of

open innovation activities moreover, the share is increasing or staying the same. In general, fear of sharing confidential knowledge should not stand in front of promoting innovativeness and collaboration while possible precautions should be implemented directly.

From the table 13, it can be concluded that survey participants companies from Turkey face main challenges like fear of sharing confidential knowledge, innovation activities takes too much time or resources and communication difficulties. Additionally, during the open innovation activities, companies faced more lack of open innovation process knowledge than before the activities started. This was also detected in the survey process, where while having contact with possible participants, some of people did not know what open innovation activities are. In some cases, possible participants knew what open innovation was as an action but the term was not familiar. Moreover, some people thought that open innovation is just a normal part of collaboration and not a differently defined action. Therefore, both in survey and messages sent to possible survey participants, open innovation as a term and action was explained with possible examples.

In overall, from table 13, it can be concluded that the share of almost half of the challenges listed increased during the open innovation process went forward from the starting point. However, the share of some challenges faced got reduced and for example, high decrease can be spotted in the share of facing negative attitude. In some organizations this can be a significant problem or barrier for adapting open innovation and especially in literature more focus on has been shifted towards this topic while there is already research made about not invented here syndrome in 1982 by Katz and Allen. Also, the share of lack of top management support has decreased which can have a link for negative attitudes faced. This is because especially during the adaptation of open innovation, top management has a crucial role in fighting against possibly appealing resistance. For instance, Hannen et al. (2019) conclude that not-invented-here syndrome is in overall a negative attitude against external information and countermeasures towards root causes of this problem may take both a lot of time and resources. Therefore,

it is a really positive finding that in Turkey, in overall based on this research, companies can reduce the incidence of this challenge. One good method for overcoming this challenge is for example developing team skills, provide information why external knowledge is implemented and why it can be more valuable compared to another solutions.

Table 14. Distribution of challenges by survey respondents in Russia.

RUSSIA	BEFORE	DURING	TREND
FEAR OF SHARING CONFIDENTIAL KNOWLEDGE	45,6 %	50,9 %	More
INNOVATION ACTIVITIES TAKES TOO MUCH TIME OR RESOURCES	26,3 %	24,6 %	Less
FEAR OF LOSING OWN INNOVATION	38,6 %	15,8 %	Less
LACK OF COMMITMENT	31,6 %	24,6 %	Less
NEGATIVE ATTITUDE (INNOVATION COMING ELSEWHERE ETC.)	19,3 %	24,6 %	More
PROBLEMS WITH CONTRACTS	26,3 %	33,3 %	More
LACK OF OPEN INNOVATION PROCESS KNOWLEDGE	19,3 %	29,8 %	More
DIFFICULTIES WITH MANAGING OPEN INNOVATION PROCESS	12,3 %	21,1 %	More
COMMUNICATION DIFFICULTIES	29,8 %	22,8 %	Less
LACK OF TOP MANAGEMENT SUPPORT	31,6 %	28,1 %	Less
ORGANIZATIONAL BARRIERS	29,8 %	21,1 %	Less
OTHER	3,5 %	3,5 %	Same

In the table 14, the share of different challenges faced before and after the open innovation activities by survey respondents in Russia is presented. Just like in similar table of Turkey, also in Russia the share of approximately half of the challenges is increasing from the before the start procedures of open innovation projects. However, some differences can be spotter between the tables 13 and 14 especially in the shares of different challenges but still, in overall, the trend is quite similar with some of the challenges. Just like in Turkey, fear of sharing confidential knowledge possess a high share both in before and during the open innovation activities but in Russia, the share increases little bit from the begging. However, the share of this challenge is quite significant because both before and after the open innovation activities about half of the respondents informed that they fear this challenge. Other the most common challenges are for example lack of management support, problems with contracts and lack of commitment. Still, fear of losing own innovation was encountered by over one third of respondents but during the

open innovation activities this rate decreased to just around 15 percentage. This fear can be encountered before the open innovation activities for instance because of prejudices of being open instead of focusing on just closed innovation actions.

On other hand, challenges which can be linked together like communication difficulties, lack of top management support and lack of commitment values in during the open innovation activities decreased from the before values. However, surprisingly the share of negative attitude increased which can probably be linked to lack of open innovation process knowledge. For example, Antons and Piller (2015) present that in not-invented-here syndrome people may underestimate the utility while showing negative attitude towards external knowledge where functions like value and knowledge may suffer. It is normal that negative thoughts over decreased innovativeness and process control may harm the adaptation process of open innovation. Therefore, companies should remember that different tools are just good in specific open innovation activities. Additionally, some respondents pointed out that they have a lot of confidential information but nevertheless, open innovation is important for the projects, which the organization is funding. These kind of difficulties depending on the type, are handled with IP protection, contracts and forming common policies between different parties.

In the table 15, the distribution of different challenges faced before and after the open innovation activities by survey respondents in India is presented. In overall, the trends in the table 14 are quite similar to table 15 but some differences can be spotted especially with the challenges of problems with contracts, lack of open innovation process knowledge, communication difficulties and organizational barriers. However, generally the share of different challenges are decreasing from the before values which indicates almost positive trend. Also, the share of challenges like fear of sharing confidential knowledge, negative attitude and difficulties with managing open innovation process are increasing just like in Russia.

Table 15. Distribution of challenges by survey respondents in India.

INDIA	BEFORE	DURING	TREND
FEAR OF SHARING CONFIDENTIAL KNOWLEDGE	42,3 %	51,9 %	More
INNOVATION ACTIVITIES TAKES TOO MUCH TIME OR RESOURCES	38,5 %	13,5 %	Less
FEAR OF LOSING OWN INNOVATION	19,2 %	17,3 %	Less
LACK OF COMMITMENT	36,5 %	30,8 %	Less
NEGATIVE ATTITUDE (INNOVATION COMING ELSEWHERE ETC.)	28,8 %	36,5 %	More
PROBLEMS WITH CONTRACTS	26,9 %	19,2 %	Less
LACK OF OPEN INNOVATION PROCESS KNOWLEDGE	21,2 %	15,4 %	Less
DIFFICULTIES WITH MANAGING OPEN INNOVATION PROCESS	19,2 %	32,7 %	More
COMMUNICATION DIFFICULTIES	28,8 %	30,8 %	More
LACK OF TOP MANAGEMENT SUPPORT	26,9 %	17,3 %	Less
ORGANIZATIONAL BARRIERS	28,8 %	28,8 %	Same
OTHER	0,0 %	0,0 %	Same

The main theme that can be concluded from the trend of the challenges is that the share of fear of sharing confidential knowledge is increasing or at least staying the same while the process is going forward. In one way this concerning but at the same time quite normal part of open innovation due to its characteristics. However, new innovations are coming in fast pace while old procedures or products are being improved. Therefore, it should be proposed that companies should not focus too much into hiding knowledge, rather they should have more focus into how to innovate and develop. For example, in mobile phone industry, new phones are being published in really fast pace where every year new improvements are done. From there it can easily be understood that technology can become even really quickly outdated but of course it is clear that this lays base for newer innovations.

Sometimes, especially for new or smaller sized companies open innovation activities may be somehow unfamiliar and hard ones. Additionally, companies may face adoption problems where company can be confused over using right tools and techniques in right tasks. However, for some of the companies working more closely with customers or suppliers is not an unfamiliar thing because especially in collaboration with customers can be really beneficial for the business in order to understand markets and customer needs.

Still, moving from this to open innovation activities company needs to build an operational process which supports these activities. Moreover, for this company's goals and strategy needs to aligned while a good communication ways and channels needs to supported.

6.1.3 Main challenges by the size of the companies

This research is categorizing companies by the number of employees in the company. The share and classification of companies who participated in this research is presented in the table 16. Usually, in the existing literature, researches are done for the classification where companies are divided between small and medium-sized enterprises (SMEs) and large enterprises. Respectively, this research follows same classification way purely based on the employee number due to there is no information about annual turnovers of the companies. One of the main aims of this study was to have responses from every size of the business but still maintain balance between the shares. The share of large enterprises is little bit less compared to SMEs but still the ratio is in satisfied level where one business size does not cover too big majority of the total answers.

Table 16. Share and classification of survey participants' companies.

Number of employees	Share of total respondents	Size of business	Classifications
Under 10	11,20 %	Micro	Small and medium-sized enterprise (SME)
10 - 49	23 %	Small	
50 - 249	23 %	Medium	
250 or over	42,80 %	Large	Large enterprise

Innovation activities and technological developments are the keys to the sustainability and growth of a company (Borowski, 2021). Therefore, managing the innovation activities have been tried to be linked to the effect of company sizes (Gomes, Isak & Scherer, 2009), depending on the size of companies: micro-, small-, medium- and large-sized company (Borowski, 2021). While innovation emphasizes the importance of growth and

a way to survival for companies (Bigliardi, Ferraro, Filippelli & Galati, 2020), open innovation gives the opportunity for development (Gomes, Isak & Scherer, 2009) by influencing the firm performance due to increasing market challenges with the help of external and internal flow of innovative strategies (Bigliardi, Ferraro, Filippelli & Galati, 2020).

For SMEs, financial factors can have a major role for the overall development and growth while Abdulsaleh and Worthinton (2013) claim that different strategies of financing will be required at various periods of the companies' cycle of growth. However, Bigliardi et al. (2020) point out that human recourse commitment as a part of organizational factor is having also a positive effect on atmosphere of innovation moreover, on inbound and outbound open innovation. Furthermore, finding by van de Vrande et al. (2009) concludes that SMEs practice open innovation activities because of motives towards markets which can be based on for instance fulfilling customer needs and not falling behind the competitors in competition. Combination of necessity for open innovation and the openness for collaboration highlights that in addition to large companies, SMEs can also have collaboration between business competitors which further can promote SMEs in open innovation ecosystems.

The shares of different challenges faced by survey participants who are classified as small and medium-sized enterprises (SMEs) are presented in the figure 18. Both before and during the open innovation activities, fear of sharing confidential knowledge, innovation activities takes too much time or resources and communication difficulties are the ones which have the highest share. In overall, clear increase in the share can be seen in fear of sharing confidential knowledge but also in appearance of negative attitudes and problems in contracts. In other hand, the shares of fear of losing own innovation, lack of open innovation process knowledge and communication difficulties are decreasing appreciably. Surprisingly, the share of lack of top management support is quite low both before and during the open innovation activities. Moreover, this indicates that in SMEs, top management is supporting open innovation actions which in one hand provides positive information. Yet, it is quite common for SMEs to have problems with resources or

process knowledge because of their limited knowledge base, limited resources and lack of capabilities.

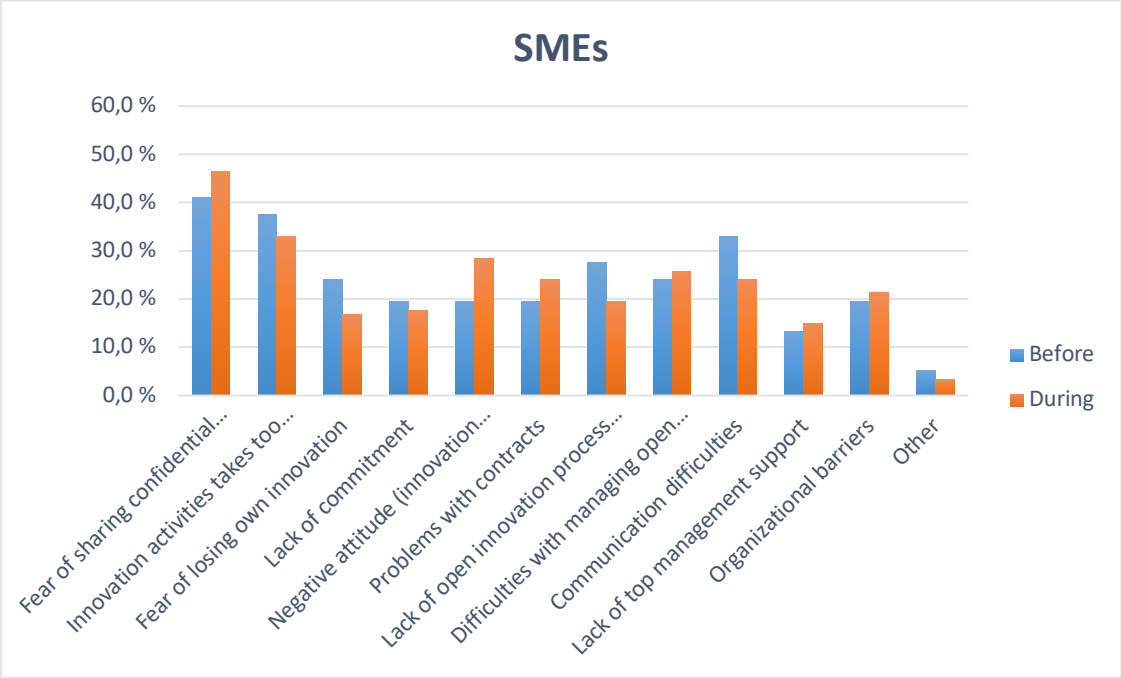

Figure 18. Distribution of challenges by SMEs.

In order to SMEs to become more competitive, they should swift more focus towards finding practical ways to innovate and at the same time reduce additional costs and time required for these processes. However, it needs to be remembered that the open innovation challenges may be contacted directly to external collaborator. For example, Bertello et al. (2021) found out that in some cases SMEs were not delighted of collaboration with research organizations due to lack of effort. Bertello et al. (2021) added that this can be due to lack of advanced systems in SMES which makes it harder to provide all the valuable information and sometimes protecting the most valuable information was also a barrier for ideal collaboration. Although, companies should notice that exposing confidential knowledge can lead into negative consequences on value or status but still it can bring better visibility or attract potential collaborators.

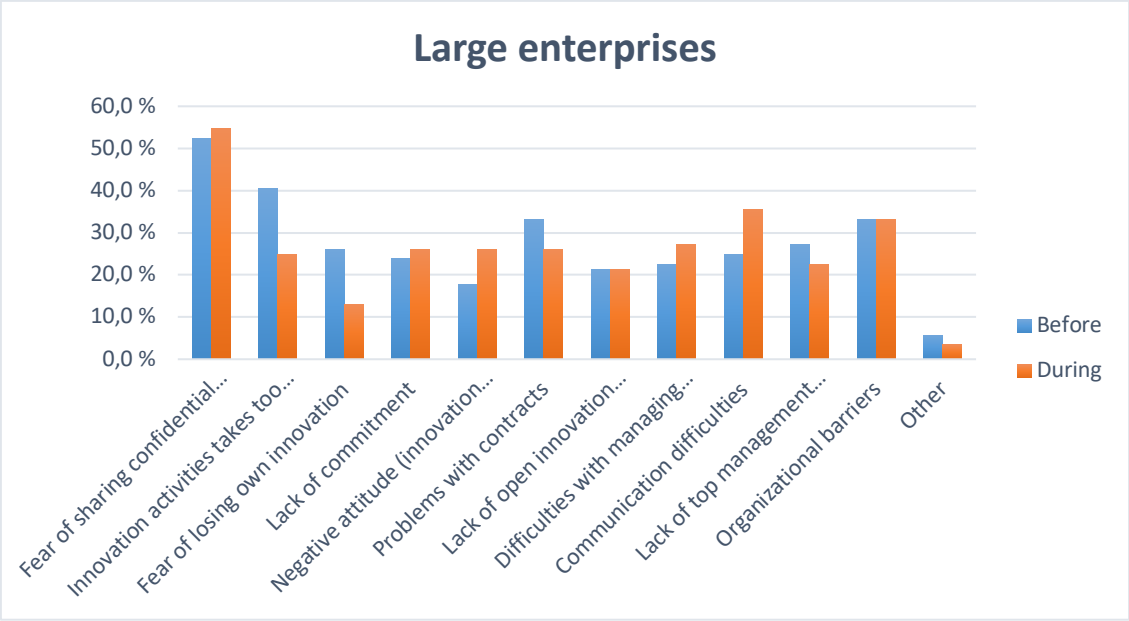

Figure 19. Distribution of challenges by large enterprises.

Innovative developments depending on the size of companies have an impact of the growth since internal arrangements and the external markets of large companies are stronger (Gomes, Isak & Scherer, 2009). Large companies adapt and engage in significant alteration easily. Therefore, innovation advantages are taken rapidly due to higher volumes with equal their sizes (De Wit & Bosma, 2014). On the other hand; the larger you are, the more challenges to overcome according to some authors. With open innovation activities, the flowing network becomes larger as well as the advantage taking of the new information gets harder (Bigliardi, Ferraro, Filippelli & Galati, 2020). Another perspective shows that large companies should always keep innovation activities alive. Therefore, collaborations with start-up and small-sized companies are not rare in order to strengthen innovation (Usman & Vanhaverbeke, 2017). Also, Bunswicker and Chesbrough (2018) point out that inbound open innovation activities are more common than outbound activities due to IP protection concerns while large companies tend to carefully direct information flows inside and outside the projects. According to this research, the share of fear of sharing confidential knowledge is high among large enterprises (figure 19); over the half large enterprises in this research pointed out that they often come up with this problem both before and during the open innovation activities. However, for instance, the share of the challenge “innovation activities takes too much

time or resources" is reducing significantly while moving towards the execution of the project which provides positive sight because usually financial and other resources are exactly the limiting barriers and factors for open innovation activities.

At some cases co-operation and coordinating bigger sizes of companies were mentioned to be harder due to the greater performance that they need to achieve. According to Chesbrough (2006), open innovation activities create a new path from internal to more external innovations and technological developments for companies. Therefore, internal resisting occurs, like for instance not-invented-here syndrome in large companies. About not-invented-here syndrome, the employees and the organization of a company have a suspicious attitude against a new external innovative activity. Therefore, strengthening communication skills within the company and external partners should be focused on, like also Hannen et al. (2019) argue. Additionally, it needs to be remembered that innovation management is not just purely about economic aspects but also psychological human aspects.

Besides other challenges of large companies in innovative activities, fear of sharing confidential knowledge is also an important aspect for the sake of projects (Obra-dović, Vlačić & Dabić, 2021). According to Stefan and Bengtsson's research, different parameters and effects were investigated for companies with protection mechanisms that sometimes was called as paradox (Stefan & Bengtsson, 2016). However, the time management and cost of these time intervals are always another side of the negative effect of knowledge sharing that large companies face (Obradović, Vlačić & Dabić, 2021).

In addition to a challenge of "Innovation activities takes too much time or resources" also, fear of losing own innovation is reducing significantly while moving from the before the open innovation value to during the actions value. Same trend was also visible with SMEs but in large enterprises the change is even more. In overall, fear of losing own innovation is slowing down companies to adapt different open innovation tools and companies should think more with the thought that open innovation activities are giving

more knowledge and benefits than the losses may be. However, it must be remembered that this thought model is just working if every stakeholder involved is following common defined rules. In other hand, open innovation activity is not always just about finding solutions for occurring problems but also with different competencies create something new through collaboration.

6.2 Open innovation collaboration between different partners

6.2.1 Collaboration by country

Especially during the last decade, the interest towards open innovation both in academic and business environment have been increasing. More research on this topic has been made which can be seen in companies increasing interest towards open innovation also in emerging economies but De Paulo et al. (2017) conclude that open innovation's evolution in emerging economies is still quite unknown. However, Badir, Frank and Bogers (2019) point out that also in emerging economies in companies' innovation frameworks, highlighting the importance of external information sources has become more fundamental factor. Therefore, companies in open innovation ecosystems are enlarging organizational resources along the collaboration across the organization's boundaries while evolving different activities and actors. Also, open innovation can be seen as a valuable model where the core idea is that all the collaborators are benefiting from this model (Boger, Chesbrough & Strand, 2020)

This research mostly focuses on open innovation collaboration between partners who are customers, suppliers, universities and research centers, competitors and companies in other industries. As figure 20 shows from the survey results, companies in Turkey, Russia and India tend to have the most open innovation collaboration with customers while competitors are least chosen partner for collaboration. Partnerships with universitates and research centers in Turkey tend to be quite popular along customers and

suppliers while this can be seen in for example different research projects which then is utilized in business.

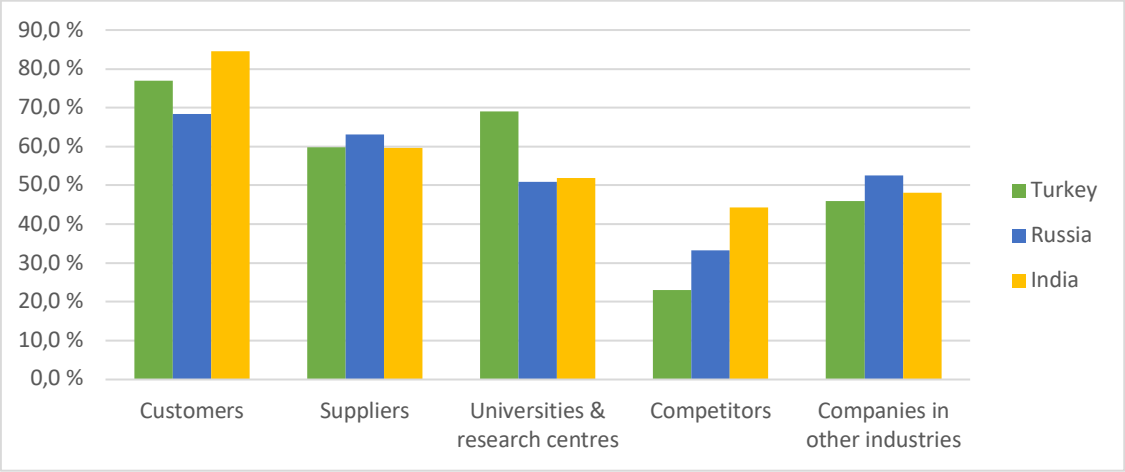

Figure 20. External collaboration of case countries.

In overall, research and development and idea generation activities are the most popular ones in open innovation collaboration. This finding is not something new moreover, Enkel, Gassmann and Chesbrough (2009) point out in their research paper that in the technology based industries the amount of co-operative R&D projects covered almost half of the all R&D projects which company had. Still, this research gives even greater share for this where four-fifths open innovation actions in Turkey (figure 21) were R&D projects. In other hand, relatively small share can be seen in engineering, manufacturing and even in commercialization. For instance, study from Johansson and Larsson (2009) points out that Swedish manufacturing companies does not completely practice open innovation approaches while Yun, Kim and Yan (2020) conclude that different engineering channels of open innovation are needed. Chesbrough (2003) claims that with the help of open innovation activities, companies can take advantage on external ideas while commercializing those to the market. Still, according to this research in Turkey, Russia and India commercialization is practiced by just about one third companies of this research sample.

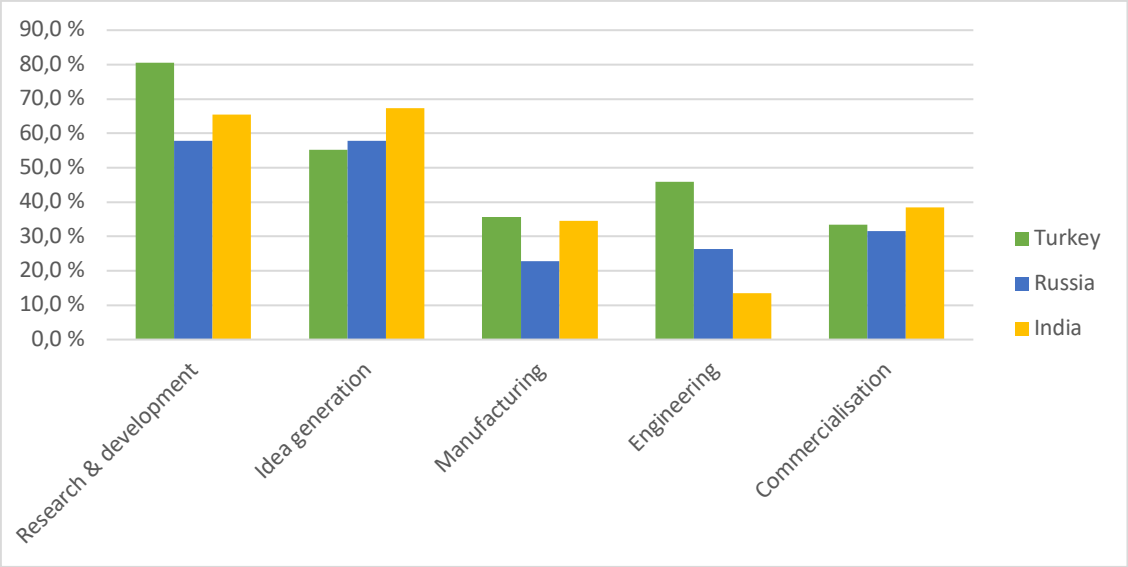

Figure 21. Areas of open innovation collaboration by countries.

Like main results of this research shows, open innovation collaboration tends to be the most successful with customers from the innovation point of view (figure 22). Also, collaboration in overall with suppliers tends to be high while collaboration between Turkish companies and companies in other industries are having quite high success rate of 90 percentage. In other hand, open innovation collaboration with customers does not meet all the expectations while only almost half of the collaborations led to innovation. In most of the cases, the main challenge for successful collaboration with competitors was either negative attitude or simply fear of sharing confidential business knowledge.

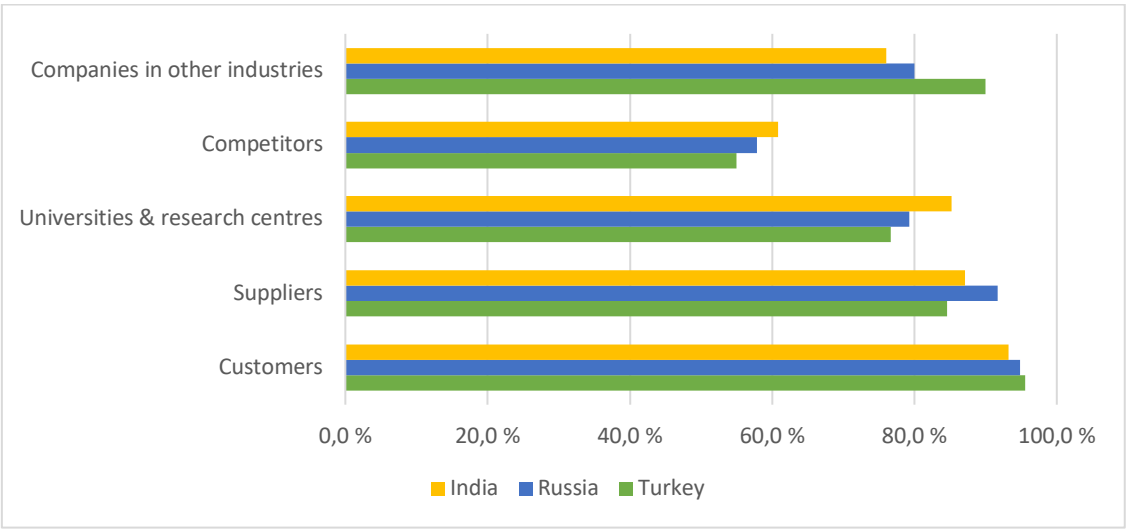

Figure 22. Case countries collaboration that resulted in innovation.

6.2.2 Collaboration by the size of the company

At the beginning, the first extensive literature studied open innovation in large organizations and later the focus has been moved towards SMEs. Usually SMEs face difficulties due to either the newness or smallness of the company while this effects on resources required to leverage networks. Also, it can be stated that open innovation is highly based on external partners where managing the relationships between different stakeholders is a crucial task (Albats, Alexander, Mahdad, Miller;& Post, 2020). However, SMEs usually have greater ability to be more flexible in order to find new business opportunities while Lahi and Elenurm (2015) point out that actually qualitative evidence which proofs that large companies possess significantly higher advantage in the area of innovation does not exists. Of course larger companies have better ability to access external resources and have wider ecosystem around innovations but still these companies tend to face more challenges.

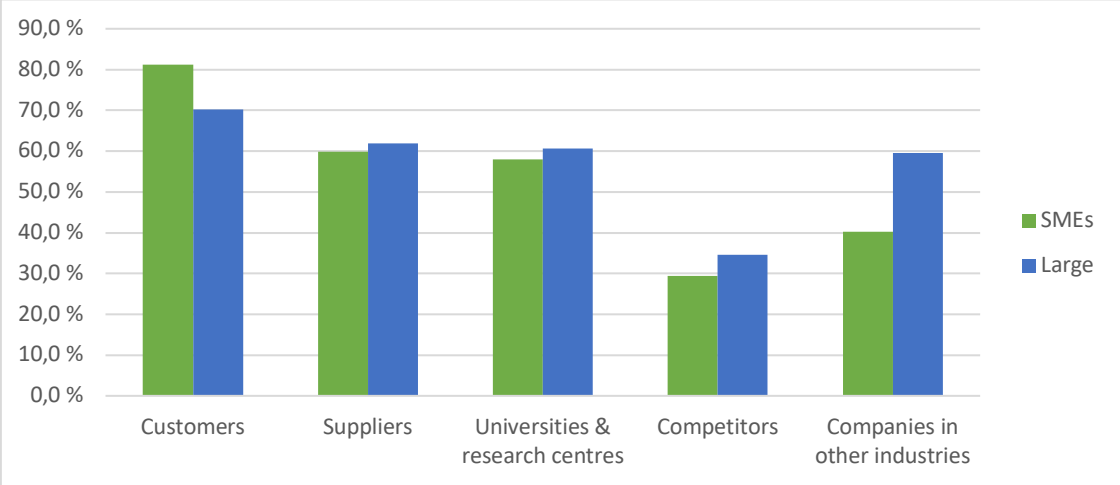

Figure 23. SMEs' and large companies' external collaborations.

Technology has become more complex and sometimes even high investments are required in this area. Hence, companies may have difficulties to manage these problems which makes information to be divided across different companies. Therefore, for companies it is important to have collaboration between different actors while building networks or alliances are fascinating concepts. In the figure 23, the open innovation partnerships between different actors and SMEs and large companies is presented.

According to the survey results, both SMEs and large companies prefer customers as open innovation partner while collaboration with competitors are the least favorable. However, large companies tend to collaborate more with the companies in other industries compared to SMEs that can be explained with the size of network which large companies have.

Both SMEs and large companies tend to have open innovation activities on the areas of R&D and idea generation as figure 24 shows. Especially the use of open R&D system is a good opportunity to outsource R&D ventures when there is not a clear idea or path for the business markets. Outsourcing manufacturing can be seen one way to obtain better competitive advantage in the competition and according to figure 24, large companies tend to practice more open innovation activities in the field of manufacturing than SMEs.

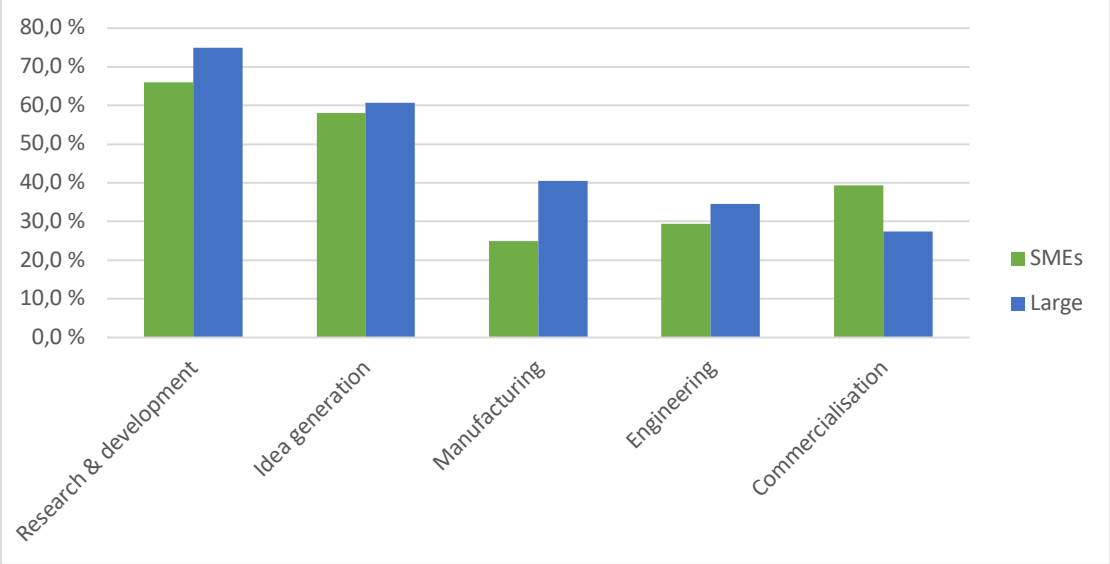

Figure 24. Areas of open innovation collaboration by company sizes.

Outsourcing manufacturing processes for offshore companies can be a beneficial decision in the terms of finance while these kind of actions require capital and right network which is potentially why SMEs does not utilize this collaboration type. Nevertheless, SMES tend to have more open innovation activities in the area of commercialization than large companies. However, this research is not in a line with the results of study concluded by Henttonen and Lehtimäki (2017) where it is stated that SMEs use open

innovation more in the area of commercialization than research and development. Yet, Henttonen's and Lehtimäki's research was concluded for 13 technology based SMEs in forestry sector in Finland which arises concerns if these results can be compared or reflected directly with the target group of this research.

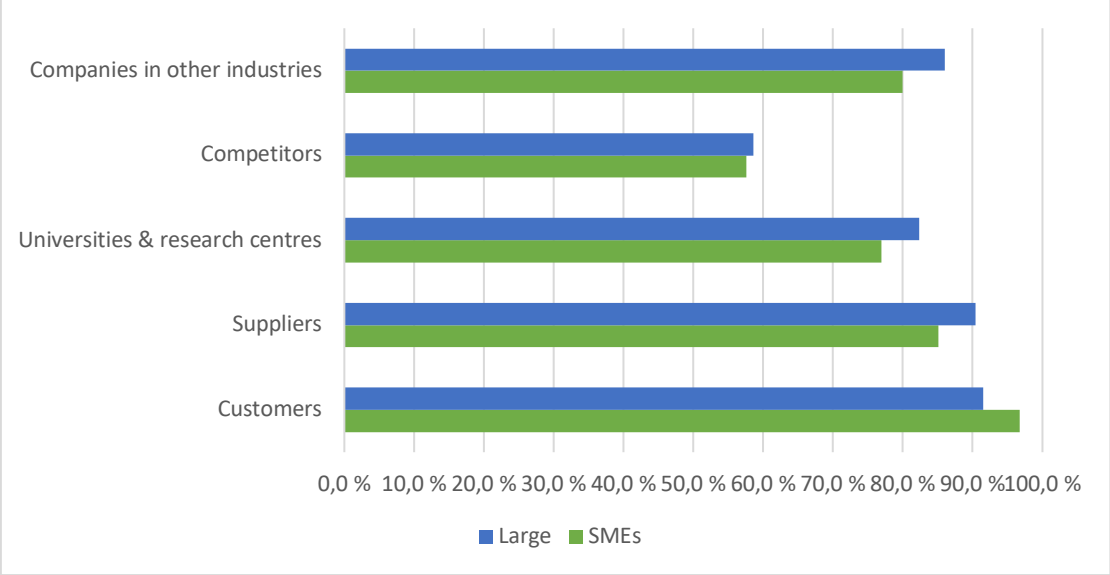

Figure 25. SMEs' and large companies collaboration that resulted in innovation.

SME's and large companies collaboration which was followed by an innovation is presented in the figure 25. The most successful open innovation collaboration was with customers and suppliers while also partnership with the companies in other industries proves to be a considerable option. Still, as the trend of this research indicates, the open innovation activities with competitors does not pay of that usually in both SMEs and large companies. In some cases, collaboration was unsuccessful because of the solutions were not mature enough or then there was low amount of specific product knowledge from outside sources. Also, the process oriented point of view from universities resulted into problems where companies were only expecting positive results or results which they may rationalize. However, in overall, the trends in the figure 25 can be directly reflected into main conclusion of the survey results presented previously in the figure 17.

7 Framework for Overcoming or Avoiding Open Innovation Challenges

In this chapter, the framework for overcoming or avoiding open innovation challenges is presented. In overall, literature around open innovation topic is too often either highly promoting benefits of open innovation or vice versa challenges and barriers are just presented in overall without common practical ways to act while those problems arise. However, just like mentioned in limitations of this research, this framework does not include legal factors. This is due to in different countries, legal regulations may differ and therefore, it is almost impossible to just present overall solutions for these kind of difficulties. Still in other challenge types, in overall, the real change mostly starts from the top management because especially old and routinized ways are hard to be changes just like rooted expectations in overall. However, it should be remembered that not always overcoming or avoiding certain root causes of difficulties is inexpensive and little bit resources consuming process. Vice versa, it may require a lot of different resources like financial and personnel based while also the result may not show immediately.

Higher levels of open innovation activities require large amount of knowledge and resources. Controlling many aspects of open innovation progress becomes more challenging due to the lack of the knowledge base and assets. For this reason, small and medium-sized enterprises (SMEs) face sometimes a less effective side of open innovation. Struggles with the liability of their sizes are creating limitations and leaving them as back markers in the competitive market. Collaboration with other companies allows a huge reservoir of resources for the open innovation activities of small and medium-sized firms. SMEs should be able to cooperate with different sources such as customers, suppliers, universities and competitors. Particularly, the SME strategies of collaborations are suggested to be made at the stage of commercialization (Lee, Park, Yoon & Park, 2010). As it can be understood from the term of SMEs, their size is the boundary of performing in big markets. Additionally, it is evidence of a lack of financial, labor and resource power which can be overcome by cooperation. There-fore, other liabilities such as marketing,

manufacturing, funding which small and medium-sized companies face can be achieved by external-widen knowledge that open innovation provides.

Open innovation provides open activities and knowledge sharing. Research and development (R&D) activities that are made have a strong connection between companies' openness and their innovation performance. Additionally, source sharing allows additional knowledge heterogeneity and is achieved as a consequence of taking into consideration of the significance of an open strategy. On the contrary, companies must protect themselves during external knowledge sharing for innovative developments. For this reason, the reliance on external open innovation activities has been a risk for companies. The role of protecting open innovation and investigating the reliance on external sources have become crucial decision breakers. Protection of different stages of open innovation activities is achieved by using different protection methods. The companies that seek higher levels of innovation performance are aware of the value of external knowledge in open innovation activities while privacy also should be protected at the same time. Therefore, a paradox that was created for the protection of mechanisms of knowledge during open innovation has been invented even though the procedure is not inexpensive and rapid (Obradović, Vlačić & Dabić, 2021).

In the figure 26, framework for dealing with open innovation challenges is presented. This framework provides an overall ground for companies to follow their open innovation activities especially if challenges or barriers are detected. In addition to this, this framework highlights periodical reviewing where companies should explore whether possible challenges occur and make sure that they have all the right tools for open innovation activities. This framework does not focus on procedures open innovation procedures moreover, it has a pure focus on possible challenges and periodic reviewing. The framework starts with open innovation activities which followed by choice of whether open innovation challenges are occurring or not. If there is not challenges occurring then company should make sure that they have right tools for open innovation and further they can continue open innovation actions while remembering periodical reviews.

According to the framework, if company detects open innovation challenges, they should first analyze the overall situation which then helps to find out the reason behind the challenge. After the reason for occurring challenge is found, company should classify and define it while also taking into account whether the same challenge or reason for the challenge has happened before. Classification of the challenge helps companies to find out right tools and personnel for the solving process of the challenge. However, if occurring problem is related to external open innovation partner, then the company should contact the partner and together try to find the root cause for the problem. In other hand, if the occurring problem is not related to external partner for example in the internal cases, then the company should locate the root cause and after that explore different tools and ways to overcome this root cause. Nevertheless, in both scenarios, process is followed by eliminating the root cause of occurring problem and with periodic reviews they should make sure that developments and improvements are successful ones.

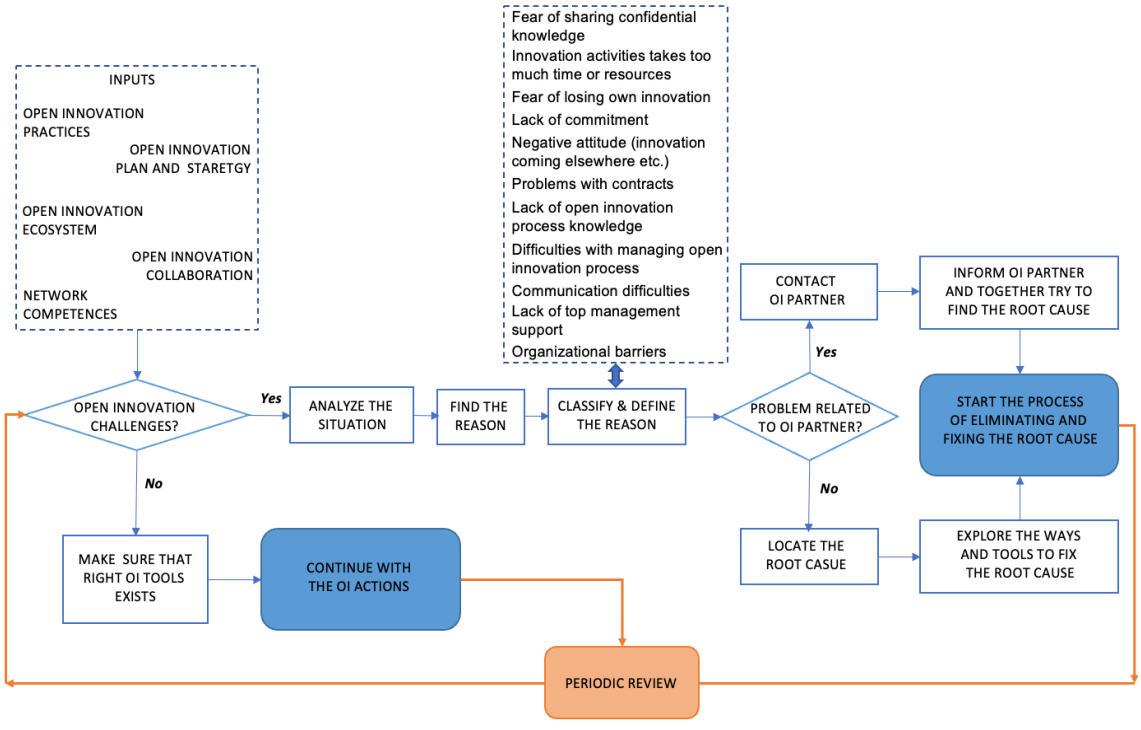

Figure 26. Framework for occurring open innovation challenges.

Traditional management tools of companies were insufficient for open innovation. Therefore an open mindset and arrangeable innovation activities have paved the way for open innovation and development. Previously, experiments and data collected about an innovative activity were based on targets' use experience or needs which were expensive and long processes. Furthermore, developing an idea based on R&D activities were required more resources and they were time-consuming. After the attempt of integrating targets' in the development process assisted innovation work and the creative value increase. Therefore, challenges like time management and the cost of the activity have been overcome by using co-developers such as customers, suppliers, competitors in open innovation activities. Consequently, external information reconsideration and creating a new perception of innovation provide a long-life term when an open innovation idea launches into the market.

From a start-up to large enterprises, companies face the adapting problem from traditional innovation to open innovation. While the stages of innovation are complicated enough, the corporations' collaborations add other challenges to the process. By innovation's nature, the adaptation and execution parts are highly unpredictable. Therefore, the complexity of open innovation reaches another level of uncertainty with additional twists. Fear of sharing internal knowledge and losing control over innovative activities may force companies to make wrong decisions. Gurca et al. (2021) point out that knowledge sharing is one of the main challenges in openness. This barrier makes the processes of open innovation slow down and can be overcome by special treatment. The internal side of corporations should consider open innovation as part of the innovative stages. Otherwise, open innovation activities cannot be achieved by leaving out of the development zones due to fears of companies. Additionally, representing the other parts of the innovative stages provides the process a better conclusion while the open innovation handles its potential talent.

During the management of open innovation activities, the challenges can be both external and internal. Therefore, one of the major problems of open innovation is the attitude

and approach against innovation from internal resources. A social phenomenon called "Not Invented Here (NIH) Syndrome" has been a common tendency during innovation activities among companies (Chesbrough & Crowther, 2006). NIH syndrome can be described as a tendency for organizations or people to reject and underestimate the ideas from external resources. The resistance of external knowledge and examples of some of the rejecting that were made by companies could be evidence of a diagnosis of NIH syndrome. Furthermore, this keeps stunting open innovation in almost every industry in the market. In short, an error during decision-making where companies have a tendency to put more value on their own ideas above outsiders is challenging for innovative developments. Therefore, developing and creating new ideas that come by innovation performance of companies should go without the impediment of these biases. As the adoption of the open innovation stage of a company starts, dealing with NIH syndrome is expected. Internal teams are suggested to overcome this challenge over time. During this process, a structural solution mechanism should be created for effectively solicits ideas and communication skills in a timely manner.

Figure 27. Seven step framework for overcoming open innovation challenges.

Companies may either follow more detailed framework like presented in figure 27 or then at some cases, especially in the cases where problem is not a new one, companies

can follow the seven step framework which is presented in the figure 27. This framework is purely based on occurring challenges which is then followed by defining the problem. After this, the phase of brainstorming and coming up with different solutions are followed where companies are thinking the ways of overcoming occurring challenges. In some cases, like when challenge is not a new one, companies can either use a previously proved successful approach or then with the help of brainstorming try to find a new way to overcome the problem. After this, stakeholders are evaluation and selecting the most suitable solution while also planning for the executions of this plan is made. However, before starting the execution process, stakeholders should first conform the plan while pondering different outcomes and requirements. Here it is important that all the crucial stakeholders are involved to the decision process. After the execution plan is conformed and right personnel assigned, it is time for execution process for overcoming the occurring challenge. Although this framework is clear and quite easy to follow still, company and different stakeholders have to make sure that communication in every stage is sufficient and comprehensive enough.

DMAIC- model is a data-driven development cycle in Six Sigma which includes phases of define, measure, analyze, improve and control (Tong, Tsung & Yen, 2004). This method can be compared to method like Plan-Do-Check-Act and it is a suitable tool for problem solving (de Mast & Lokkerbol, 2012). When Six Sigma processes are implemented in a right way, the results can be remarkable ones in the terms of customer satisfaction and financial profit (Deshmukh & Lakhe, 2009). For example, in the improve part of the DMAIC-process, the main aim is to eliminate the root cause for occurring problem (Pallavi, Malik, Gupta;& Jha, 2018) and the framework for overcoming open innovation challenges is presented in the figure 28 below. The reason why this model was chosen for the framework is because of the nature of model and how it makes improvements while eliminating certain defects. In this model, company is following every step and it is obligatory to pass every step. After the point of analyze, company is evaluating whether redesign is necessary or not. If it is necessary, then process starts again from the measure

phase and follows same the path. Otherwise, company just continues with the model in the normal order.

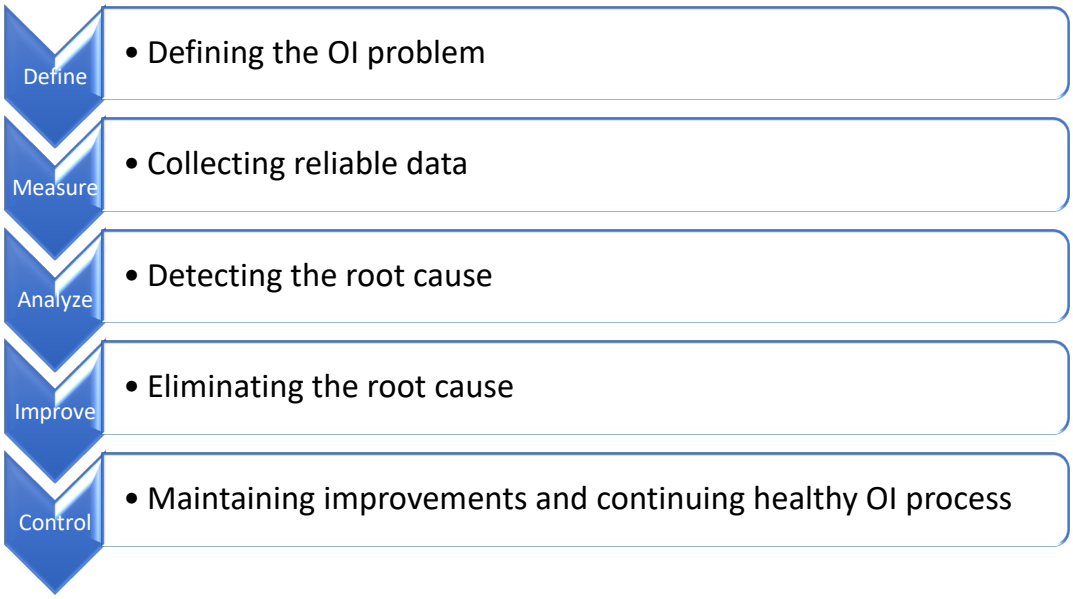

Figure 28. DMAIC-model for eliminating open innovation problems.

The DMAIC-model for eliminating open innovation problems begins with the defining the open innovation problem while problem statement will be made. Also, it company should make sure that the objectives and the scope of the process is well known. After this the second step is collecting reliable data by measuring the performance of current status and documenting all the necessary data. Here, also all the possible defect reason are listed while in the analyze part company's aim is to identify and further analyze the root cause. Advantageous ways for this are for instance statistical analysis, cause and effect analysis and failure mode and effects analysis. In the improve part, company aims to eliminate the root cause by implementing selected potential solutions. Here, company may use also piloting and evaluation of solutions. At the last step, the main aim is to both control and to maintain implemented improvements while also continuing the healthy OI process. Here, improvements can be maintained by for example using the tools of the 5's of lean, statistical process control for monitoring, creating a quality control plan or using control chart. The persons who are involved in the improvement process should be trained well enough including also other stakeholders to the improvement project.

8 Conclusion of the Study

The final chapter of this research is summarizing the objectives and findings of the study. Moreover, main findings both from literature and the survey results are going to be concluded for validations of the research question and objectives. Lastly, conclusion part of the study is concluded with the possible future opportunities and recommendations.

The research gap between large enterprises and SMEs has been covered well during the last years while different, trends and benefits are recognized well. Also, in literature there is a broad amount of researches which focus on specific open innovation challenges like NIH syndrome (Chesbrough & Crowther, 2006), lack of internal commitment (Van de Vrande, De Jong, Vanhaverbeke & De Rochemont, 2009) and fear of exploiting confidential knowledge (Rouyre & Fernandez, 2019). However, amount of researches in where a wider view of different challenges which companies face both before and during the open innovation activities is not high. Therefore, this study aims to fill this gap in research where based on some factors like size of the company or the industry where company is operating in is not limited out of the study. The database of this study includes 196 survey responses from the countries of Turkey, Russia and India. Because innovation is part of every sized companies actions, therefore limitations are set just on the presence of open innovation activities during the last five years.

This study shows that value-chain stakeholders like customer and suppliers have a great impact in both SMEs and large companies where open innovation collaboration was quite successful in the terms of new innovation. Also, unlike usually thought, SMEs are able to have successful open innovation activities while handling external pressure with simpler decision-making processes, better communication and market driven mind. Additionally, it is not unusual that other companies than high-technology based companies are practicing open innovation activities while the research concluded by Chesbrough and Brunswicker (2013) show that by the year 2013 even almost four-fifths of respondents had open innovation activities in some capacity.

It is clear that open innovation brings a lot of opportunities but at the same time it brings more complexity into innovation management. For example, there is a lot of succesful stories where exploiting too much information was seen first as a negative thing but further the value from this was captured and utilized. Chesbrough (2011) brings out good example of this where LEGO started to produce programmable motors for their parts but later because of the hacking ways to illegally program these pieces got published. Later LEGO captured the opportunity of this by publishing a software which made it possible to modify the programing of these motored LEGO pieces.

This research maps out and comparing different challenges which companies face both before and during the open innovation activities. In the figure 29 below, concluded share of different challenges which different subgroups face before the open innovation activities are presented. From this figure it is quite easy to see whether some trends are existing in between different groups. For example, fear of sharing confidential knowledge tends to be the most common challenge which companies face while communication difficulties lack of open innovation process knowledge seems to have quite similar share in every subgroup.

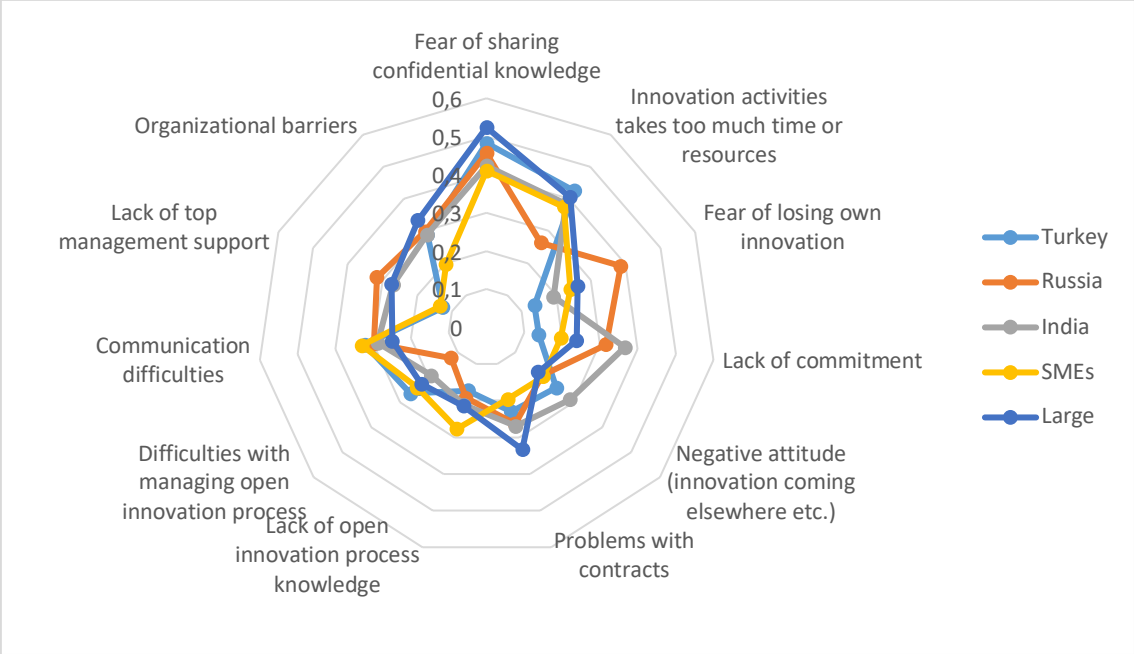

Figure 29. Challenges faced by groups before the open innovation activities.

In figure 30, challenges which different subgroups face during the open innovation activities is listed. Just like in figure 20, fear of sharing confidential knowledge continues to be the most common challenge which companies face during the open innovation activities. Gurca et al. (2021) states that in complicated projects, sharing of knowledge is required across organizational borderlines while it may bring out challenges. In this research, SMEs and large companies tend to have more similar trend almost in half of the challenges appearing. However, especially one similar trend, which is visible in the literature, can be highlighted from the results; the share of negative attitude is increasing from the before open innovation activities shares. This indicates that in companies, resistance towards implementation or usage of external knowledge is existing. Therefore, regardless the country, industry or size of the company, top management should try to find the root cause for this problem and put enough effort on eliminating it.

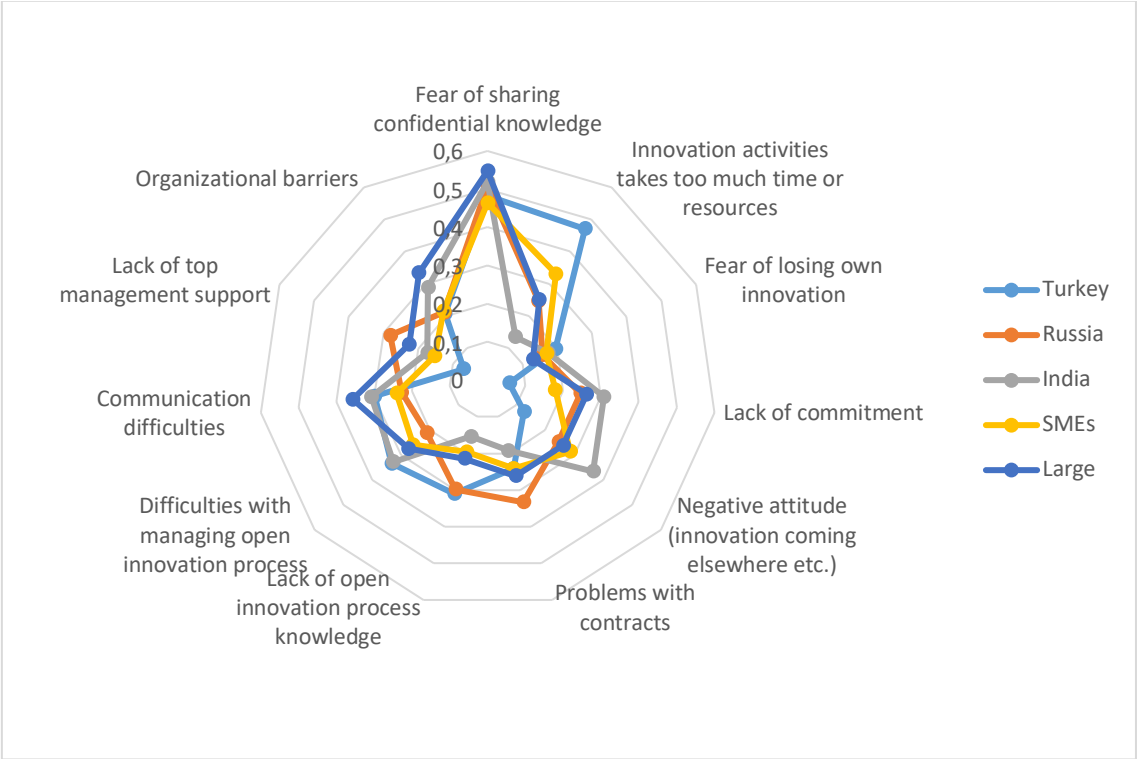

Figure 30. Challenges faced by groups during the open innovation activities.

This research provide three different frameworks for overcoming different challenges occurring while practicing open innovation activities. Every three of those frameworks

are highly related to occurring problems where the main idea is to both eliminate the root cause of the problem while maintaining improvements. In overall, it does not matter which of the three frameworks company implements to its open innovation practices; company should use the one which suits its situation the best and further try to react as quickly as possible for occurring challenges.

8.1 Main takeaways of the research

In overall, companies see pretty well value in innovation and open innovation activities while taking advantage of these innovation strategies. However, companies tend to face different challenges or barriers in both before and during the open innovation activities which the further may drive companies to fail in collaboration projects. These drivers of failure in companies' open innovation systems according to this research are: firms' lack of understanding of the potential benefits of OI; a lack of information about the capabilities of potential partners; and lastly, a lack of information about the trustworthiness of potential partners.

One of the main themes in open innovation challenges which can be concluded from the trend of the challenges is that the share of fear of sharing confidential knowledge is increasing while starting executing the open innovation activities. In addition, this trend is not linked to just for company size or country. Moreover, the same increasing and high possessing theme is visible in every case country and size of the company. Therefore, it should be proposed that companies should not put all the effort into hiding knowledge, rather they should have more focus into how to innovate and develop. If companies are just focusing too much on hiding all the valuable information they may fall behind the main rivals in the competition environment. Also, there exists some success stories where companies exploited too much confidential information but then later overturned this unfortunate situation as their advantage by for example exploiting all the information while creating a new market opportunities.

In addition to the fear of sharing confidential knowledge, also negative attitudes like not-invented-here syndrome was possessing a high impact in companies open innovation activities. This negative attitude can be described in as a tendency to underrate external information from different sources. The solution for this problem starts usually from the top management while communication plays a key role. Management should focus on changing the company culture while providing enough information of why implementing external ideas is an useful idea compared to another available solutions. Still, it should be remembered that removing this problem can take both resources and time while results may not show up directly.

From the open innovation collaboration, activities with customers is the most successful one while on other hand collaboration with competitors does not always make the dream work. While working with the customers, companies may acquire more direct information of what customers want and what they value. Therefore, for example companies may take advantage of combining both open innovation and servitization. In other hand, collaboration with competitors was usually unsuccessful due to fear of sharing confidential information and difficulties of managing these open innovation processes. Also, in overall, companies in different sector and case countries faced this challenge of managing open innovation processes. Here, survey participant pointed out the role of legal issues, being efficient with the process and lack of existence of efficient structure. Similarly, companies sometimes felt that they were having open innovation activities with wrong external partner mostly due to lack of realizing the capabilities of potential partners.

Lastly, three different frameworks were developed in the case of challenges occurring in open innovation activities. Every framework developed in this research is relies highly on the existence of occurring challenges or barriers while highlighting the importance of maintaining improvements and having periodical reviews. While the stages of innovation can appear to be complicated, companies collaborations with external partners add other challenges to this process. Therefore, especially when occurring challenge is

related to open innovation partner, company should collaborate in both finding and eliminating the root cause of the occurring problem with the partner. After this, companies should not rely on the thought that similar problems will not arise again. Moreover, they should maintain and analyze the situation with the help of for instance statistical process control tools and creating a quality control plan. Companies should also note that improvement processes can be made in collaboration relations and internal processes but sometimes the main origin for challenges can be in cultural barriers. Therefore, companies should align with open innovation practices and portfolio with their goals and organizational strategy where innovations are seen as an opportunity alongside the collaboration.

8.2 Future research and recommendations

Open innovation can be seen a fascinating and important part of obtaining competitive advantage in the business environment. With the successful open innovation activities companies may create a new product or service, build a strong innovation ecosystem, reduce different costs or find a new revenue streams. Still, as this research shows, companies face different challenges related to open innovation activities at different stages of this collaboration process. Therefore, for instance, the share of different challenges faced in different industries in a wide range can be an interesting subject for a research. This research takes just an overall glance on this however, due to low sample size the results are just guiding ones.

Usually, the investments on R&D is a well-known indicator for innovativeness while many companies try to follow this trend. Companies may try to spend a lot on R&D while hoping to innovate better and more. Still, not always expenses on R&D follow with innovation results and therefore, it would be interesting to find out whether there is a correlation between R&D investments and innovativeness. Moreover, this research just explores innovativeness from innovation success point of view where collaboration is seen successful when it ends up with innovation.

References

Abdulsaleh, A. M. & Worthington, A. C. (2013). Small and medium-sized enterprises financing: *A review of literature. International Journal of Business and Management*, 8(14), 36.

Abulrub, A. H. G. & Lee, J. (2012). Open innovation management: challenges and prospects. *Procedia-Social and Behavioral Sciences*, 41, 130-138.

Ahmed, S., Halim, H. A. & Ahmad, N. H. (2018). Open and closed innovation and enhanced performance of SME hospitals—A conceptual model. *Business Perspectives and Research*, 6(1), 1-12.

Ahn, J. M., Ju, Y., Moon, T. H., Minshall, T., Probert, D., Sohn, S. Y. & Mortara, L. (2016). Beyond absorptive capacity in open innovation process: the relationships between openness, capacities and firm performance. Technology Analysis & Strategic Management, 28(9), 1009-1028.

Ahn, J. M., Minshall, T. & Mortara, L. (2017). Understanding the human side of openness: the fit between open innovation modes and CEO characteristics. *R&D Management*, 47(5), 727-740.

Albats, E., Alexander, A., Mahdad, M., Miller, K. & Post, G. (2020). Stakeholder management in SME open innovation: interdependences and strategic actions. *Journal of Business Research*, 119, 291-201.

Alexeev, M. & Weber, S. (2013). The Oxford handbook of the Russian economy. New York: Oxford University Press.

Alsos, G. A., Eide, D. & Madsen, E. L. (2014). Handbook of research on innovation in tourism industries. Cheltenham, UK: Edward Elgar Publishing.

Antikainen, M., Mäkipää, M. & Ahonen, M. (2010). Motivating and supporting collaboration in open innovation. *European Journal of Innovation Management*, 13(1), 100-119.

Antons, D. & Piller, F. T. (2015). Opening the black box of “not invented here”: Attitudes, decision biases, and behavioral consequences. *Academy of Management Perspectives*, 29(2), 193-217.

Appleyard, M. M. & Chesbrough, H. W. (2017). The Dynamics of Open Strategy: From Adoption to Reversion. *Long Range Planning*, 50(3), 310-321.

Archibugi, D., Filippetti, A., & Frenz, M. (2013). Economic crisis and innovation: is destruction prevailing over accumulation?. *Research Policy*, 42(2), 303-314.

Badir, Y. F., Frank, B. & Bogers, M. (2020). Employee-level open innovation in emerging markets: linking internal, external, and managerial resources. *Journal of the Academy of Marketing Science* , 48, 891-913.

Balasubramanyam, V. N. (2019). The economy of India. New York: Routledge.

Barbara, B. & Galati, F. (2013). Models of adoption of open innovation within the food industry. *Trends in Food Science & Technology*, 30(1), 16-26.

Bertelllo, A., Ferraris, A., De Bernardi, P. & Bertoldi, B. (2021). Challenges to open innovation in traditional SMEs: an analysis of pre-competitive projects in university-industry-government collaboration. *International Entrepreneurship and Management Journal*, 1-16.

Bigliardi, B., Dormio, A. I. & Galati, F. (2012). The adoption of open innovation within the telecommunication industry. *European Journal of Innovation Management*, 15(1), 27-54.

Bigliardi, B., Dormio, A. I. & Galati, F. (2012). The adoption of open innovation within the telecommunication industry. *European Journal of Innovation Management*, 15(1), 27-54.

Bigliardi, B., Ferraro, G., Filippelli, S. & Galati, F. (2020). The influence of open innovation on firm performance. *International Journal of Engineering Business Management*, 12(1), 1-14.

Bogers, M., Burcharth, A. & Chesbrough, H. (2019). Open innovation in Brazil: Exploring opportunities and challenges. *International Journal of Innovation*, 7(2), 178-191.

Bogers, M., Chesbrough, H., & Strand, R. (2020). Sustainable open innovation to address a grand challenge: Lessons from Carlsberg and the Green Fiber Bottle. *British Food Journal*, 122(5), 1505-1517.

Borgatti, S. P. & Halgin, D. S. (2011). On network theory. Organization science, 22(5), 1168-1181.

Borowski, P. F. (2021). Innovation strategy on the example of companies using bamboo. *Journal of Innovation and Entrepreneurship*, 10(3), 1-17.

Boyne, G. A. (2002). Public and private management: what's the difference? *Journal of management studies*, 39(1), 97-122.

Brem, A., Nylund, P. A. & Hitchen, E. L. (2017). Open innovation and intellectual property rights: How do SMEs benefit from patents, industrial designs, trademarks and copyrights? *Management Decision*, 55(6), 1285-1306.

Brunswicker, S. & Chesbrough, H. (2018). The Adoption of Open Innovation in Large Firms: Practices, Measures, and Risks A survey of large firms examines how firms approach open innovation strategically and manage knowledge flows at the project level. *Research-Technology Management*, 61(1), 34-45.

Buchanan, E. A., & Hvizdak, E. E. (2009). Online survey tools: Ethical and methodological concerns of human research ethics committees. *Journal of empirical research on human research ethics*, 4(2), 37-48.

Bullinger, A. C., Rass, M., Adamczyk, S., Moeslein, K. M. & Sohn, S. (2012). Open innovation in health care: Analysis of an open health platform. *Health Policy*, 105(2-3), 165-175.

Carlson, K. D. & Herdman, A. O. (2012). Understanding the impact of convergent validity on research results. *Organizational Research Methods*, 15(1), 17-32.

Cervantes, M. & Meissner, D. (2014). Commercialising public research under the open innovation model: new trends. *Foresight-Russia*, 8(3), 70-81.

Cetindamar, D. & Ulusoy, G. (2008). Innovation performance and partnerships in manufacturing firms in Turkey. *Journal of Manufacturing Technology Management*, 19(3), 332-345.

Chattopadhyay, D. (2020). Financing innovation in India: challenges and opportunities . (W. W. Organization producer) Retrieved 17. May 2021 from The global innovation index 2020: Who will finance innovation?: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020-chapter13.pdf

Chesbrough, H. (2004). Managing open innovation. *Research Technology Management*, 47(1), 23-26.

Chesbrough, H. (2006). Open business models: How to thrive in the new innovation landscape. Boston, Massachusetts: Harvard Business Press.

Chesbrough, H. (2006). Open innovation: a new paradigm for understanding industrial innovation. Open innovation: Researching a new paradigm, 0-19.

Chesbrough, H. (2012). Open innovation: Where we've been and where we're going. *Research-Technology Management*, 55(4), 20-27.

Chesbrough, H. W. (2003). Open innovation: The new imperative for creating and profiting from technology. Boston, Massachusetts: Harvard Business Press.

Chesbrough, H. W. (2003). The era of open innovation. *MIT Sloan Management Review*, 44(3), 35-41.

Chesbrough, H. W. (2007). Why companies should have open business models. *MIT Sloan management review*, 48(2), 22-28.

Chesbrough, H. W. & Appleyard, M. M. (2007). Open innovation and strategy. *California management review*, 50(1), 57-76.

Chesbrough, H. & Bogers, M. (2014). Explicating open innovation: Clarifying an emerging paradigm for understanding innovation. New Frontiers in Open Innovation. Oxford: Oxford University Press, Forthcoming, 3-28.

Chesbrough, H. & Brunswicker, S. (2013). Chesbrough, H., & Brunswicker, S. (2013). Managing open innovation in large firms. Garwood Center for Corporate Innovation at California University, Berkeley in US & Fraunhofer Society in Germany.

Chesbrough, H. & Brunswicker, S. (2014). A fad or a phenomenon?: The adoption of open innovation practices in large firms. *Research-Technology Management*, 57(2), 16-25.

Chesbrough, H. & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries*. R&d Management*, 36(3), 229-236.

Chiaroni, D., Chiesa, V., & Frattini, F. (2011). The Open Innovation Journey: How firms dynamically implement the emerging innovation management paradigm. *Technovation*, 31(1), 34-43.

Christensen, J. F., Olesen, M. H. & Kjær, J. S. (2005). The industrial dynamics of Open Innovation—Evidence from the transformation of consumer electronics. *Research policy*, 34(10), 1533-1549.

Clò, S., Florio, M. & Rentocchini, F. (2020). Firm ownership, quality of government and innovation: Evidence from patenting in the telecommunication industry. *Research Policy*, 49(5), 103960.

Cloodt, M., Hagedoorn, J. & Roijakkers, N. (2010). Inter-firm R&D networks in the global software industry: An overview of major trends and patterns. *Business History*, 52(1), 120-149.

Cornell University, INSEAD & World Intellectual Property Organization. (2020). Global Innovation Index 2020: Who Will Finance Innovation? (S. Dutta, B. Lanvin & S. Wunsch-Vincent supplier.) Redeemed 2021. May 16 from https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf

Crescenzi, R. & Jaax, A. (2017). Innovation in Russia: the territorial dimension. *Economic geography*, 93(1), 66-88.

Crupi, A., Del Sarto, N., Di Minin, A., Phaal, R. & Piccaluga, A. (2020). Open innovation environments as knowledge sharing enablers: the case of strategic technology and innovative management consortium. *Journal of Knowledge Management.*

Dahlander, L. & Gann, D. M. (2010). How open is innovation? *Research policy*, 39(6), 699-709.

Dahlander, L., Gann, D. M. & Wallin, M. W. (2021). How open is innovation? A retrospective and ideas forward. *Research policy*, 50(4), 104218.

Dahlander, L., O'Mahony, S. & Gann, D. M. (2016). One foot in, one foot out: how does individuals' external search breadth affect innovation outcomes? *Strategic Management Journal*, 37(2), 280-302.

Davila, T., Epstein, M. & Shelton, R. (2012). Making innovation work: How to manage it, measure it, and profit from it. FT press; Updated edition.

De Mast, J. & Lokkerbol, J. (2012). An analysis of the Six Sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics*, 139(2), 604-614.

De Paulo, A. F., Carvalho, L. C., Costa, M. T., Lopes, J. E. & Galina, S. V. (2017). Mapping open innovation: A bibliometric review to compare developed and emerging countries. *Global Business Review*, 18(2), 291-307.

De Wit, G. & Bosma, N. (2014). The influence of innovation on firm size. SCALES-paper N200318.

Del Vecchio, P., Mele, G., Ndou, V. & Secundo, G. (2018). Open Innovation and Social Big Data for Sustainability: Evidence from the Tourism Industry. *Sustainability*, 10(9), 3215.

Demil, B. & Lecocq, X. (2010). Business model evolution: in search of dynamic consistency. *Long range planning*, 43(2-3), 227-246.

Demirbağ, K. Ş. & Yildirim, N. (2018). Barriers to Openness: The Case of Technology Development Zone Companies. *The Journal of International Scientific Researches*, 3(1), 29-50.

Den Hertog, P. & Bilderbeek, R. (1999). Conceptualising service innovation and service innovation patterns. Utrecht: Research Programme on Innovation in Services (SIID) for the Ministry of Economic Affairs.

Deshmukh, S. V. & Lakhe, R. R. (2009). An innovative model of Six Sigma for SMEs: the T-DMAIC model. *International Journal of Six Sigma and Competitive Advantage*, 5(2), 187-203.

Doblin. (2015). Ten Types of Innovation. Deloitte Development LLC.

Drechsler, W. & Natter, M. (2012). Understanding a firm's openness decisions in innovation. *Journal of Business Research*, 65(3), 438-445.

Du Chantenier, E., Verstegen, J. A., Biemans, H. J., Mulder, M. & Omta, O. (2009). The challenges of collaborative knowledge creation in open innovation teams. *Human Resource Development Review*, 8(3), 350-381.

Du, J., Leten, B. & Vanhaverbeke, W. (2014). Managing open innovation projects with science-based and market-based partners. *Research Policy*, 43(5), 828-840.

Du, J., Zheng, Q. & Chang, X. (2020). Dynamic process: international diversification and innovation performance from emerging economies. *Asian Journal of Technology Innovation*, 28(2), 234-250.

Dziurski, P. & Sopińska, A. (2020). Does industry matter? Drivers and barriers for open innovation in high-tech and non-high-tech industries-Evidence from Poland. *International Journal of Management and Economics*, 56(4), 307-323.

EBRD. (2012). Diversifying Russia: Harnessing Regional Diversity. London: European Bank for Reconstruction and Development.

Elia, A., Kamidelivand, M., Rogan, F. & Gallachóir, B. Ó. (2020). Impacts of innovation on renewable energy technology cost reductions. *Renewable and Sustainable Energy Reviews*, 138, 110488.

Elmquist, M., Fredberg, T. & Ollila, S. (2009). Exploring the Field of Open Innovation. *European Journal of Innovation Management*, 12(3), 326-345.

Enkel, E. & Gassmann, O. (2008). Driving open innovation in the front end: the IBM Case. St. Gallen and Friedrichshafen: Working paper University of St. Gallen and Zeppelin University.

Enkel, E., Gassmann, O. & Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&d Management*, 39(4), 311-316.

Ettlie, J. E., Bridges, W. P. & O'keefe, R. D. (1984). Organization strategy and structural differences for radical versus incremental innovation. *Management science*, 30(6), 682-695.

Fabrício Jr, R., da Silva, F. R., Simões, E., Galegale, N. V. & Akabane, G. K. (2015). Strengthening of Open Innovation Model: using startups and technology parks. *IFAC-PapersOnLine*, 48(3), 14-20.

Fajsia, A. & Morač, S. (2015). Open innovation in manufacturing SMEs-integration into value networks. *Annals of DAAAM & Proceedings*, 26(1), 1076-1081.

Felin, T. & Zenger, T. R. (2020). Open Innovation: A Theory-Based View. *Strategic Management Review*, 1(2), 223-232.

Fu, X., Li, J., Xiong, H. & Chesbrough, H. (2014). Open innovation as a response to constraints and risks: evidence from China. *Asian Economic Papers*, 13(3), 30-58.

Gaddis, S. E. (1998). How to design online surveys. *Training & Development*, *52*(6), 67-72.

Galati, F., Bigliardi, B. & Petroni, A. (2016). Open innovation in food firms: Implementation strategies, drivers and enabling factors. *International Journal of Innovation Management*, 20(3), 1650042.

Galia, F. & Legros, D. (2004). Complementarities between obstacles to innovation: evidence from France. *Research policy*, 33(8), 1185-1199.

Gammeltoft, P. (2006). Internationalisation of R&D: trends, drivers and managerial challenges. *International journal of technology and globalisation*, 2(1-2), 177-199.

Gann, D. (2001). Putting academic ideas into practice: technological progress and the absorptive capacity of construction organizations. *Construction Management & Economics*, 19(3), 321-330.

Gassmann, O. & Enkel, E. (2004). Towards a theory of open innovation: three core process archetypes. R&D Management Conference (RADMA) 2004. Lissabon.

Gassmann, O., Enkel, E. & Chesbrough, H. (2010). The future of open innovation. *R&d Management,* 40(3), 213-221.

Gay, B. (2014). Open innovation, networking, and business model dynamics: the two sides. *Journal of Innovation and Entrepreneurship*, 3(1), 1-20.

Ghaston, I. & Scott, G. J. (2012). Entrepreneurship and open innovation in an emerging economy. *Management Decision*, 50(7), 1161-1177.

Giannopoulou, E., Yström, A. & Ollila, S. (2011). Turning open innovation into practice: Open innovation research through the lens of managers. *International Journal of Innovation Management*, 15(3), 505-524.

Giannopoulou, E., Yström, A., Ollila, S., Fredberg, T. & Elmquist, M. (2010). Implications of Openness: A Study into (All) the Growing Literature on Open Innovation. *Journal of Technology Management & Innovation*, 5(3).

Gnyawali, D. R. & Park, B.-J. R. (2011). Co-opetition between giants: Collaboration with competitors for technological innovation. *Research policy*, 40(5), 650-663.

Gomes, C. M., Isak, K. & Scherer, F. L. (2009). The Company Size Effect in Innovative Performance. *Journal of Technology Management and Innovation*, 4(4), 14-31.

Grewal, D., Hulland, J., Kopalle, P. K. & Karahanna, E. (2020). The future of technology and marketing: a multidisciplinary perspective. *Journal of the Academy of Marketing Science*, 48, 1-8.

Grishunin, S. & Suloeva, S. (2015). Project Controlling in Telecommunication Industry. Internet of Things, Smart Spaces, and Next Generation Networks and Systems. 9247, ss. 573-584. St. Petersburg: Springer, Cham.

Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). *Survey methodology* (Vol. 561). John Wiley & Sons.

Gruber, M. & Henkel, J. (2006). New ventures based on open innovation–an empirical analysis of start-up firms in embedded Linux. *International Journal of Technology Management*, 33(4), 356-372.

Guba, E. G. & Lincoln, Y. S. (1989). *Fourth generation evaluation.* Newbury Park, CA: Sage.

Gudanowska, A. E., Alonso, J. P. & Törmänen, A. (2018). What competencies are needed in the production industry? The case of the Podlaskie Region. *Engineering Management in Production and Services*, 10(1), 65-74.

Guegan, D., Hassani, B. & Zhao, X. (2014). Emerging countries sovereign rating adjustment using market information: Impact on financial institutions investment decisions. In M. E. Arouri, S. Boubaker & D. K. Nguyen, Emerging Markets and the Global Economy: A Handbook (p. 17-31). Oxford, UK: Academic Press.

Guertler, M. R., Von Saucken, C., Schneider, M. & Lindemann, U. (2015). How to search for Open Innovation partners? Proceedings of the 20th International Conference on Engineering Design (ICED15), 8, ss. 021-030. Milan, Italy.

Gurca, A., Bagherzadeh, M., Markovic, S., & Koporcic, N. (2021). Managing the challenges of business-to-business open innovation in complex projects: A multi-stage process model. *Industrial Marketing Management*, 94, 202-215.

Gutiérrez-García, E., Recalde, M. & Alfaro, J. A. (2020). Corporate communication in open innovation: a case-study of three multinationals. Corporate Communications: An International Journal.

Haase, Inga. (2019). Open innovation: Challenges of Integrating new forms of innovation in SMEs. In *Open innovation and entrepreneurship* (p. 89-107). Springer, Cham.

Hagedoorn, J. & Zobel, A.-K. (2015). The role of contracts and intellectual property rights in open innovation. *Technology Analysis & Strategic Management*, 27(9), 1050-1067.

Hagedoorn, J., Roijakkers, N. & Kranenburg, H. V. (2006). Inter-Firm R&D Networks: the Importance of Strategic Network Capabilities for High-Tech Partnership Formation. *British Journal of Management*, 17(1), 39-53.

Hameed, W. U., Nisar, Q. A. & Wu, H.-C. (2021). Relationships between external knowledge, internal innovation, firms' open innovation performance, service innovation and business performance in the Pakistani hotel industry. *International Journal of Hospitality Management*, 92, 102745.

Hameed, W. U., Altaf, M. & Ahmed, A. (2019). Open innovation challenges: Empirical evidence from Malaysian small and medium-sized enterprises (SME's). *Journal of Management Research*, 6(1), 28-53.

Han, K., Oh, W., Im, K. S., Chang, R. M., Oh, H. & Pinsonneault, A. (2012). Value cocreation and wealth spillover in open innovation alliances. *MIS Quarterly*, 36(1), 291-315.

Hannen, J., Antons, D., Piller, F., Salge, T. O., Coltman, T. & Devinney, T. M. (2019). Containing the Not-Invented-Here Syndrome in external knowledge absorption and open innovation: The role of indirect countermeasures. *Research Policy*, 48(9), 103822.

Hara, T. (2003). Innovation in the pharmaceutical industry: the process of drug discovery and development. Gloucestershire, UK: Edward Elgar Publishing.

Harmsen, J., De Haan, A. B. & Swinkels, P. L. (2018). Product and process design: Driving innovation. Berlin/Boston: Walter de Gruyter GmbH & Co KG.

Henkel, J., Schöberl, S. & Alexy, O. (2014). The emergence of openness: How and why firms adopt selective revealing in open innovation. *Research Policy*, 43(5), 879-890.

Henttonen, K. & Lehtimäki, H. (2017). Open innovation in SMEs: Collaboration modes and strategies for commercialization in technology-intensive companies in forestry industry. *European Journal of Innovation Management*, 20(2), 329-247.

Herskovits, R., Grijalbo, M. & Tafur, J. (2013). Understanding the main drivers of value creation in an open innovation program. *International Entrepreneurship and Management Journal*, 9(4), 631-640.

Herzog, P. (2011). Open and closed innovation: Different cultures for different strategies (2nd edition p.). Germany: Springer Science & Business Media.

Hevia, C. & Neumeyer, A. (2020). A perfect storm: COVID-19 in emerging economies. (S. Djankov & U. Panizza) COVID-19 in Developing Economies, 25-37.

Hofstede, G. (2001). Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations (2nd edition p.). Thousand Oaks, California: Sage Publications.

Hofstetter, R., Dahl, D. W., Aryobsei, S. & Herrmann, A. (2021). Constraining Ideas: How Seeing Ideas of Others Harms Creativity in Open Innovation. *Journal of Marketing Research*, 58(1), 95-114.

Hoskisson, R. E., Eden, L., Lau, C. M. & Wright, M. (2000). Strategy in emerging economies. *Academy of management journal*, 43(3), 249-267.

Howells, J. (2011). Services and innovation and service innovation: new theoretical directions. In F. Gallouj & F. Djellal, The handbook of innovation and services: a multi-disciplinary perspective (p. 68-69). Cheltenham, UK: Edward Elgar Publishing.

Huang, S., Chen, J. & Liang, L. (2018). How open innovation performance responds to partner heterogeneity in China. *Management Decision*, 56(1), 26-46.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation*, 31(1), 2-9.

Huston, L. & Sakkab, N. (2006). Connect and Develop: Inside Procter & Gamble's New Model for Innovation. *Harvard business review*, 84(3), 58-66.

International Monetary Fund. (April 2021). World Economic Outlook: Managing Divergent Recoveries.

Iqbal, J. & Hameed, W. U. (2020). Open Innovation Challenges and Coopetition-Based Open-Innovation Empirical Evidence From Malaysia. *Innovative Management and Business Practices in Asia*, 144-166.

Janeiro, P., Proença, I. & Conceição Gonçalves, V. d. (2013). Open innovation: Factors explaining universities as service firm innovation sources. *Journal of Business Research*, 66(10), 2017-2023.

Johansson, C. & Larsson, T. (2009). Implementation of open innovation practices in Swedish manufacturing industry. Conference on Engineering Design: 24/08/2009-27/08/2009. 1, 435-446. Stanford: Design Research Society.

Johnstone, N., Haščič, I. & Popp, D. (2010). Renewable energy policies and technological innovation: evidence based on patent counts. *Environmental and resource economics*, 45(1), 133-155.

Joshi, A. W. & Sharma, S. (2004). Customer knowledge development: antecedents and impact on new product performance. *Journal of marketing*, 68(4), 47-59.

Kafouros, M. I. & Forsans, N. (2012). The role of open innovation in emerging economies: Do companies profit from the scientific knowledge of others? *Journal of World Business*, 47(3), 362-370.

Kanungo, R. P., Rowley, C. & Banerjee, A. N. (2018). Changing the Indian Economy: Renewal, Reform and Revival. Amsterdam, Netherlands: Elsevier.

Karahan, M. & Karhan, G. (2013). A case study on innovation activities in Turkey and the obstacles for innovation. *Procedia-social and behavioral sciences*, 75, 129-138.

Kazemargi, N., Cerruti, C. & Appolloni, A. (2016). Adopting open innovation in supply networks. *International Journal of Management and Enterprise Development*, 15(2-3), 174-190.

Keeley, L., Walters, H., Pikkel, R. & Quinn, B. (2013). Ten Types of Innovation: The Discipline of Building Breakthroughs. Hoboken, New Jersey: John Wiley & Sons.

Keupp, M. M. & Gassmann, O. (2009). Determinants and archetype users of open innovation. *R&d Management*, 39(4), 331-341.

Khosropour, H., Feizi, K., Tabaeean, K. & Taheri, Z. (2015). The Effect of Open Innovation on Technology Intelligence in Aviation Industry of Iran. *Science, Technology and Society*, 20(1), 89-113.

Kleiner-Schäfer, T. & Liefner, I. (2021). nnovation success in an emerging economy: A comparison of R&D-oriented companies in Turkey. *Growth and Change*, 52(1).

Kline, S. J. & Rosenberg, N. (2010). An Overview of Innovation. Studies on science and the innovation process: Selected works of Nathan Rosenberg, 173-203.

Koberg, C. S., Detienne, D. R. & Heppard, K. A. (2003). An empirical test of environmental, organizational, and process factors affecting incremental and radical innovation. *The Journal of High Technology Management Research*, 14(1), 21-45.

Kubitschko, S. & Kaun, A. (2016). Innovative methods in media and communication research. In An Introduction to Innovative Methods in Media and Communication Research (p. 1-3). Cham, Switzerland: Springer International Publishing.

Kumar, N. & Puranam, P. (2012). India inside: The emerging innovation challenge to the West. Boston, Massachusetts: Harvard Business Press.

Kumar, P., Reinitz, H. W., Simunovic, J., Sandeep, K. P. & Franzon, P. D. (2009). Overview of RFID technology and its applications in the food industry. *Journal of Food Science*, 74(8), R101-R106.

Küng , L. (2008). Innovation and Creativity in the Media Industry: What? Where? How? In C. Dal Zotto & H. Van Kranenburg, Management and innovation in the media industry (p. 3-6). Northampton, Massachusetts, USa: Edward Elgar Publishing.

Lahi, A. & Elenurm, T. (2015). SME open innovation implicating factors in different innovation phases. The International Journal *of Management Science and Information Technology (IJMSIT)* (16), p. 29-45.

Lakshmi, S. & Mohideen, M. A. (2013). Issues in reliabilityand validity of research. *International journal of management research and reviews*, 3(4), 2752.

Lam, L., Nguyen, P., Le, N. & Tran, K. (2021). The relation among organizational culture, knowledge management, and innovation capability: Its implication for open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), 16.

Laursen, K. & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic management journal*, 27(2), 131-150.

Leckel, A., Veilleux, S. & Dana, L. P. (2020). Local open innovation: a means for public policy to increase collaboration for innovation in SMEs. Technological Forecasting and Social Change, 153, 119891.

Lee, S., Park, G., Yoon, B. & Park, J. (2010). Open innovation in SMEs—An intermediated network model. *Research policy*, 39(2), 290-300.

Leitão, J., Pereira, D. & Brito, S. d. (2020). Inbound and Outbound Practices of Open Innovation and Eco-Innovation: Contrasting Bioeconomy and Non-Bioeconomy Firms. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 145.

Li, J. & Lin, B. (2019). The sustainability of remarkable growth in emerging economies. *Resources, Conservation and Recycling*, 145, 349-358.

Li, Y. & Vanhaverbeke, W. (2009). The effects of inter-industry and country difference in supplier relationships on pioneering innovations. *Technovation*, 29(12), 843-858.

Lichtenthaler, U. (2007). The drivers of technology licensing: An industry comparison. *California management review*, 49(4), 67-89.

Lichtenthaler, U. & Ernst, H. (2009). Opening up the innovation process: the role of technology aggressiveness. *R&d Management*, 39(1), 38-54.

Lifshitz-Assaf, H. (2017). Dismantling knowledge boundaries at NASA: From problem solvers to solution seekers. *Administrative Science Quarterly*, 1-37.

Lopes, A. P. & de Carvalho, M. M. (2018). Evolution of the open innovation paradigm: Towards a contingent conceptual model. *Technological Forecasting & Social Change*, 132, 284-298.

Luo, Z. (2014). Smart Manufacturing Innovation and Transformation: Interconnection and Intelligence: Interconnection and Intelligence. Hershey : IGI Global.

Mahdi, S., Nightingale, P. & Berkhout, F. (2002). A Review of the Impact of Regulation on the Chemical Industry: Final Report to the Royal Commission on Environment Pollution. Science and Technology Policy Research. Brighton: University of Sussex.

Marinagi, C., Trivellas, P. & Reklitis, P. (2015). Information quality and supply chain performance: The mediating role of information sharing. *Procedia-Social and Behavioral Sciences*, 175, 473-479.

Marques, J. P. (2014). Closed versus open innovation: evolution or combination? *International Journal of Business and Management*, 9(3), 196-203.

Martinez-Conesa, I., Soto-Acosta, P. & Carayannis, E. G. (2017). On the path towards open innovation: Assessing the role of knowledge management capability and environmental dynamism in SMEs. *Journal of Knowledge Management*, 21(3), 553-570.

Martínez-Torres, M. d., Rodriguez-Piñero, F. & Toral, S. L. (2015). Customer preferences versus managerial decision-making in open innovation communities: the case of Starbucks. *Technology analysis & strategic management*, 27(10), 1226-1238.

Martinez, M. G. (2014). Co-creation of value by open innovation: Unlocking new sources of competitive advantage. *Agribusiness*, 30(2), 132-147.

Mazzola, E., Bruccoleri, M. & Perrone, G. (2012). The effect of inbound, outbound and coupled innovation on performance. *International Journal of Innovation Management*, 16(6), 1240008.

Mina, A., Bascavusoglu-Moreau, E. & Hughes, A. (2014). Open service innovation and the firm's search for external knowledge. *Research policy*, 43(5), 853-866.

Monteiro, F., Mol, M. & Birkinshaw, J. (2017). Ready to be open? Explaining the firm level barriers to benefiting from openness to external knowledge. *Long Range Planning*, 50(2), 282-295.

Morgan, L. & Finnegan, P. (2010). Open innovation in secondary software firms: an exploration of managers' perceptions of open source software. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, 41(1), 76-95.

Nair, A., Guldiken, O., Fainshmidt, S. & Pezeshkan, A. (2015). Innovation in India: A review of past research and future directions. *Asia Pacific Journal of Management*, 32(4), 925-958.

Ndou, V., Vecchio, P. D. & Schina, L. (2011). Open Innovation Networks: the role of innovative marketplaces for small and medium enterprises' value creation. *International Journal of Innovation and Technology Management*, 8(3), 437-453.

Nerone, M. A., Junior, O. C. & Liao, Y. (2014). Classification of the Open Innovation Practices: the Creativity Level. ISPE CE, 871-879.

Noh, Y. (2015). Financial effects of open innovation in the manufacturing industry. *Management Decision*, 53(7), 1527-1544.

O'Sullivan, D. & Dooley, L. (2008). Applying Innovation . Sage publications.

Obradović, T., Vlačić, B. & Dabić, M. (2021). Open innovation in the manufacturing industry: A review and research agenda. *Technovation*, 102, 102221.

OECD. (2021). Gross domestic spending on R&D (indicator). Retrieved 16. May 2021 from doi: 10.1787/d8b068b4-en

Olsen, C., & St George, D. M. M. (2004). Cross-sectional study design and data analysis. *College entrance examination board*, *26*(03), 2006.

Pallavi, S., Malik, S. C., Gupta, A. & Jha, P. C. (2018). A DMAIC Six Sigma approach to quality improvement in the anodising stage of the amplifier production process. *International Journal of Quality & Reliability Management*, 35(9).

Patra, S. K. & Krishna, V. V. (2015). Globalization of R&D and open innovation: linkages of foreign R&D centers in India. *Journal of Open Innovation: Technology, Market, and Complexity*, 1(1), 7.

Paulose, H. & Nair, S. (2015). Open Innovation in Emerging Markets: A Business Model Perspective. *Journal of Promotion Management*, 21(1), 1-12.

Peng, M. W., Lebedev, S., Vlas, C. O., Wang, J. C. & Shay, J. s. (2018). The growth of the firm in (and out of) emerging economies. *Asia Pacific Journal of Management*, 35(4), 829-857.

Perkmann, M. & Walsh, K. (2007). University–industry relationships and open innovation: Towards a research agenda*. International journal of management reviews*, 9(4), 259-280.

Perkmann, M. & Walsh, K. (2007). University–industry relationships and open innovation: Towards a research agenda. *International journal of management reviews*, 9(4), 259-280.

Pikkarainen, M., Hyrkäs, E. & Martin, M. (2020). Success Factors of Demand-Driven Open Innovation as a Policy Instrument in the Case of the Healthcare Industry. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), 39.

Piller, F. & Ihl, C. (2009). Open innovation with customers. *Foundations, Competences and International Trends*, 69.

Piller, F. & West, J. (2014). Firms, users, and innovation. *New frontiers in open innovation*, 29(1), 29-49.

Piller, F., Ihl, C. & Vossen, A. (2011). Customer co-creation: Open innovation with customers. In V. Wittke & H. Hanekop, New forms of collaboration and Innovation in Internet (p. 31-63). Göttingen.

Piller, F., Schubert, P., Koch, M. & Moesleim, K. (2004). From mass customization to collaborative customer codesign. ECIS 2004 Proceedings, 118.

Pinto, A., Nunes, I. L. & Ribeiro, R. A. (2011). Occupational risk assessment in construction industry–Overview and reflection. *Safety science*, 49(5), 616-624.

Plokhov, S. & Suslova, A. (2019). Analysis of Funding Innovation in the Russian Federation. Proceedings of the International Science and Technology Conference "FarEastCon" (ISCFEC 2019) (p. 326-328). Atlantis Press.

Podmetina, D., Savitskaya, I. & Väätänen, J. (2012). Open innovation in Russia: productivity and industry effect. *International Journal of Transitions and Innovation Systems*, 2(2), 151-168.

Rahman, H. & Ramos, I. (2010). Open Innovation in SMEs: From closed boundaries to networked paradigm. *Issues in Informing Science and Information Technology*, 7(4), 471-487.

Ramani, S. V. (2014). Innovation in India: Combining Economic Growth with Inclusive Development. Delhi, India: Cambridge University Press.

Ratten, V., Braga, V., Álvarez-García, J. & del Rio-Rama, M. d. (2020). Tourism innovation: The role of technology, sustainability and creativity. In Tourism Innovation: Technology, Sustainability and Creativity (p. 1-13). Abingdon, UK: Routledge.

Reed, R., Storrud-Barnes, S. & Jessup, L. (2012). How open innovation affects the drivers of competitive advantage. *Management Decision*, 50(1), 58-73.

Remneland-Wikhamn, B. Ljungberg, J. Bergquist, M. & Kuschel, J. (2011). Open innovation, generativity and the supplier as peer: The case of iphone and android. *International Journal of Innovation Management*, 15(1), 205-230.

Rogers, M. (1998). The definition and measurement of innovation. Parkville, Australia: The University of Melbourne.

Roijakkers, N., Bell, J. & Vanhaverbeke, W. (2014). Open Innovation through R&D partnerships: Implementation challenges and routes to success. In C. R (editor), Open Innovation through strategic alliances (1st edition p. 41-58). New York: Palgrave Macmillan.

Rouyre, A. & Fernandez, A.-S. (2019). Managing knowledge sharing-protecting tensions in coupled innovation projects among several competitors. *California Management Review*, 62(1), 95-120.

Saatçıoğlu, Ö. Y. (2013). Barriers In Partnerships In Open Innovation Process. *Girişimcilik ve İnovasyon Yönetimi Dergisi*, 2(3), 99-119.

Saebi, T. & Foss, N. J. (2015). Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. *European Management Journal*, 33(3), 201-213.

Salter, A., Criscuolo, P. & Ter Wal, A. L. (2014). Coping with open innovation: responding to the challenges of external engagement in R&D. *California Management Review*, 56(2), 77-94.

Sanchez, P. M. (2007). The employee survey: More than asking questions. *Journal of Business Strategy*, 28(2), 48-56.

Sarkar, S. & Costa, A. I. (2008). Dynamics of open innovation in the food industry. *Trends in Food Science & Technology*, 19(11), 574-580.

Satell, G. (2017). Mapping innovation: a playbook for navigating a disruptive age. New York: McGraw-Hill Education.

Savitskaya, I. & Torkkeli, M. (2011). A framework for comparing regional open innovation systems in Russia. *International Journal of Business Innovation and Research*, 5(3), 332-346.

Scheuren, F. (2004). What is a Survey?. Alexandria: American Statistical Association.

Schiele, H. (2010). Early supplier integration: the dual role of purchasing in new product development. *R&d Management*, 40(2), 138-153.

Schiele, H. (2012). Accessing Supplier Innovation By Being Their Preferred Customer. *Research Technology Management*, 55(1), 44-50.

Secchi, E. (2016). Open innovation networks and the role of intermediaries: An agent-based simulation. Agent-Based Simulation of Organizational Behavior, 329-344.

Sener, S. & Tunali, C. B. (2017). A comparison of the innovation performance of Turkey with European Union. *Journal of Business, Economics and Finance*, 6(2), 141-146.

Senvar, O. & Akkartal, E. (2018). An overview to Industry 4.0. *International Journal of Information, Business and Management*, 10(4), 50-57.

Sergi, B. S. (2019). Exploring the future of Russia's economy and markets: towards sustainable economic development (First edition). Bradford, UK: Emerald Publishing Limited.

Shafer, S. M., Smith, H. J. & Linder, J. C. (2005). The power of business models. *Business horizons*, 48(3), 199-207.

Shahzad, K. (2018). Managing successful buyer-supplier relationships: Aligning the enabling roles of governance structure. Acta Wasaensia, University of Vaasa.

Shahzad, K. (2021a). Creating entrepreneurship ecosystem of SME-SME-Academia by inter-organizational network solutions. In Academy of Management Proceedings (Vol. 2021, No. 1, p. 15085). Briarcliff Manor, NY 10510: Academy of Management.

Shahzad, K. (2021b). Understanding the impact of entrepreneurial ecosystem interactions on innovative capabilities: Towards a conceptual framework. In the proceedings of R&D Management Conference, (forthcoming).

Shahzad, K., Dan, S., Holtkamp, P. & Niemi, MK. (2021). Managing change for open innovation: Exploring the limits of open collaboration. In the Proceedings of 18th International Open and User Innovation Conference, June 21-22, 2021, RWTH Aachen University,

Shahzad, K., Ali, T., Takala, J., Helo, P. & Zaefarian, G. (2018). The varying roles of governance mechanisms on ex-post transaction costs and relationship commitment in buyer-supplier relationships. *Industrial Marketing Management*, 71, 135-146.

Siakas, D. & Siakas, K. (2016). User Orientation through Open Innovation and Customer Integration. In C. Kreiner, R. O'Connor, A. Poth & R. Messnarz, Systems, Software

and Services Process Improvement. EuroSPI 2016. Communications in Computer and Information Science (633, p. 325-341). Springer International Publishing.

Sibirskaya, E. V., Stroeva, O. A., Khokhlova, O. A. & Oveshnikova, L. V. (2014). An analysis of investment-innovation activity in Russia. *Life Science Journal*, 11(7s), 155-158.

Sieg, J. H., Wallin, M. W. & Von Krogh, G. (2010). Managerial challenges in open innovation: a study of innovation intermediation in the chemical industry. *R&D Management*, 40(3), 281-291.

Siegel, D. S., Waldman, D., Atwater, L. E. & Link, A. (2003). Commercial Knowledge Transfers from Universities to Firms: Improving the Effectiveness of University–Industry Collaboration. *The Journal of High Technology Management Research*, 14(1), 111-133.

Singh, S. K., Naqshbandi, M. M. & Jayasingam, S. (2014). Open innovation in SMEs: drivers and inhibitors. *Asia-Pacific Tech Monitor*, 31(2), 20-25.

Sivam, A., Dieguez, T., Ferreira, L. P. & Silva, F. J. (2019). Key settings for successful Open Innovation Arena. *Journal of Computational Design and Engineering*, 6(4), 507-515.

Spender, J.-C., Corvello, V., Grimaldi, M. & Rippa, P. (2017). Startups and open innovation: a review of the literature. *European Journal of Innovation Management*, 20(1), 4-30.

Spithoven, A., Clarysse, B. & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation*, 30(2), 130-141.

Spithoven, A., Vanhaverbeke, W. & Roijakkers, N. (2013). Open Innovation Practices in Small and Medium Enterprises. *Small Business Economics*, 41, 537-562.

Squires, A. (2009). Methodological challenges in cross-language qualitative research: A research review. *International journal of nursing studies*, 46(2), 277-287.

Stanisławski, R. & Lisowska, R. (2015). The relations between innovation openness (open innovation) and the innovation potential of SMEs. Procedia economics and finance, 1521-1526.

Stanko, A. M., Fisher, J. G. & Bogers, M. (2017). Under the Wide Umbrella of Open Innovation. *Journal of Product Innovation Management*, 34(4), 543-558.

Stefan, I. & Bengtsson, L. (2016). Appropriability: a key to opening innovation internationally? International *Journal of Technology Management*, 71(3-4), 232-252.

Stuart, T. E. (2000). Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry. *Strategic management journal*, 21(8), 791-811.

Taner, M. T., Sezen, B. & Antony, J. (2007). An overview of six sigma applications in healthcare industry. *International Journal of Health Care Quality Assurance*, 20(4).

Tatoglu, E. & Demirbag, M. (2008). Transition in the age of anxiety: the Turkish case. *Journal of Management Development*, 27(7), 653-659.

Teirlinck, P. & Poelmans, E. (2012). Open innovation and firm performance in small-sized R&D active companies in the chemical industry: the case of Belgium. *Journal of Business Chemistry*, 9(3), 117-132.

Teirlinck, P. & Spithoven, A. (2013). Research collaboration and R&D outsourcing: Different R&D personnel requirements in SMEs. *Technovation*, 33(4-5), 142-153.

Thomas, E. (2018). From Closed to Open Innovation in Emerging Economies: Evidence from the Chemical Industry in Brazil. *Technology Innovation Management Review*, 8(3), 26-37.

Toma, A., Secundo, G. & Passiante, G. (2018). Open innovation and intellectual property strategies. *Business Process Management Journal*, 24(2), 501-516.

Tong, J. P. C., Tsung, F., & Yen, B. P. C. (2004). A DMAIC approach to printed circuit board quality improvement. *The International Journal of Advanced Manufacturing Technology*, 23(7-8), 523-531.

Traitler, H., Watzke, H. J. & Saguy, S. I. (2011). Reinventing R&D in an open innovation ecosystem. *Journal of food science*, 76(2), R62-R68.

Trott, P. & Hartmann, D. A. P. (2009). Why'open innovation'is old wine in new bottles. *International Journal of Innovation Management,* 13(04), 715-736.

UNCTAD. (2021). Technology and Innovation Report 2021. New York: United Nations Publications.

Usman, M. & Vanhaverbeke, W. (2017). How start-ups successfully organize and manage open innovation with large companies. *European Journal of Innovation Management*, 20(1), 171-186.

Valencia, R. C. (2013). The future of the chemical industry by 2050. Zurich, Switzerland: John Wiley & Sons.

Van de Vrande, V., De Jong, J. P., Vanhaverbeke, W. & De Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, 29(6-7), 423-437.

Vanhaverbeke, W. (2006). The interorganizational context of open innovation. Open innovation: Researching a new paradigm, 205-219.

Velikova, E. & Cohen, J. (2019). The Role of Innovation for Improving Operations Management in Tourism. In G. Rafailova & S. Marinov, Tourism and intercultural communication and innovations (p. 45-60). Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Verger, A., Lubienski, C. & Steiner-Khamsi, G. (2016). The emergence and structuring of the global education industry: Towards an analytical framework. World yearbook of education, 3-24.

Wallin, M. W. & Von Krogh, G. (2010). Organizing for open innovation: focus on the integration of knowledge. *Organizational dynamics*, 39(2), 145-154.

Wang, C. & Kafouros, M. I. (2009). What factors determine innovation performance in emerging economies? Evidence from China. *International Business Review*, 18(6), 606-616.

Wang, X. & Xu, M. (2018). Examining the linkage among open innovation, customer knowledge management and radical innovation: The multiple mediating effects of organizational learning ability. *Baltic Journal of Management*, 13(3), 368-389.

West , J. & Gallagher, S. (2006). Challenges of open innovation: the paradox of firm investment in open-source software. *R&d Management*, 36(3), 319-331.

West, J. & Bogers, M. (2014). Leveraging external sources of innovation: a review of research on open innovation. *Journal of product innovation management*, 31(4), 814-831.

West, J., Salter, A., Vanhaverbeke, W. & Chesbrough, H. (2014). Open innovation: The next decade. *Research Policy*, 43(5), 805-811.

West, J. & Bogers, M. (2017). Open innovation: current status and research opportunities. *Innovation*, 19(1), 43-50.

Westerlund, M. & Leminen, S. (2011). Managing the challenges of becoming an open innovation company: experiences from Living Labs. *Technology Innovation Management Review*, 1(1), 19-25.

Wright, K. B. (2005). Researching Internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of computer-mediated communication*, *10*(3), JCMC1034.

Wu, J. (2014). Cooperation with competitors and product innovation: Moderating effects of technological capability and alliances with universities. *Industrial Marketing Management*, 43(2), 199-209.

Wüstenhagen, R., Wolsink, M. & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy*, 35(5), 2683-2691.

Yami, S. & Nemeh, A. (2014). Organizing coopetition for innovation: The case of wireless telecommunication sector in Europe. *Industrial Marketing Management*, 43(2), 250-260.

Yeung et al., A. W. (2020). Open innovation in medical and pharmaceutical research: A literature landscape analysis. Frontiers in Pharmacology, 11.

Yun, J. J., Kim, D. & Yan, M.-R. (2020). Open Innovation Engineering-Preliminary Study on New Entrance of Technology to Market. *Electronics*, 9(791), 1-10.

Zhang, Y., Huang, M. & Hao, D. (2010). Knowledge capacity and the process types of open Innovation. International Conference on Information, Networking and Automation (ICINA).

Appendices

Appendix 1. Challenges of open innovation – Survey (Eng.)

General Info

All the information is handled confidentially and used for research purposes only. Company names or personal information will not be either shared or published.

Name of the company (optional):_____

In which industry does your company operate?:_____

In which country are you working in?:_____

How many employees are there in your company?

- Under 10
- 10-49
- 50-249
- 250 or over

Does research and development (R&D) activities exist in your company?

- Yes
- No
- It is outsourced

Did your company have any open innovation activities at some capacity during the last five years?

- Yes
- No
- Yes, but it was not successful

If the open innovation project was NOT successful, what was the main reason for failure?:_____

Challenges of Open Innovation

The purpose of this section is to find out different challenges of open innovation both before and during the innovation activities.

How important role has innovation in your company?

Not important at all				Very important
1	2	3	4	5

What is the importance of open innovation practices in your company?

Not important at all				Very important
1	2	3	4	5

Before the open innovation activities, what kind of challenges did your company face?

- o Fear of sharing confidential knowledge
- o Innovation activities takes too much time or resources
- o Fear of losing own innovation
- o Lack of commitment
- o Negative attitude (innovation coming elsewhere etc.)
- o Problems with contracts
- o Lack of open innovation process knowledge
- o Difficulties with managing open innovation process
- o Communication difficulties
- o Lack of top management support
- o Organizational barriers
- o Other: _____

During the open innovation activities, what kind of challenges did your company face?

- o Fear of sharing confidential knowledge
- o Innovation activities takes too much time or resources
- o Fear of losing own innovation
- o Lack of commitment
- o Negative attitude (innovation coming elsewhere etc.)
- o Problems with contracts
- o Lack of open innovation process knowledge
- o Difficulties with managing open innovation process
- o Communication difficulties
- o Lack of top management support
- o Organizational barriers
- o Other:_____

How risky do you see certain challenge types for your company's open innovation activities? (1 – low risk, 5 – high risk)

	1	2	3	4	5	Don't know
Financial						
Managerial & organizational						
Strategical						
Regional & environmental						
Cultural						
Legal						
Uncertainty						

How did your company overcome or avoid challenges related to open innovation activities?:_____

Open innovation collaboration

The purpose of this section is to map different external open innovation stakeholders during the last five years. Also, the success rate of different stakeholders will be explored.

With which open innovation stakeholder has your company collaborated during the last five years? (You may choose one or more)

- Customers
- Suppliers
- Universities & research centers
- Competitors
- Companies in other industry
- Other:_____

In which area or phase of innovation process has your company had open innovation collaboration with external stakeholders? (You may choose one or more)

- Research & development
- Idea generation
- Manufacturing
- Engineering
- Commercialization
- Other:_____

How successful was open innovation collaboration with your external stakeholder(s)?
(1 – not successful at all, 5 – very successful)

	1	2	3	4	5	Didn't have collaboration
Customers						
Suppliers						
Universities & research centers						
Competitors						
Companies in other industries						
Other stakeholders						

Did collaboration with your external partner(s) lead to innovation?

	Yes	No	Didn't have collaboration
Customers			
Suppliers			
Universities & research centers			
Competitors			
Companies in other industries			
Other stakeholders			

If you are interested in receiving the final results of this research (in English), please give an email address for later contacting:_____

If you have any comments on this survey or open innovation topic itself, please feel free to share your thoughts down below:_____