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## Faculty of Business Economics

Master of Management

### **Master's thesis**

***Diversity in workgroups and its impact on innovation.***

#### **Christel Nitu**

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

#### **SUPERVISOR :**

dr. Relinde COLEN



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Universiteit Hasselt  
Campus Hasselt:  
Martelarenlaan 42 | 3500 Hasselt  
Campus Diepenbeek:  
Agoralaan Gebouw D | 3590 Diepenbeek

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**2019**



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Christel Nitu

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## Executive summary

Diversity in work groups is a subject that has been discussed by several researchers over the years. Due to changes in the workforce demography – migration, aging population, an equal proportion of women and men in the population, and others- the steady increasing need of organizations for globalization and alliances, the importance of knowing the impact of diversity on innovation becomes more and more important (Jackson,1995). There are two different categories of diversity: demographic and cognitive. Demographic diversity describes readily detectable not directly task-related attributes such as gender, age, education, knowledge, effectiveness, and others. Whereas cognitive diversity refers to underlying attributes which are directly task-related - social status, attitudes, values, personality characteristics (Jackson *et al.*, 2003; Jehn *et al.*, 1999; Van der Vegt, 2003).

The focus of this paper lies on diversity in age, gender, education and knowledge within workgroups and their impact on innovation. Innovation refers here to the quality of the performance and not the quantity. These dimensions of diversity are mainly represented in most organizations. It is therefore interesting to investigate them in the context of innovation, in order to straighten out prejudices such as women being less interested in innovation or younger employees being more creative than older ones. Previous investigations revealed that age diversity within workgroups has a negative impact on innovation contrary to gender diversity and diversity in education and knowledge. This paper sought to portray these findings by first, analyzing the literature of several researchers. Second, the findings of an empirical study on the effects of multidisciplinary work teams within the context of innovation contests were examined. These contests were arranged by an organization in 2014, 2015, and 2016.

The quantitative analysis revealed some interesting findings. Diversity in gender is the only variable that indicated a significant but negative correlation in regards to value creation – variable used to evaluate the innovative performance of teams. These result is consistent with those of Horwitz (2007) and suggests a negative correlation between gender and collaboration. Contrary to expectations, this study did not find a significant correlation between diversity in age, education, and knowledge, and performance. One of the more surprising findings to emerge from this study is that the results of both regressions show a positive and significant correlation between team size and the performance.

Overall, it can be said that diversity is inevitable in organizations. Companies should, therefore, engage the extent to which diversity is present in the workplace in order to manage it appropriately and to profit from the advantages of diversity. Heterogenous teams should be managed differently than homogenous teams. Considering that several studies, which were discussed in the previous paragraphs surprisingly indicate that diversity in age tends to have a negative impact on performance, it is advisable to ensure that the age difference between group members is not excessive. Nevertheless, a certain level of cooperation between the different age groups should not be avoided, allowing different perspectives and experiences to be exchanged, which can be relevant to the group. In regards to gender diversity, even if some studies have found out that diversity in gender is rather negative, a positive influence cannot be excluded, as it may influence the innovation performance positively Østergaard (2011). Regarding education and knowledge, only people whose

knowledge is related to the subject of interest should work together. This includes the presence of top managers and employees from different departments. As a result, problems in communication, disagreements and the creations of groups (in -groups and out- groups) which in turn will have a negative impact on the overall team performance can be avoided.

Finally, appropriate management - by, for instance, selecting one person who will be in charge of taking essential decisions, clear guidelines, regular feedback session, and others. - the team size and a common objective are important when it comes to diversity in work groups.

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# 1. Introduction

## 1.1. Focus of study and Problem Statement

Whether in the news, in the newspaper or on the radio, probably the most discussed topics in the economic field in Europe are the ever-increasing population (through migration) and the bringing out of new innovations. Also, in Belgium, the statistics show a high population growth. Belgium counted in January 2018 11,376,070 inhabitants with 51% women and 49% men, which demonstrates an increase of 53,982 compared to the year before. In Flanders alone, the population was about 6,552,967 at the beginning of 2018, compared to 6,516,001 at the end of 2017.<sup>1</sup> Of these 6,552,967, 50% were female and 49.5% male. There are practical as many women as men in Flanders, which is also recognizable in the work environment. More and more women practice a profession which is rather exerted by men as for instance, in the finance or IT sector. This is as well the case for "female employments" which is progressively executed by males (teachers, nurses, kindergarteners, and others). However, the increase in the population can be explained by the natural balance between births and deaths - more births than deaths - and positive net migration. These migrants have different backgrounds, experiences, and knowledge, which they incorporate into their daily life. In addition to the increasing population, younger age groups are decreasing which leads to an aging population with overaged inhabitants.

It is therefore not surprising that we are repeatedly confronted with diversity, be it at work, at school or in free time.

In this study, I will focus on innovative performance, of teams, from hereon called team performance and the relationship with diversity. Innovation, which refers to the process where people communicate and interact to come up with something new, is becoming increasingly important for many companies. There are probably many different reasons behind this. One reason may be that people are becoming more and more demanding and striving for new products or services. Additionally, advances in technology and science make it easier for industries to discover and explore new opportunities.

Multiple studies have already investigated the relationship between team performance and diversity in its broad sense. Mullins (2013) sees diversity as "the multiplicity of perceivable and unperceivable differences of individuals that are not homogenous." Several studies have shown that diversity in workgroups is positively related to performance because it stimulates creativity, flexibility, and openness towards new ideas (Van der Vegt, 2003), allows team members to learn from each other and to find better ways to solve problems by combining their knowledge (Van der Vegt, 2003). Cohen and Levinthal even argue that "diversity can also increase the firms "absorptive capacity" (Østergaard, 2011). They use this term to describe an organization's capability to assess and employ external information. However, other studies have stated that too much diversity can lead to the

---

<sup>1</sup> <https://statbel.fgov.be/en/themes/population/structure-population>



opposite effect as communication between the members becomes more difficult which in turn can create conflicts and slow down teamwork (Van der Vegt, 2003).

This thesis will examine the way in which diversity in age, gender, and education/knowledge within workgroups impact performance. These dimensions of diversity are mainly represented in most organizations. Therefore, it is interesting to investigate them in the context of innovation in order to straighten out prejudices such as women being less interested in innovation or younger employees being more creative than older ones. Previous investigations revealed that age diversity within workgroups has a negative impact on innovation contrary to gender diversity and diversity in education.

This paper seeks to portray these problems by analyzing the literature of several researchers. The data in this framework was gathered during innovation contests with the aim of studying multidisciplinary work teams.

The overall structure of this paper takes the form of five chapters, including this introductory chapter. Chapter two begins by laying out the literature study and looks at diversity, the different dimensions of diversity and their impact on performance. The third chapter is concerned with the methodology used for this study, it also explains the principle of innovation and the concept of innovation contests. The fourth chapter presents the results of the statistical analyses on innovation contests and the information obtained during a phone interview with a former participant. Finally, the conclusion gives a summary and recommendations for further research.

## 2. Literature review

This introductory section provides an overview of the main subject, which is diversity. Furthermore, the different dimensions and the results of previous studies or research on the impact diversity has on team performance are discussed. Before examining the theory of diversity, it is necessary to explain the concept of Innovation.

### 2.1. Diversity



Innovation is a term frequently used in the literature, but to date, a generally accepted definition of innovation is lacking. The business dictionary defines innovation as "the process of translating an idea or invention into a good or service that creates value or for which customers will pay" (Business Dictionary, n.d.). A broader perspective has been adopted by Lundvall (1985,1992) "[...] innovation is an interactive process that often involves communication and interaction among employees in a firm and draws on their different qualities from all levels of the organization" (Østergaard, 2011). This paper will use the definition suggested by Loch *et al.* (2001) and Sommer and Loch (2004) who see it as a process of problem-solving – or a search for solutions which embrace false steps, experimentation, serendipity, and uncertainty (Boudreau, Lacetera, & Lakhani, 2011). On this account, innovation requires good communication and information exchange between persons and therefore heightens the importance of knowing the factors that have an influence on the innovation process.

Regarding diversity, a variety of definitions of the term diversity have been suggested. However, this paper will use the definition suggested by Mullins (2013) who saw it as „the multiplicity of perceivable and unperceivable differences of individuals that are not homogenous“. The existence of dissimilarities within an organization is nowadays unavoidable. People of different ages are increasingly working together and young, highly educated employees can be found at higher-level positions. According to Jackson (1995), there are two additional reasons besides the changing workforce demography, that lie behind this phenomenon of increasing diversity in organizations. These two reasons are part of the development of new organizational forms. The first is globalization, which refers to an economic process that focuses on extending businesses overseas. This phenomenon can be related to diversity in age and gender. The second reason is alliances, which can be either interdepartmental - different departments in an organization are working together to consolidate knowledge, information, and others – or interorganizational – describes the relationship between two or more independent organizations. These strategies are mainly used by organizations to stay competitive in the market and cause diversity in knowledge and education within work teams.

When it comes to diversity, many distinctions can be made. Jackson (1995) first distinguishes between two categories of attributes: readily detectable and underlying. Readily detectable attributes refer as the world 'readily' itself already says to attributes that are easy to detect and need less rapprochement. They are also characterized by the fact that they are generally rigid - e.g., a person is either male, female or transgender and does not switch between these sexes. Underlying attributes, in contrast, are more difficult to explain and analyze as there are inconsistent,

for example, social status, attitudes, values, personality characteristics, and behavioral style. These two attributes can be further categorized into task-related and relations-oriented. Readily detectable attributes which are task-related comprise department or unit membership, educational level, and others. Readily detectable attributes which are relations-oriented encompass characteristics like sex, age, physical features, race, national origin, and others. Aspects like knowledge, skills, abilities, and experience are counted among underlying attributes that are task-related. Lastly, underlying attributes are relations-oriented and consist of social status, attitudes, values, personality characteristics, behavioral style. Table 1 summarizes the attributes and their subcategories.

Table 1: Summary of the attributes and their sub-categories

	Readily detectable attributes	Underlying attributes
Task-related	Department / Unit membership, education/ knowledge	Knowledge, skills, abilities, experience  <b>Cognitive Diversity</b>
Relation-oriented	Sex, age, physical features, race, national origin, educational level/ knowledge  <b>Demographic diversity</b>	Social status, attitudes, values, personality characteristics, behavioral style

Readily detectable attributes have reference to demographic diversity whereas underlying attributes relate to cognitive diversity. Further, the latter describes directly task-related informational diversity and the former not directly task-related or 'surface-level' diversity (Jackson *et al.*, 2003; Jehn *et al.*, 1999). Demographic diversity relates to "differences in directly measurable demographic attributes of individuals, such as gender, age, and tenure as determinants of attitudes, gap process, and effectiveness." (Van der Vegt, 2003) Cognitive diversity, however, is linked to differences within team members in terms of knowledge, values, and skills.

**2.2. Advantages of diversity related to team performance**

Nurturing diversity within organizations and primarily workgroups can lead to positive impacts in the overall team performance as there are a number of advantages that diversity implies.

First, diversity stimulates creativity within work teams. Van der Vegt and Janssen (2003) for instance claim that demographic diversity increases creativity. This view is supported by Cohen and Levinthal (1990).

A second way in which diversity can benefit teams' innovation performance is that it enables better decision making and problem-solving. As for Van der Vegt and Janssen (2003), teams that are composed of heterogeneous people, from different departments, with different knowledge, skills, and abilities, are expected to be better in decision making, compared to homogenous groups where team members have the same knowledge, skills, and abilities. They assume that as group members interact in a critical and investigative way and are capable to identify, extract and synthesize the

dissimilar perspectives it enables them to come at high-quality innovative decisions. Moreover, various information and decision theories indicate that diversity contributes to increased cognitive processing - which refers to the process of thinking-, careful analysis, and better use of information. Similarly, Cohen and Levinthal (1990) state, that, broader search space, better problem solving, new combinations of knowledge and an increase in the firm's absorptive capacity are some advantages of diversity in groups. Jackson (1996) asserts that it is important to know what impression the team members have of each other, as it will not only determine in the long term if the members want to stay in the team or not but it stimulates cooperativeness, indulgence, and a problem-solving angle through negotiation processes.

Finally, diversity is also expected to benefit individual growth. Cohen and Levinthal (1990) and Jackson (1996) share this belief. However, a broader perspective has been adopted by Jackson (1996), who argues that individual growth and learning can be related to the "assembly bonus effect". It refers to situations where people perform better when they are working with others in a team than when they were working alone. The reason for this might be the presence of experts in the team. However, this does not mean that only the low ability members gain from such a team. The experts also acquire new knowledge as they take the role of a teacher which enables them to improve their own thinking. Another reason is that it stimulates the experts to reconsider their assumptions and rules they usually use. Likewise, Østergaard (2011), holds the view that that organizations which embrace diversity may profit from complementarities that can bring up development in other domains and broader routines.

Overall, it can be said that organizations can benefit in many ways from diversity in workgroups. It is, therefore, likely that a connection exists between diversity and innovation. Østergaard (2011) claims a positive connection between these two. However, in 1999, Cady and Valentine published the article 'Team Innovation and Perceptions of consideration. What difference does diversity make?' in which they specify that diversity does not have an impact on the quality of innovation but on the quantity. This assumption will be further discussed in the next chapters

### **2.3. Disadvantages of diversity related to team performance**

If diversity in work teams is badly managed, it can entail some consequences, which in turn can affect team performance. Jackson (1996) analyzed these consequences. First, she draws a distinction between consequences linked to each group member individually -as diversity can impact each member independently and in different ways - and consequences linked to the entire team. Both individual and team consequences determine how team members work together and are related to overall team performance. She further divides the individual and team consequences into short-term effects and long-term outcomes. According to Jackson (1995), one short term effect in regard to the team as a whole is decision making and problem-solving.

Groups tend to pay little attention to the unique information that each team member has, called "unshared knowledge" and instead center on the information that is known by all of the group from the beginning - "shared information." Further, group members have the tendency to treat information

based on their own preferences and opinions, which leads to biased information pooling (Hendriks, 2017)<sup>2</sup>. This paradigm is known as hidden profile (Stasser, 1988). If information and knowledge are not shared with the other team members or are even ignored, the decision-making process becomes less effective which makes it additionally more difficult to detect the best solution to a specific problem. The reason why team members don't share unique information or knowledge is in the opinion of Jackson (1996), the lack of confidence. Laughlin and Adamopoulos (1980) conducted a study on social combination processes and individual learning. Owing to a model fitting and a model testing approach, they were able to prove the hypothesis that teams are expected to accept a different perspective if not less than two members of the team possess the same information and ability to justify their perspective. This phenomenon is called the "truth supported wins." A research conducted by Solomon Asch (1951, 1956) confirms Jackson's assumption of lack of confidence, as it reports that as one team member had a different perception than the others, this team member then renounced on his perception even if the perception was proven to be right.

Another short-term effect, mentioned by Jackson (1996) is status and power. Unfortunately not much research has been done to show the impact of expertise-based status or power on decision making but for Jackson, everyday experiences last to claim that expertise based status or power influence communication, attempts, negotiations and the allotment of resources. Besides, several studies have been carried out to determine the effect of socially defined status. Socially defined status describes a status which is based on for, instance age and gender (Berger, Cohen & Zelditch 1966, 1972). Individuals with higher status are inclined to have a more assertive non-verbal behavior when it comes to communication. They also speak, criticize and command more and also interrupt others repeatedly. In addition, they tend to exert more influence and are, therefore, more influential (Levine & Moreland, 1990). As a result, team members with a lower status participate less. This, in turn, can have an impact on the creativity level of the team and process losses (Steiner, 1972). Next, to this, the implementation of decisions represents another short-term effect. In the opinion of Jackson (1996), diversity slows down the process from decision making to decision execution. The possible

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<sup>2</sup> Strategic management: Introduction to classic thought on strategic management. Prof. dr. Walter Hendricks (Hendriks, 2017)

reason for this may be that diversity within the groups can lead to recurring disagreements, communication problems, and other difficulties which slow down the work process. However, it improves the teams' attentiveness in welcoming feedback about their decision quality.

Cohesiveness is another short-term effect, which aggravates decision-making. In this context, cohesiveness is about interpersonal attraction and appreciation between the team members. Several studies have shown that most of the time homogeneity, within a team, reaches a greater effect on performance than heterogeneity (Brewer, 1979; Guzzo & Dickson, 1996; Messick & Massie, 1989). This can be ascribed to the similarity/attraction hypothesis which describes the fact that people prefer to work with people who have the same background as they probably have the same life experiences and values which facilitates the interaction between them and leads to positive reinforcement in regard to attitudes and beliefs (Byrne, Clore & Worchel, 1996). Byrne *et al.* (1967) conducted two experiments, which permitted them to confirm the hypothesis on the similarity/attraction theory. Likewise, Burt & Reagans (1997) and Lincoln & Miller (1979), affirm that when people have the free choice to choose the person they want to interact with, they opt for someone who is similar. It, therefore, seems that homophily in work teams is rather preferred by the members of a group than heterogeneity.

Communication is another important aspect within a diverse group and is also mentioned by Jackson (1996) as one of the short term effects. For Miller & Jablin (1991), communication is about producing, transmitting and interpreting which in turn enables the processing of information within a team. Communication is highly diverse: verbal or non-verbal channels, direct or indirect, passive or proactive. In addition, communication can also be related to the similarity-attraction theory – developed by Newcomb (1961,1968) – as people prefer to speak with homogenous people rather than to heterogeneous. Researchers like Van der Vegt (2003) and Williams & O'Reilly (1998) support this view. They claim that these factors, have a negative impact on group attractiveness, commitment, the ability to meet the needs of the other team members and social integration. Furthermore, it decreases the psychological attachment. And as communication becomes more difficult in highly diversified teams, transaction costs rise similarly to conflicts, distrust, dissatisfaction and competitive behavior (Østergaard, 2011).

With regard to the long-term outcomes of team diversity Jackson (1966) found out that managers of diverse teams are more likely to leave the team after a certain time. The reasons behind it are greater numbers of conflicts and the feeling of dissatisfaction which is obviously the case for each team member. The feeling of dissatisfaction can drive them to leave the team. Additional aspects that cause team members to leave the team are decreases in group attractiveness, commitment, the ability to meet the needs of the other team members, social integration and psychological attachment. Additionally, distrust and increased competitive behavior are consequences of diverse teams (Østergaard, 2011).

Hambrick and Mason (1984) developed the "upper echelons theory," which describes the advantages and disadvantages of diversity related to top management teams (TMT). According to Hambrick and Mason (1984), diversity can lead to two different effects. On the one hand, they believe that diversity within TMT's enables the access to different perspectives and insights, which in turn are allied to

innovative ideas, and higher quality decisions that have a positive impact on teams' performance. On the other hand, diversity creates higher levels of conflicts, coordination costs, and difficulties in the implementation process. All this has, of course, a negative effect on the performance of TMTs. In the opinion of Hambrick and Mason (1984) diversity in TMTs leads to high-level strategic decisions but inhibit the implementation process. As a consequence, an organization can either have high-quality decisions or quality implementation but not a combination of both (Hendriks, 2017).

Figure 1: Basic model of the upper echelons theory (Hendriks, 2017):

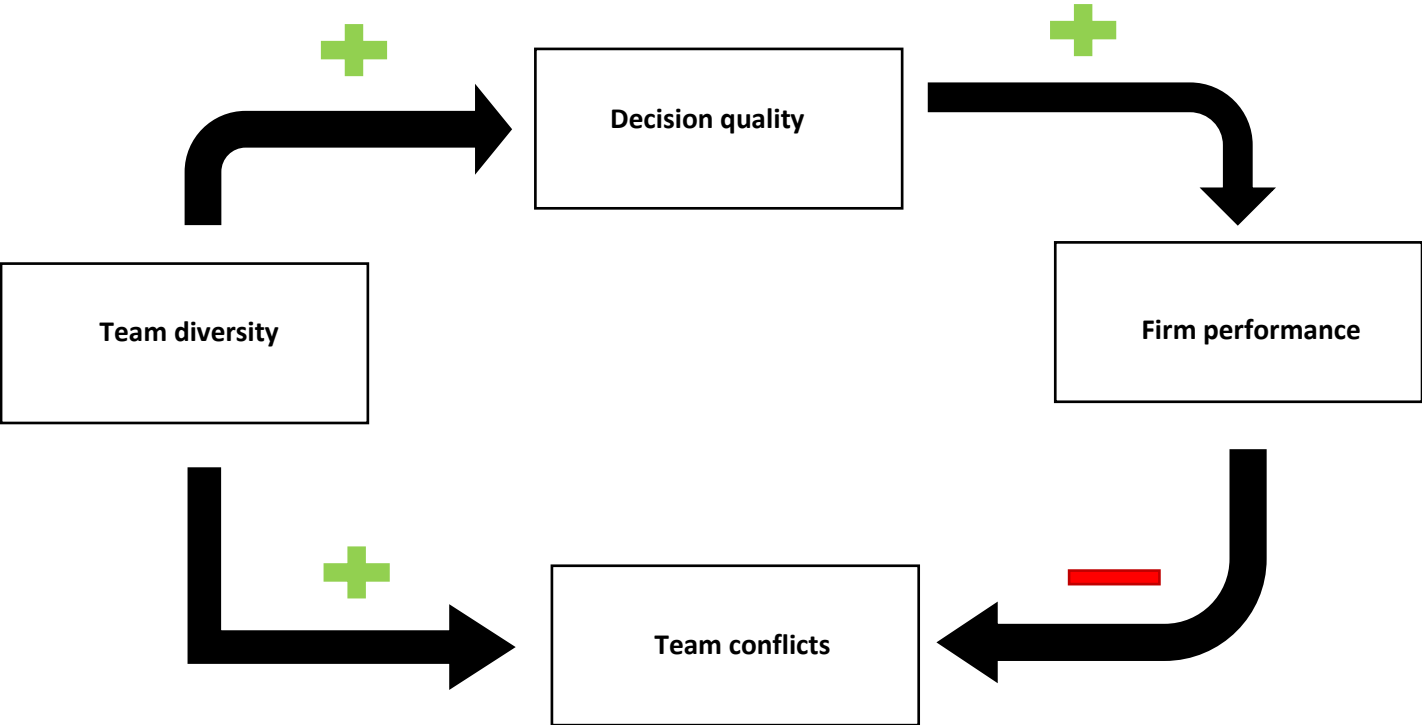
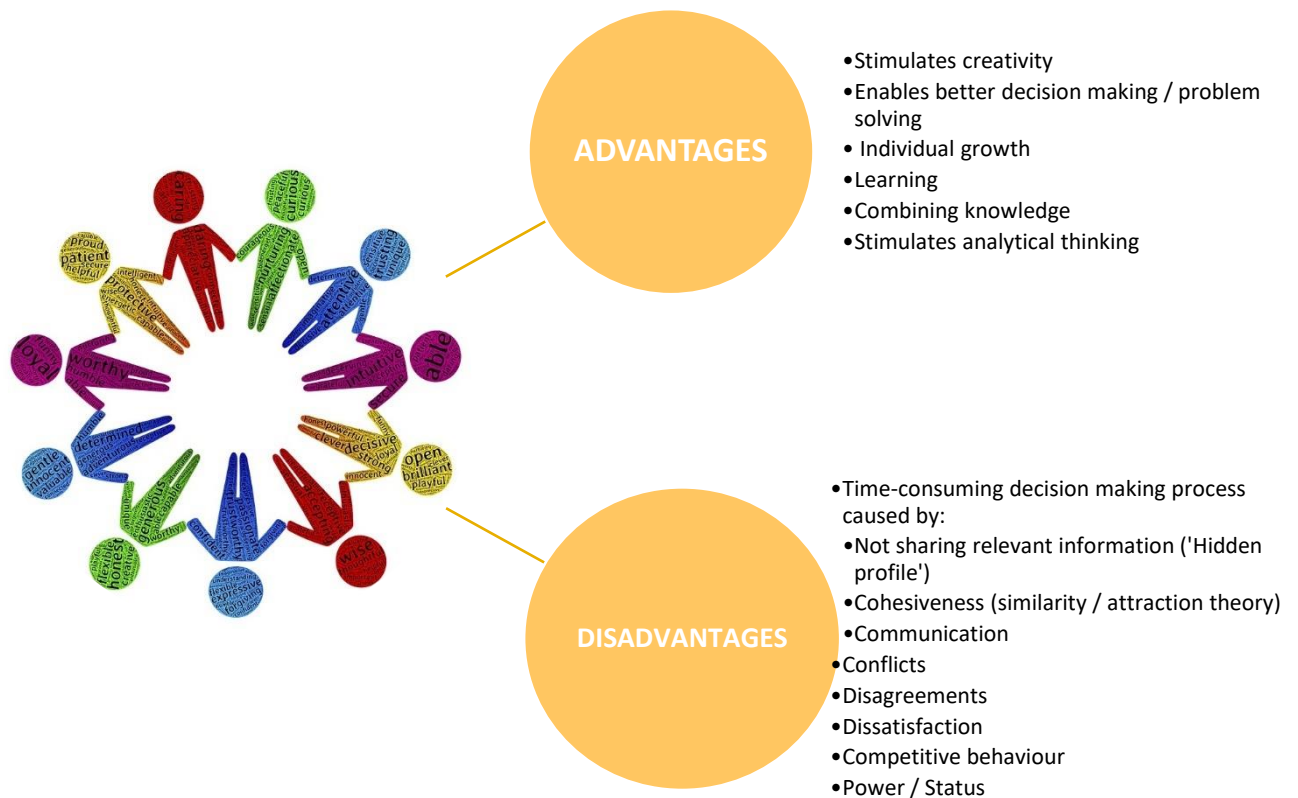


Figure 2 provides an overview of the advantages and disadvantages of diversity, based on the previous paragraphs.

Figure 2: Advantages and disadvantages of diversity



### 2.3.1. Impact of diversity on innovation

After having a look at the general impact of diversity on team performance, this paragraph will present a narrow view on demographic diversity. Demographic diversity - refers to readily detectable attributes which are relation oriented - the focus lies on age, gender and education/knowledge. Various studies have been conducted to examine the effects of diversity within teams on innovation. However, a great number of these studies focalize on diversity within TMT's. This section gives an outline of the results discovered by several researchers.



### 2.3.1.1. Demographic diversity

#### 2.3.1.1.1. Age diversity

One might think that differences in age between team members has a positive influence on the innovation outcomes and the way the teamwork proceeds. Since people with different views, life experiences and attitudes relating to technology, communication, and others, can learn from each other. Surprisingly, several kinds of quantitative research conducted by Cady and Valentine (1999), and Østergaard (2011) have shown that age has no or even a negative impact on innovation. Østergaard (2011) conducted an analysis to test the assumption that employee diversity is connected to greater innovative performance. In order to examine this hypothesis, he made use of data collected from an innovation survey administered by DISK04 in 2006.<sup>3</sup> The survey was sent to a representative sample composed of Danish firms that employ at least 20 employees. The survey yields a response rate of 42.9%<sup>4</sup>. Which represents a quite low response rate, as less than the half of all organizations responded. The accuracy of the results can, therefore, be questioned. Further, Østergaard (2011) integrated an employer-employee dataset to get information about the structure of organizational teams.<sup>5</sup> Nevertheless, this study has also some limitations as it did not take into account the different plants an organization owns, it only focused on the largest plant. Additionally, the survey does not give more specific information on each team member. Østergaard (2011) analyzed the data by using two different measures – the Shannon-Weaver entropy index, used to quantify diversity within organizational teams and the standard error and the coefficient of variation, which were used to illustrate the separation of attitudes. The entropy-based Index is composed of:

$$H = - \sum_{i=1}^s P_i (\ln P_i) \text{ where,}$$

s represents the number of categories of a dimension on a group and  $P_i$  the possibility of finding the system in circumstance i (Cady and Valentine; 1999).

As a consequence, he was able to prove several hypotheses; one of them is: "*There is a negative or neutral relation between age diversity and the likelihood that firms innovate*" (Østergaard, 2011). The results of the analysis provide support for this hypothesis as age shows a significant negative effect on the likelihood that firms innovate. The reason why age diversity has a negative impact on team performance might be because the combination of young and old team members can lead to both, aggressive strategies and maintenance of ideas and a mechanism to evaluate new ideas (Hambrick & Mason, 1984; Horwitz, 2007; Cady & Valentine, 1999). In the same vein Zaja *et al.* (1991) states that innovative performance decreases as a result of disagreements caused by a high variation in perspectives on a broad range of issues and variation in training between young and old team members.

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<sup>3</sup> The center of attention of this survey was large scale innovation, and therefore dealt with innovation and not "innovation proxies". Østergaard (2011)

<sup>4</sup> The management of 4136 organizations received the questionnaire but only 1775 replied.

<sup>5</sup> The dataset stems from a survey directed by the Integrated Database for Labor and Market Research (IDA) from 2003 to 2005. It gives explicit information about all organizations in Denmark and the individuals on the Danish labor market.

In contrast to the authors mentioned above, Pelled *et al.* (1999) claim that age diversity can be positive as it lessens harmful emotional conflicts which arise in teams with similarity in age. Members of such teams tend to compare their careers which can cause rivalry.

### **2.3.1.1.2. Gender diversity**

Gender diversity is another dimension of diversity that can be related to variations in experiences and views as women and men do not always share the same opinions on political, economic and technological trends (Østergaard, 2011). Similar to age diversity, this dimension holds on two opposing views. A statistical test conducted by Horwitz (2007) reveals a negative correlation between gender and collaboration with  $-0.02$ ,  $p > 0.05$ . Further analysis showed that there is no relationship between gender diversity and innovation Milliken & Martins (1996). Cady and Valentine (1999) conducted a field experiment during a technical contest carried out by Fortune 500. with fifty teams. Fifty teams participated and each team was composed of four to seven members, aged between 20 and 70. The experiment was organized to answer the question of what effect age, race, sex and function diversity have on innovation and perceptions of consideration. After analyzing the results Cady and Valentine (1999) found that an increase in gender diversity results in a negative impact on the quantity of innovation generated -  $p < .01$ ,  $B = -18.32$ ,  $\eta^2 = .15$ . In the detailed review of forty years of research on demography and diversity in organizations Williams and O'Reilly (1998) concluded that gender diversity seems to have a more negative impact on the group process as it enhances the creation of social categories (e.g. in groups/outgroups). Additionally, men who have to work in a female dominated group feel socially integrated by their female co-workers. Contrary to females, in male-dominated groups, who feel less socially integrated by their male co-workers. (Snavey, 1983). Further, Konrad, Winter, and Gutek (1992) detected a higher level of sexist stereotyping in male-dominated groups and a lower-level in female-dominated groups. Nevertheless, even if men are more socially integrated into female-dominated groups, they feel less satisfied and have high negative psychological outcomes than women in male-dominated groups. As for group performance, various studies discovered that women in male-dominated groups tend to be negatively evaluated by the other male team members (Nieva & Gutek, 1980; Ruble, Cohen & Ruble, 1984).

In contrast, authors such as Hoffman and Maier's (1961) claims in their article that gender diversity fosters innovation. This finding is in agreement with Østergaard (2011) who tested the hypothesis of a positive correlation between gender diversity and the likelihood of organizations to innovate. His study shows a strong positive and significant correlation between these two variables ( $0.342$ ,  $p > 0.01$ ) and therefore supports the hypothesis. He further claims that a balance between female and male team members has to exist in order to profit from a positive innovation performance. Rogelberg and Rumery (1996) hold the view that the number of males in teams has a positive link to decision quality<sup>6</sup>.

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<sup>6</sup> Decision quality simply describes the quality of a decision made without taking into account its outcome.

### **2.3.1.1.3. Diversity in education and knowledge**

As was pointed out in Table 1, education and educational level are both readily detectable attributes. However, only education is part of demographic diversity. The difference between education and educational level is that the first concerns the content of education, for instance, a Master's in Economics or a training in accounting. The latter one is related to the educational degree (e.g. High school diploma Bachelor, Master, and others). It is, therefore, possible to associate education with knowledge.

Having defined the difference between education and educational level this final section of this chapter will first discuss diversity in education, followed by a review on diversity in knowledge.

In regards to diversity in education, it is assumed that teams composed of people with higher levels of education are able to solve complex problems by developing creative solutions. This assumption accords with an earlier observation done by Bantel and Jackson (1989). They analyzed the composition of top management teams (TMT) in the banking sector<sup>7</sup>. The study was designed to determine the effect of team composition on innovation. The hypothesis of interest that was tested is, that there is a positive correlation between diversity in education within TMT's and innovation. The results of the study indicate that a positive correlation between education and innovation, as  $\beta = 0.31, 0.34, \text{ and } 0.19$ ; with all  $p$  values  $< 0.05$ . What is surprising is, that the results showed also that diversity in education is one of the most powerful predictors in innovation compared to the average age, diversity in age, tenure heterogeneity and functional expertise. These findings corroborate the results found by Østergaard (2011). He, therefore, concludes that teams with several highly educated members who in addition are diverse in their educational background are more likely to innovate. However, Bental and Jackson (1989) assume that diversity in education only leads to dysfunction when there is a high level of diversity in the team.

As for knowledge, Taylor and Greve (2006) executed a study on comic books brought to the public between 1972 and 1996 to analyze the impact of knowledge and experience on individuals and team innovation. They assume that the presence of a variety of knowledge and information lead to original outcomes. As Arthur (1989) and March & Simon (1958) they are also aware of the dysfunctions, as for instance unwieldy and impractical outputs, that can arise in teams with highly diverse knowledge. One of the hypotheses that were tested concerned the outcome level after an increase in the creators' knowledge. After three different modeling approaches of the linear regression, they found out that this hypothesis can be supported. The Analysis showed a significant and positive effect on the hypothesis.

This chapter has reviewed the key aspects of innovation and diversity. As far as diversity is concerned, it can be summarized that there are conflicting opinions regarding diversity in age and gender. One question that needs to be asked, is why there is no significant relationship between age diversity and innovation. It seems possible that the exceptional positive results found by Østergaard (2011) and Cady and Valentine (1999) are due to high heterogeneity in age within the sample

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<sup>7</sup> The results of the study are based on a sample of 199 banks in the U.S.

studied. Another reason can be that these studies were made several years ago and therefore do not go with the recent environmental structure. Surprisingly, there is only consensus about the positive correlation between diversity in education/knowledge and innovation. Overall, these studies highlight the need for studying the impact of diversity on performance.



## 3. Methodology

This part of the thesis presents the findings of an empirical study on the effects of multidisciplinary work teams within the context of an innovation contest. Analyzing the results will give deeper insights into how diversity can influence team performance. Before proceeding to examine the results, it will be necessary to give a brief explanation about innovation contests.

### 3.1. Innovation contests

According to Bullinger (2010), an innovation contest is a competition between innovators who try to come up with a solution for a specific problem defined ahead by an organizer, by using their skills, experience, and creativity. Terwiesch and Ulrich (2010) argue that an innovation contest takes in two basic activities: creating a pool of opportunities and selecting the winner (Bantel & Jackson; 1989). An Innovation opportunity can be a newly sensed need, a lately discovered technology or a combination between a need and a possible solution.

As claimed by Robert Mayhew and Simon Schaffer, who are both Professors in history, innovation contests have their origin in the 18<sup>th</sup> century. Because of the international trade and the global spread, it was important to be able to determine the exact longitude at sea. However, this turned out to be very complicated and became a problem to be solved. That is why Prince Phillip II of Spain offered a prize equivalent to 1,6 million euros for the person who would be able to solve this problem. In the early stage, innovation contests were used by public institutions as they had the necessary reputation and financial opportunity to convince people to participate. (Brown, 2013).

But since the 19<sup>th</sup>-century, companies also make use of this approach for different kinds of tasks. It can, for instance, be used as an open innovation method, with a focus on the external environment to spur innovation by integrating outstanding (concerned) people such as customers, suppliers, partners, and others. who can give suggestions and ideas. This, in turn, coincides Bill Joy's assumption "no matter who you are, most of the smartest people work for someone else" (Knowledge@Wharton, 2014). Whether such a contest is organized internally or externally, it allows solving complex problems, small or large, as long as it is related to a highly unstructured question (Terwiesch & Ulrich).

#### 3.1.1. Concept of the contest

Innovation contests also called idea or design competitions and comprise of a five-stage innovation process - idea generation and mobilization, advocacy and screening, experimentation, commercialization, diffusion, and implementation (Bantel & Jackson). The contest is divided into different rounds. The number of rounds depends on the organization that runs the contest. During the first round, a wide variety of ideas or solutions to a specific problem are submitted by the participants. Most commonly, these solutions have to be presented to a jury of experts which then selects the most promising ones. However, it also occurs that participants evaluate each other during the different round, only the best ideas proceed to the final stage, where the winner will be selected.

In the second round, the selected solutions have to be refined and presented for the second time to the jury. These steps are repeated as often as necessary. During the last round, the best solutions are presented and the winner selected. The winner of an innovation contest receives an award. The most common rewards are a cash price and/ or the possibility to develop the idea further. However, it depends on the aim and target of the organizer.

### **3.1.2. Reasons for innovation contests**

First, innovation contests are a great approach to get stakeholders involved with the aim to come up with ideas that would not have been found in a conventional way. As it allows organizations to get information about tacit knowledge on the subject of interest (Knowledge@Wharton, 2014). Second, it stimulates creativity and creates new ways of thinking. "It gives people an equal playing field. There is a sense of energy and excitement" (Terwiesch & Ulrich). An additional reason for organizing innovation contests is the fact that it is an engaging team-building exercise. Besides, there are some additional positive effects which are summarized in the table below.

The first column presents the different objectives (stimulation, development, and promotion) that the organizer might pursue when organizing an innovation contest. The second column represents the positive effects associated with the different types of objectives. Stimulation for instance results in positive effects such as creativity, teambuilding, generation of new ideas, and others. Promotion, on the other hand, increases the brand or image, corporate social responsibility, sustainability, and others. The positive effects of the different objectives can be interlinked.

Table 2: Overview of the different objectives and their positive effects

Objectives	Positive effects
Stimulation	<ul style="list-style-type: none"> <li>▪ User feedback and identification of trends and unmet needs / Research</li> <li>▪ Idea generation</li> <li>▪ Creativity</li> <li>▪ Teambuilding</li> </ul>
Development	<ul style="list-style-type: none"> <li>▪ Ideas/ designs</li> <li>▪ Concepts/ solutions</li> <li>▪ Skills</li> <li>▪ Knowledge</li> </ul>
Promotion	<ul style="list-style-type: none"> <li>▪ Brand/ Image</li> <li>▪ Business</li> <li>▪ Organizational change</li> <li>▪ Corporate social responsibility</li> <li>▪ Recruiting/HR</li> <li>▪ Sustainability</li> <li>▪ Customer relationship</li> </ul>

According to Haller (2011), there are two different strategic application areas and three major objectives that innovation contests can generate. The different areas can be divided into “greater good” - the advancement of technological or societal development - and “corporate challenges” (Haller, 2011). Haller (2011) makes a clear distinction between objectives of innovation contests that pursue a “greater good” strategy and those with a “corporate challenges”. As for corporate challenges, innovation contests stimulate idea generation by gathering user feedback and identifying trends. These ideas can be further developed to create new products or services. According to him, the contests also promote the brand and image of an organization thanks to word of mouth, changes within the organization - as employees can be asked about their opinions about the organization’s future - corporate social responsibility, and recruitment by identifying potential employees among participants.

In contrast to Haller (2011), the table above shows that different objectives can lead to the same positive effect. For instance stimulation and development, which are different objectives but share common positive effects such as idea generation. In addition, Haller (2011) might not cover all the positive effects. The article “Why some Innovation Tournaments Succeed and Others Fail” (Knowledge@Wharton, 2014) for instance states that each suggestion submitted can give organizations an idea about unmet needs and in the case of an internal innovation contest and it can reveal the creativity level of the employees. In addition, it might be possible that an innovation contest is organized with the aim to combine strategies.



### **3.1.3. Difficulties occurring during innovation contests**

But of course, there are also some negative aspects of innovation contests. One problem, which however is not relevant for this setting is that innovation contests cannot be applied to every problem and by every company. As a consequence, some companies opt for other ways to spur innovation.

The major difficulty, however, is the evaluation and selection of the best solution. A method to eradicate this concern of selecting the best idea is specific software programs Terwisch and Ulrich developed such a web-based software tool, named *Darwinator*. The tool has the objective to measure the quality of innovation outcomes at the earliest stage. In addition, they suggest two requirements that have to be fulfilled in order to retain an effective selection process. The first requirement – in the case where many innovative ideas are submitted – is efficiency, “it must be cheap and fast, favoring the use of imperfect information over extensive analysis and data collection” (Terwiesch & Ulrich, 2010). The second requirement refers to accuracy, which indicates an in-depth analysis of ideas. Nevertheless, it can be challenging to combine these two requirements. For this reason, they recommend organizing multiple rounds, to narrow the submissions. These multiple rounds enable the organization to filter out the less suitable ideas in the early stage and continually improve ideas as the competition progresses.

Difficulties also arise, when too many contestants participate in a contest. There is a consensus among authors that too many participants in a contest can have a negative impact on the participant’s willingness to put in effort as they might feel that the possibility to win the contest becomes minor (Che and Gale 2003, Fullerton and McAfee 1999, Taylor 1995). This in return has an effect on the outcomes since it decreases the number of innovative ideas submitted. Boudreau *et al.* (2011) examined this assumption to find out if free entry or a restricted number of participants leads to an overall better outcome. They found out that extending the number of participants in a contest lowers their willingness to exert effort which in turn decreases the entire distribution of performance outcomes that means that implies a small negative impact on the performance level.

## 3.2. Methods

### 3.2.1. Research setting

This research is based on data collected in the context of three innovation contests that were organized from 2014 till 2016 by a consulting company specialized in IT, which is known for arranging innovation contest for its employees (Boënne, Leten & Van Dyck, 2018).

### 3.2.2. Sample

Taken as a whole, the sample consists of 392 teams. Among these 392 teams, 160 participated in 2014, 124 in 2015 and 108 in 2016, as it can be seen at the graph below.

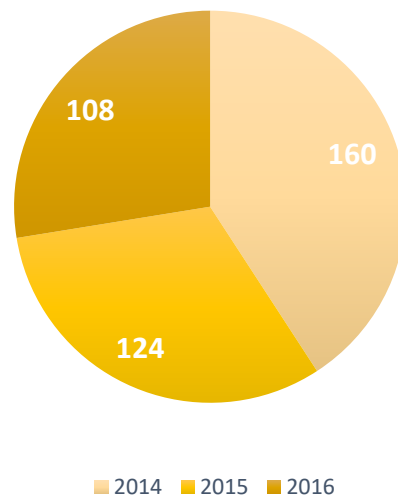


Figure 3: Number of teams

The teams were composed of either one person (52,5%, in 2014; 45,2% in 2015 and 37,0% in 2016) or two (23,1% in 2014; 17,7% in 2015 and 20,4% in 2016). Some teams counted three members (13,8% in 2014; 14,5% in 2015 and 20,4% in 2016). Further, there were teams of four (8,8% in 2014; 12,1% in 2015, and 14,8% in 2016) and five (1,3% in 2014; 10,5% in 2015, and 4,6% in 2016). In 2016, there were also teams of six (1,9%) and seven (0,9%) members. The participants were from different levels in the organization - junior analyst, senior analyst, junior consultant, senior consultant, junior manager, and senior manager and worked in one of the five departments - Digital, Operations, Financial Service, Strategy or Technology. The age of the participants ranged from 22 to 48. Table 2 illustrates the descriptive analysis of the team size and the number of departments.

Table 3: Teams size and number of departments

		Team Size		Number of Departments		
<b>2014</b>		<b>Frequency</b>	<b>Percentage</b>		<b>Frequency</b>	<b>Percentage</b>
Valid	1	84	52,5	1	103	64,4
	2	37	23,1	2	42	26,3
	3	22	13,8	3	11	6,9
	4	14	8,8	4	3	1,9
	5	2	1,3	5	1	0,6
	6	1	0,6			
	<b>Sum</b>	<b>160</b>	<b>100</b>	<b>Sum</b>	<b>160</b>	<b>100</b>
<b>2015</b>						
Valid	1	56	45,2	1	62	50
	2	22	17,7	2	39	31,5
	3	18	14,5	3	20	16,1
	4	15	12,1	4	2	1,6
	5	13	10,5	5	1	0,8
	<b>Sum</b>	<b>124</b>	<b>100</b>	<b>Sum</b>	<b>124</b>	<b>100</b>
<b>2016</b>						
Valid	1	40	37	1	59	54,6
	2	22	20,4	2	35	32,4
	3	22	20,4	3	12	11,1
	4	16	14,8	4	1	0,9
	5	5	4,6	5	1	0,9
	6	2	1,9			
	7	1	0,9			
	<b>Sum</b>	<b>108</b>	<b>100</b>	<b>Sum</b>	<b>108</b>	<b>100</b>

### 3.2.3. Procedure of the examined contests

The employees participated voluntarily in the innovation contests which took about seventeen weeks. They had free rein on the group composition, which means that they could choose if they want to work in teams or by their own and on what project. In order to get as many constructive ideas and solutions, the company gave clear challenges – more or less ten problem statements related to digitalization - but participants were also able to submit ideas outside the given challenges, called open challenges. Each contest consisted of six stages but only the best ideas made it each time to the next round. First, all teams or individuals had to submit their ideas on *Yambla*<sup>8</sup>. By publishing the ideas online, the other employees could comment, give suggestions or ask to join the team. Hereafter every team or individual refined its idea. In addition, they developed a Business model canvas, which was also published on *Yambla*. In the course of the next stage, the teams worked further on their Business model canvas by writing a one-pager. Furthermore, they presented their canvas, in the form of an elevator pitch to a jury.

<sup>8</sup> Online Platform, that helps organization to coordinate their innovation contest.

During the last stage, teams with the most promising ideas elaborated on a business opportunity plan, which they presented to the directors. In the last round, the remaining ideas were explained and a jury announced the winning teams.

As a reward, the winning teams were able to work on their ideas aside from their work. The possibility to present their own idea to the directors was for most of the participants also a reward and the reason why they engaged in innovation contests. From 2014 to 2016 about 392 ideas were submitted. Moreover, the ideas were evaluated by Boëne, Leten and Van Dyck (2018) based on meeting these criteria: novelty, feasibility, valuation creation, and specificity which were then ranked from 0 to 5 – with 0 = low level and 5 = high level. Novelty is about how new the idea is. Feasibility refers to the extent to which the idea can be implemented. Value creation correlates to the added value that the idea engenders. And specificity stands for clarity.



## 4. Data Analysis

### 4.1. Dependent variable

In order to get a deeper insight into the team's performance, all teams who participated in the innovation contests organized in 2014, 2015 and 2016 are analyzed and compared with each other. Further, the winning teams of each year – three winners per year - are examined. For this reason, the dependent variable is the quality of the submitted ideas, which focuses on novelty, feasibility, value creation and specificity. These variables are of use to determine the quality of the performances which in turn is the purpose of this paper.

### 4.2. Independent variables

The independent variables are the number of managers and departments, 'mixed gender team', and average age.

The number of managers and the number of departments can be related to diversity in education and knowledge. The second variable, 'Mixed Gender Team', is a dummy variable, allows to determine whether the teams were sheer female or male, or if there were a certain level of gender diversity. Finally, the spread of age will provide the information referred to diversity in age. Table 4 presents the summary statistics for the variables of interest for all three years.

Table 4: Descriptive statistics – Independent variables 2014 -2016

	Mean	Std. Deviation	N
Quality	9,37	2,294	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Mixed Gender Team (dummy)	,20	,404	392
Spread of Age	30,52	4,410	392

### 4.3. Control variable

Team size is the control variable, applied for getting more foresight on the diversity level that exists among the teams. For instance, a team with a higher number of members implies a greater level of diversity which in turn can have a positive impact on the teams' performance. On the other hand, a small sized team may indicate a low level of diversity which can have a negative effect on the performance.

## 4.4. Descriptive analysis -Dependent Variable

### 4.4.1. Quality of submitted ideas

As mentioned above, the quality of submitted ideas derives from the attributes used to qualify the ideas presented. Accordingly, novelty, feasibility, value creation and specificity were utilized. Each idea was evaluated on these characteristics by attributing a score from 0-5 (with 0 = low level and 5= high level).

#### 4.4.1.1. Novelty

It is apparent from the graphs below, that none of the teams got a score of 5 for novelty. The highest score that teams in 2014 and 2016 obtained was 2. In 2015, the highest score was 3. Only a few teams received a score of 0 for their submitted idea.

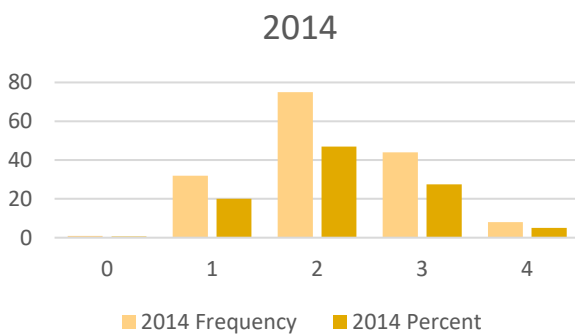


Figure 4: Score for novelty – 2014

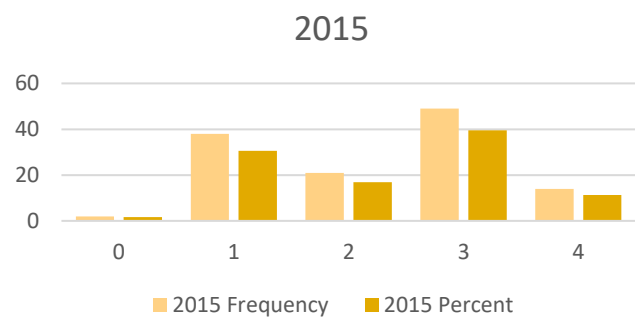


Figure 5: Score for novelty – 2015

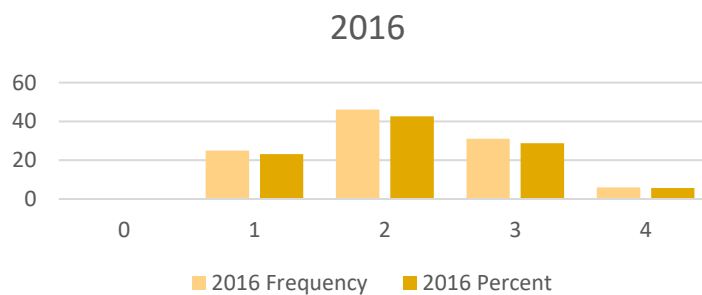


Figure 6: Score for novelty – 2016

### 4.4.1.2. Feasibility

In regards to feasibility, most of the teams attained a score of 3. Only one team in 2015 obtained a score of 5. Compared to novelty, not a team got a score of 0 for their presented idea.

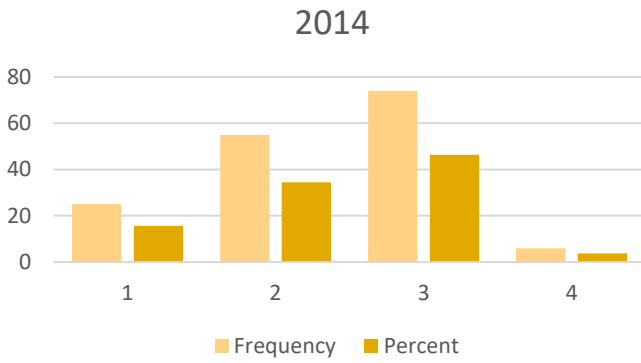


Figure 7: Score for feasibility – 2014

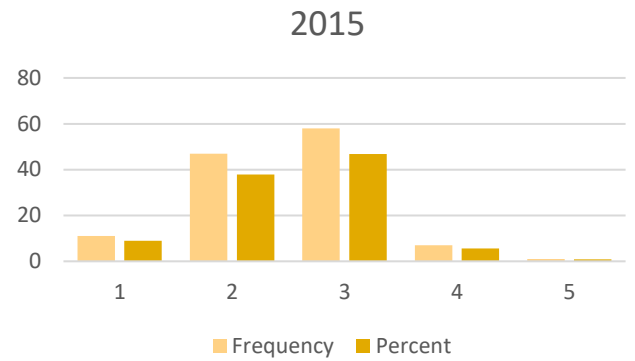


Figure 8: Score for feasibility – 2015

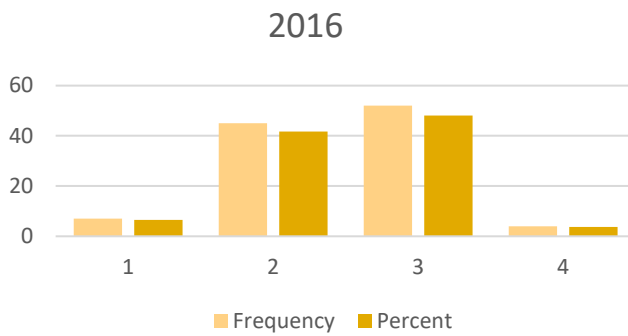


Figure 9: Score for feasibility – 2016

### 4.4.1.3. Value creation

Regarding value creation, there is a similar result as for feasibility, with the difference that the highest score that most of the teams received was 2.

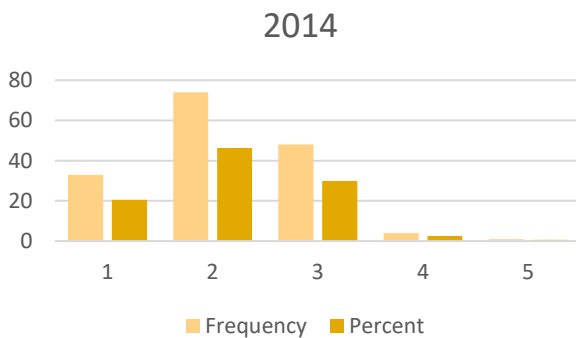


Figure 10: Score for value creation – 2014

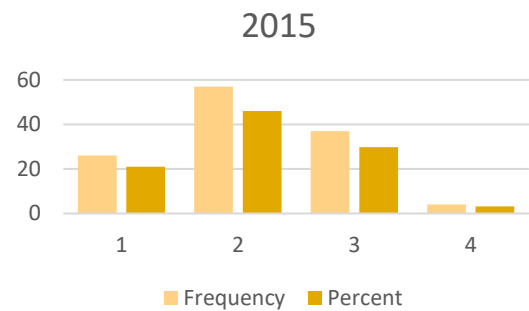


Figure 11 : Score for value creation – 2015



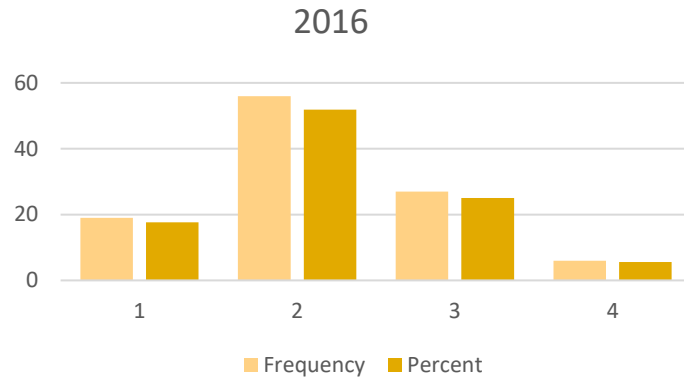


Figure 12: Score for value creation – 2016

#### 4.4.1.4. Specificity

For specificity, the highest score obtained by most of the teams varied between 2 and 3. As the graphs below show, only the teams in 2014 got a score of 3. In the years that followed, the teams substantially achieved a score of 2.

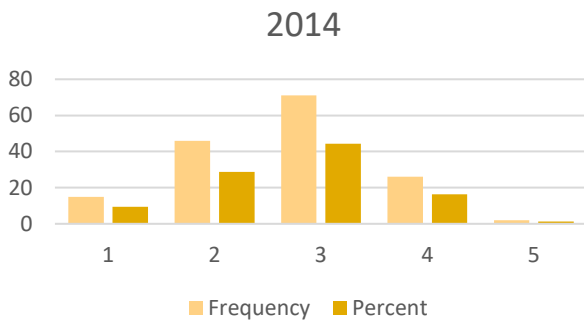


Figure 13: Specificity – 2014

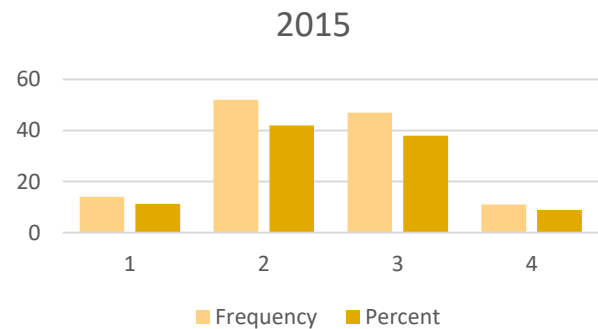


Figure 14: Specificity – 2015

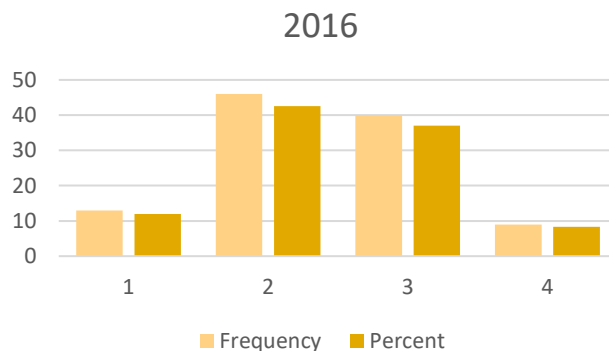


Figure 15: Specificity – 2016

An independent sample means t-test was conducted to analyze whether there is a significant difference in the quality of the submitted ideas. Table 5, shows the summary of the group statistic for 2014 and 2015. It can be seen from this table, that there is a minor difference. The teams in 2014 and 2015 obtained more or less the same scores.

Table 5: Group statistics -2014 and 2015

<b>Group statistics</b>					
	Year	N	Mean	Std. Deviation	Std. Error Mean
Quality	2014	160	9,42	2,233	,177
	2015	124	9,40	2,456	,221

The results of the t-test indicate that there is no significant difference between the variance in 2014 and 2015 as it can be seen from Table 5. In contrast, the difference between the quality of ideas submitted is considerable for 2014 and 2016. The table below shows this difference. A similar result was found when analyzing the quality of ideas submitted in 2015 and 2016.

Table 6: Group statistics – 2014 and 2016

<b>Group statistics</b>					
	Year	N	Mean	Std. Deviation	Std. Error Men
Quality	2014	160	9,42	2,233	,177
	2016	108	9,26	2,206	,212

After comparing the quality of the submitted ideas of 2015 and 2016 (Table 8), it can be said that the teams in 2016 performed lower than those from the years before. A possible explanation for this might be the inferior number of participants. However, further analyses may give more clarification.

Table 7: Group statics – 2015 and 2016

<b>Group statistics</b>					
	Year	N	Mean	Std. Deviation	Std. Error Mean
Quality	2015	124	9,40	2,456	,221
	2016	108	9,26	2,206	,212

In the interest of comparing the quality of the submitted ideas from all three years, a one-way ANOVA test was additionally conducted. The test revealed a significant difference only for specificity, with a significance value of 0.005, which is below 0.05 (Table 8). Table 9, in the Appendix, provides an overview of the results obtained from the Post-Hoc-Test (Multiple comparisons).

Table 8: One-way ANOVA output – Number of managers

One-way ANOVA						
		Sum of Squares	df	Mean of squares	F	Sig.
Novelty	Between groups	1,183	2	,592	,706	,494
	Within groups	325,896	389	,838		
	Total	327,079	391			
Feasibility	Between groups	1,471	2	,736	1,291	,276
	Within groups	221,702	389	,570		
	Total	223,173	391			
Value Creation	Between groups	,062	2	,031	,049	,952
	Within groups	244,160	389	,628		
	Total	244,222	391			
Specificity	Between groups	7,544	2	3,772	5,285	,005
	Within groups	277,630	389	,714		
	Total	285,173	391			

In regards to the winning teams, the graphs below show the scores, obtained for novelty, feasibility, value creation, and specificity. Regarding novelty, the winners of 2015 and 2016 obtained a greater score than those from 2014. Regarding value creation, one winning team of 2016 scored better than those from the previous years. The winners of 2014 and 2015 achieved a greater score for specificity.

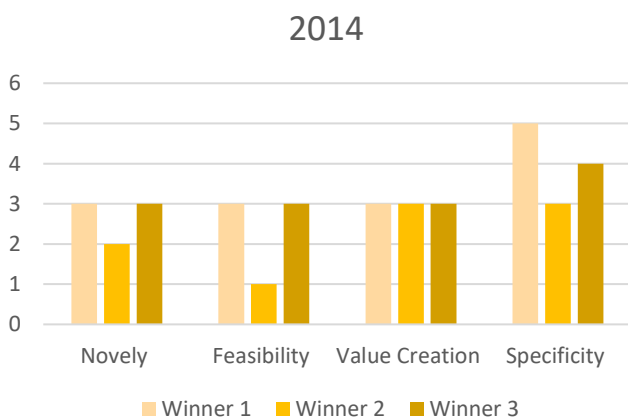


Figure 16: Scores obtained by the winners in 2014

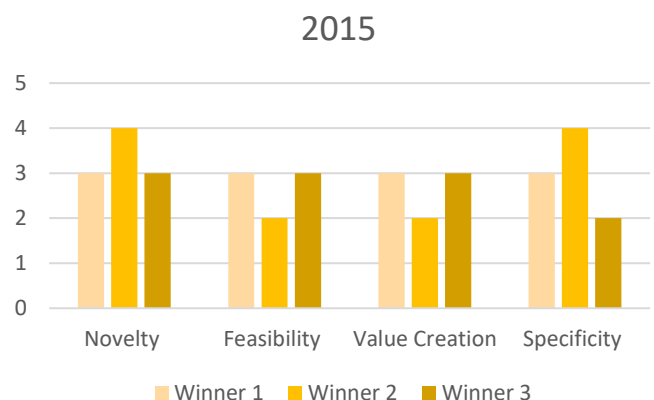


Figure 17: Scores obtained by the winners in 2015

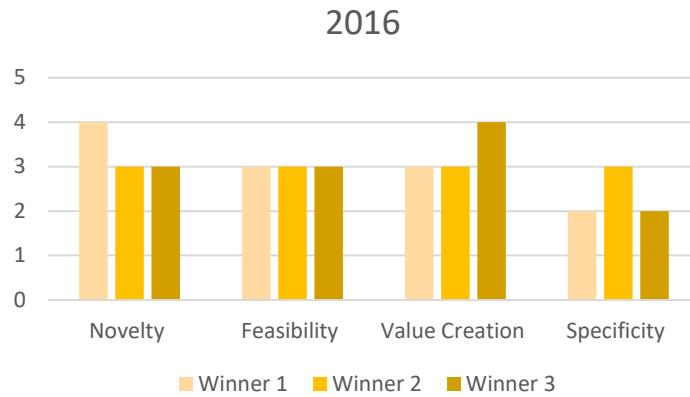


Figure 18: Scores obtained by the winners in 2016

## 4.5. Descriptive analysis – Independent variables

### 4.5.1. Number of managers and departments

With a view to diversity in education and knowledge, the number of managers within the different teams is analyzed. The number of different departments gives an indication of the background of the team members and is therefore as well relevant.

#### 4.5.1.1. Number of managers

As can be seen from Table 10 and Table 11 the number of managers per group was rather low in 2014. 43,8% of the teams had at least one manager. Only 3,8% of the teams consisted of three managers. Same can be said for 2015 and 2016. Nearly most of the teams (56% in 2015 and 62% in 2016) did not include a manager in their team. Table 12 to 15 give an overview of these findings.

Table 10: Frequency Table – Number of managers 2014

<b>Statistics</b>		
Number of Managers		
N	Valid	160
	Missing	0
Mean		,88
Median		1,00
Std. Deviation		,815
Variance		,664
Minimum		0
Maximum		3

Table 11: Number of managers 2014

<b>Number of Managers</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	58	36,3	36,3	36,3
	1	70	43,8	43,8	80,0
	2	26	16,3	16,3	96,3
	3	6	3,8	3,8	100,0
	Total	160	100,0	100,0	

Table 12: Frequency Table – Number of Managers 2015

<b>Statistics</b>		
Number of Managers		
N	Valid	124
	Missing	0
Mean		,73
Median		1,00
Std. Deviation		,779
Variance		,607
Minimum		0
Maximum		3

Table 13: Number of managers 2015

<b>Number of Managers</b>					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	56	45,2	45,2	45,2
	1	49	39,5	39,5	84,7
	2	16	12,9	12,9	97,6
	3	3	2,4	2,4	100,0
	Total	124	100,0	100,0	

Table 14: Frequency Table – Number of Managers 2016

Statistics		
Number of Managers		
N	Valid	108
	Missing	0
Mean		,60
Median		,00
Minimum		0
Maximum		4
Total		65

Table 15: Number of managers 2016

Number of Managers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	62	57,4	57,4	57,4
	1	33	30,6	30,6	88,0
	2	9	8,3	8,3	96,3
	3	2	1,9	1,9	98,1
	4	2	1,9	1,9	100,0
Total		108	100,0	100,0	

A one-way ANOVA confirms a significant decrease in the number of managers within the teams for all three years. The Tables below, as well as the graph, present the results obtained. As Table 16 shows, the significance value is 0.026 ( $p = .026$ ). As a result, it can be said, there is a statistically significant difference in the number of managers in the team.

Table 16: One-way ANOVA output – Number of managers

One-way ANOVA					
Number of Managers					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4,940	2	2,470	3,695	,026
Within Groups	260,057	389	,669		
Total	264,997	391			

However, the Multiple Comparison Table (Table 17: Post-Hoc- Test), which contains the results of the Post-Hoc-Test provides more insight into the disparity in order to find out which of the specific groups differ. The Multiple Comparison Table reveals that there is a statistically significant difference in the number of managers in 2014 and the number of managers in 2016 ( $p = 0.008$ ).

Table 17: Post-Hoc-Test – Number of Managers

Multiple Comparisons							
Dependent Variable: Number of Managers							
	(I) Year	(J) Year	Mean Difference (I-J)	Std.-Error	Sig.	95%-Confidence Interval Lower Bound	Upper Bound
Scheffé-Procedure	2014	2015	,149	,098	,314	-,09	,39
		2016	,273*	,102	,028	,02	,52
	2015	2014	-,149	,098	,314	-,39	,09
		2016	,124	,108	,516	-,14	,39
	2016	2014	-,273*	,102	,028	-,52	-,02
		2015	-,124	,108	,516	-,39	,14
LSD	2014	2015	,149	,098	,128	-,04	,34
		2016	,273*	,102	,008	,07	,47
	2015	2014	-,149	,098	,128	-,34	,04
		2016	,124	,108	,250	-,09	,34
	2016	2014	-,273*	,102	,008	-,47	-,07
		2015	-,124	,108	,250	-,34	,09

\*. The mean difference is significant at the .05 level.

It can be clearly seen from the graph below, that there is a decrease in the number of managers with 2016 counting the merest level of managers.

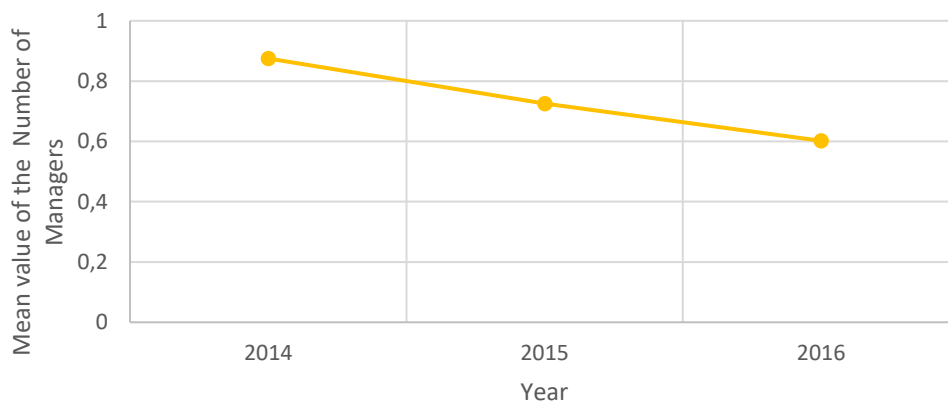


Figure 19: Number of managers

The number of managers inside the teams was relatively small, as noted earlier. In regards to the winning teams, some had at least one manager in their team. But there were also teams that won without having a manager as a team member. Further, none of these winning teams had more than two managers in their team.

Table 18: Number of Managers within the winning Teams

Winner <sup>9</sup>	Number of Managers 2014	Number of Managers 2015	Number of Managers 2016
1	1	1	2
2	2	1	0
3	1	0	1

**4.5.1.2. Number of departments**

On the issue of the number of departments, it was found that most of the participants in 2014 worked with people who were from the same department (64%), while only 26% worked in teams with members from another department (Graph 18).

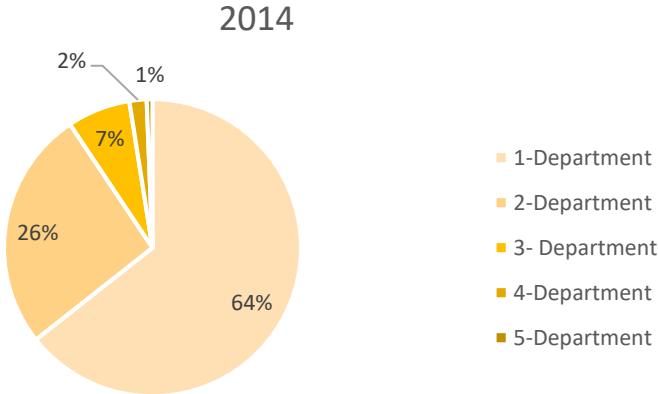


Figure 20: Number of Departments 2014

In 2015 there were again more teams that consisted of members from the same department (51%) and 31% opt for working with people from another department. However, there was a slight increase in teams composed of members from three different departments (15%).

<sup>9</sup> The winners are not ranked by their result but by on the basis of their ID number.



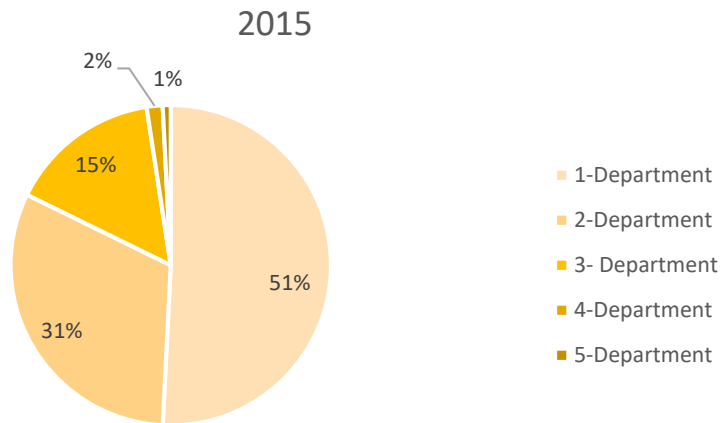


Figure 21: Number of Departments 2015

As can be seen from the graph below, not much has changed in 2016. Still, more participants worked with people from the same department. Only 10% of all teams consisted of members from three different departments.

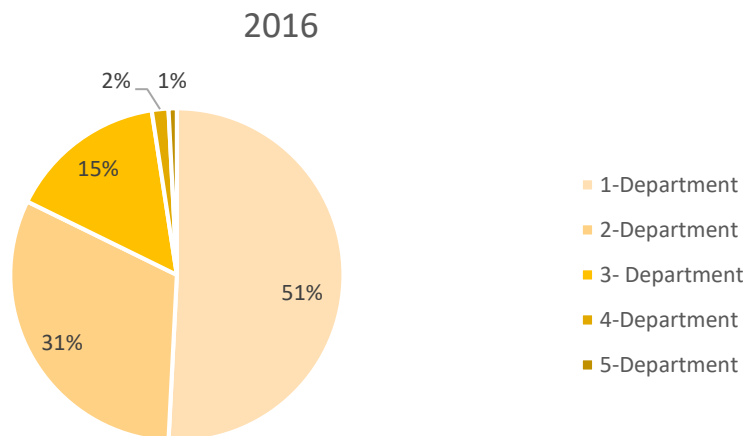


Figure 22: Number of Departments 2016

It is therefore surprising that the winning teams were mainly composed of participants from more than one department. All teams that won in 2014, had members from three distinct departments. One of the winning teams in 2016 had members from five departments, while in 2015, one team that was composed of members from the same department won the contest. Table 20 presents an overview of the winning teams' composition in regards to the number of departments.

Table 19: Number of Departments within the winning teams

Winner	Number of Departments 2014	Number of Departments 2015	Number of Departments 2016
1	3	1	5
2	3	3	2
3	3	2	2

It seems possible that these results are due to the fact that working with people from different departments, enabled sharing of relevant knowledge and information and which in turn lead to better performance.

In order to examine the relationship between the number of departments and the possibility of winning, correlation analyses were conducted for 2014, 2015 and 2016.

The Pearson correlation analysis for 2014 and 2016 revealed a significant correlation between the number of Departments and the possibility to win or not the contest (Table 20 and Table 21).

Table 20: Pearson correlation – Number of departments and possibility to win or not 2014

Correlation			
		Number of Departments	Winner or not
Number of Departments	Pearson Correlation	1	,277**
	Sig. (2-tailed)		,000
	N	160	160
Winner or not	Pearson Correlation	,277**	1
	Sig. (2-tailed)	,000	
	N	160	160

\*\* . Correlation is significant at the 0,01 level (2-tailed).

Table 21: Pearson correlation – Number of departments and possibility to win or not 2016

<b>Correlation</b>			
		Number of Departments	Winner or not
Number of Departments	Pearson Correlation	1	,052
	Sig. (2-tailed)		,563
	N	124	124
Winner or not	Pearson Correlation	,052	1
	Sig. (2-tailed)	,563	
	N	124	124

Table 22: Pearson correlation – Number of departments and possibility to win or not 2015

<b>Correlation</b>			
		Number of Departments	Winner or not
Number of Departments	Pearson Correlation	1	,297**
	Sig. (2-tailed)		,002
	N	108	108
Winner or not	Pearson Correlation	,297**	1
	Sig. (2-tailed)	,002	
	N	108	108

\*\* . Correlation is significant at the 0,01 level (2-tailed).

Contrary to expectations, the correlation analysis for 2015 did not find a significant relationship between the number of departments and the possibility to win or not.

### 4.5.2. Spread in age

The investigations of the average age of the participants from 2014 to 2016 have shown that there was a decline in age. Compared to 2014 and 2015, the candidates were rather younger. However, the decline appeared already after 2014. The participants in 2015 were already younger than those from 2014. The Graph below illustrates the decline in age for three years.

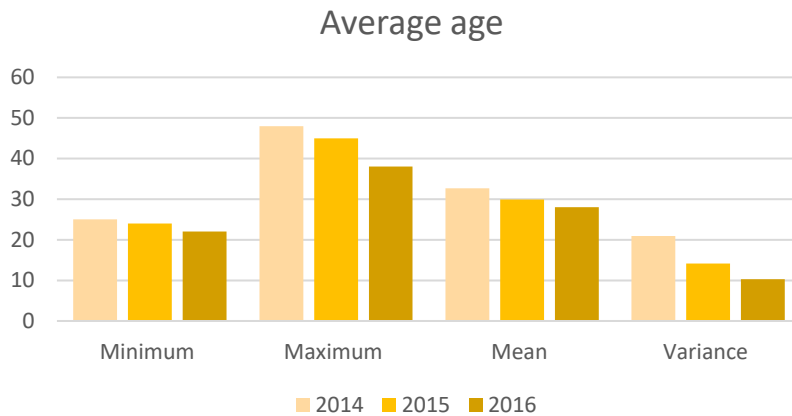


Figure 23: Average age for the three years

The graph also shows that the variance in age is relatively low. Which may indicate a deficient level of age diversity within the groups.

In order to analyze whether there is a significant difference in the spread of age, a one-way ANOVA test was conducted. The investigation has shown, that there is effectively a significant difference in average age, with  $p = .00$ , as indicated in the table below.

Table 23: One-way ANOVA output – Average age

One-way ANOVA					
Average age					
	Sum of Squares	df	Mean Square	F	Sig.
Between the groups	1434,814	2	717,407	45,237	,000
Within the groups	6169,094	389	15,859		
Total	7603,908	391			

The result of the Post-Hoc-Test reveals a significant difference in the spread of age between each of the three years. Table 24, provides an overview of the results obtained.

Table 24: Post-Hoc-Test – Average age

Multiple Comparisons							
Dependent Variable: Average age							
	(I) Year	(J) Year	Mean Difference (I-J)	Std.-Error	Sig.	95%-Confidence interval	
						Lower Bound	Upper Bound
Scheffé- Procedure	2014	2015	2,708*	,476	,000	1,54	3,88
		2016	4,616*	,496	,000	3,40	5,83
	2015	2014	-2,708*	,476	,000	-3,88	-1,54
		2016	1,908*	,524	,001	,62	3,20
	2016	2014	-4,616*	,496	,000	-5,83	-3,40
		2015	-1,908*	,524	,001	-3,20	-,62
LSD	2014	2015	2,708*	,476	,000	1,77	3,65
		2016	4,616*	,496	,000	3,64	5,59
	2015	2014	-2,708*	,476	,000	-3,65	-1,77
		2016	1,908*	,524	,000	,88	2,94
	2016	2014	-4,616*	,496	,000	-5,59	-3,64
		2015	-1,908*	,524	,000	-2,94	-,88

\*. The mean difference is significant at the .05 level.

Table 25: Spread in age of the winning team members

Winner	Average age 2014	Average age 2015	Average age 2016
1	31	34	31
2	31	30	25
3	31	29	27

Table 24, which gives an overview of the spread in age of the winning teams' members, matches with the observations made based on Graph 21. As can be seen, the differences between the average age of the team members in 2015 and 2016 who won the contests inferior. However, when comparing the winners for each year with each other, it can be seen that the spread in age between these groups does not differ significantly.

### 4.5.3. Mixed Gender Team

The variable, mixed gender teams, provides some insight into the level of gender diversity during the contest in 2014, 2015 and 2016. Among the 160 ideas submitted in 2014, 41 were submitted by teams composed of females and males. In 2015, 54 ideas were presented by mixed gender teams, in contrast to only 34 mixed gender teams in 2016.

**Mixed Gender Team**

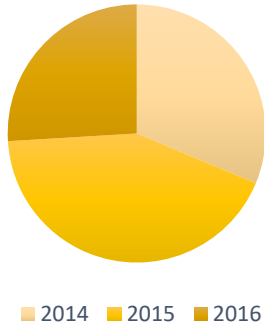


Figure 24: Mixed gender teams

The findings of the one-way ANOVA test confirm this difference in gender diversity as a significant variance,  $p = 0.036$ , was found.

Table 26: One-way ANOVA test – Mixed Gender Team

One-way ANOVA					
Mixed Gender Team (dummy)					
	Sum of Squares	df	Mean Square	F	Sig.
Between groups	1,077	2	,538	3,346	,036
Within groups	62,597	389	,161		
Total	63,673	391			

The post-hoc test shows only one significant difference between the mixed gender teams in and the mixed gender teams in 2016, with  $p = 0.010$  (Table 27).

This result is not surprising as there was a substantial decrease in the number of mixed teams after 2015 as Figure 25 provides illustrations.

Table 27: Post-Hoc-Test – Mixed Gender Team

Multiple Comparisons							
Dependent Variable: Mixed Gender Team (dummy)							
	(I) Year	(J) Year	Mean Difference (I-J)	Std.-Error	Sig.	95%-Confidence interval	
						Lower Bounder	Upper Bounder
Scheffé- Procedure	2014	2015	-,060	,048	,460	-,18	,06
		2016	,077	,050	,310	-,05	,20
	2015	2014	,060	,048	,460	-,06	,18
		2016	,136*	,053	,036	,01	,27
	2016	2014	-,077	,050	,310	-,20	,05
		2015	-,136*	,053	,036	-,27	-,01
LSD	2014	2015	-,060	,048	,213	-,15	,03
		2016	,077	,050	,126	-,02	,17
	2015	2014	,060	,048	,213	-,03	,15
		2016	,136*	,053	,010	,03	,24
	2016	2014	-,077	,050	,126	-,17	,02
		2015	-,136*	,053	,010	-,24	-,03

\*. The mean difference is significant at the .05 level.

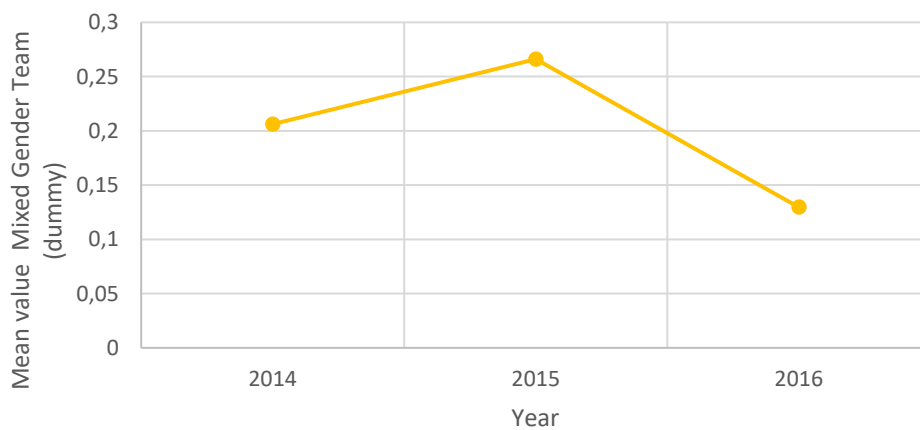


Figure 25: Changes in the number of mixed gender teams

In regards to the winning teams, the table below shows that five of the nine teams consisted of mixed gender members. However, the mixed gender teams in 2014 and 2015 were rather male-dominated – only one member of the team was female. But in spite of that, the mixed gender team of 2016 is female dominated – three female members and two male members.

Table 28: Mixed Gender Team- Winning Teams

Winner	Mixed Gender Team 2014	Mixed Gender Team 2015	Mixed Gender Team 2016
1	0	0	0
2	1	1	0
3	1	1	1

## 4.6. Descriptive analysis – Control variable

### 4.6.1. Team size

The control variable which is team size might as well have an impact on the team’s performance, therefore a descriptive study was implemented. There was a slight change in the number of team members during the three years with first a decrease in the maximum amount of team members after 2014, followed by a minor increase in 2016. The Table below, together with Figure 26, illustrates the changes in team size for the three years.

Table 29: Descriptive statistics – Team size

Descriptive Statistics								
Team Size								
	N	Mean	Std.- Deviation	Std.-Error	95%- Confidence interval for the Mean value		Minimum	Maximum
					Lower Boulder	Upper Boulder		
2014	160	1,85	1,100	,087	1,68	2,02	1	6
2015	124	2,25	1,406	,126	2,00	2,50	1	5
2016	108	2,39	1,406	,135	2,12	2,66	1	7
Total	392	2,13	1,308	,066	2,00	2,25	1	7



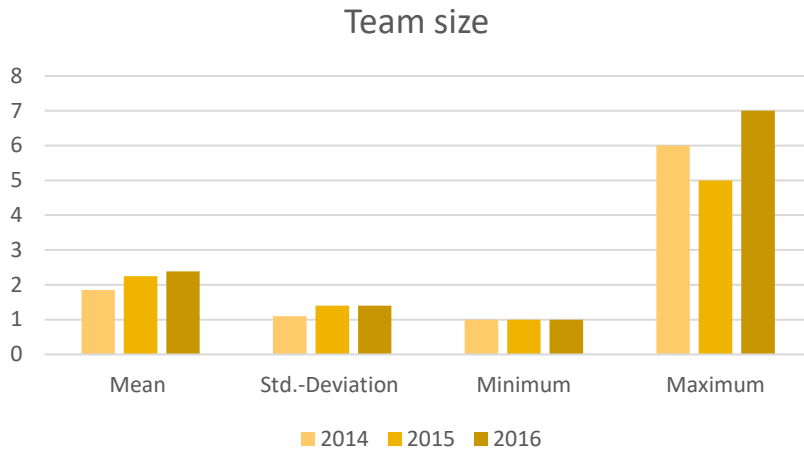


Figure 26: Team size

Based on the table below, and by only focusing on the mean value for all three years, it can be said that the winning teams from 2016 were in some extent larger than those from the previous years. Only one of the winning teams in 2015 was composed of a single person. It can therefore not ruled out that the number of team members has an impact on performance and with regard to innovation contests probably even influences the chances of winning.

Table 30: Mixed Gender Team- Winning Teams

Winner	Team size 2014	Team size 2015	Team size 2016
1	4	1	6
2	4	4	3
3	4	4	4
Mean	4	3	4,333

## 4.7. Linear Regression

In addition to the descriptive analysis, the t- and ANOVA tests, and correlation analysis, an ordinary least squares regression (linear regression) was conducted, using SPSS and a significance level of 5% to investigate the impact of the independent variables on the dependent variable. The independent variable is the quality of idea submitted whereas the dependent variables are equal to those used for the descriptive analysis (number of managers, number of departments, age, and mixed gender teams). Team size is once again the control variable.

Table 31: Linear regression – descriptive statistics

Descriptive Statistics			
	Mean	Std.-Deviation	N
Quality	9,37	2,294	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Spread of Age	30,52	4,410	392
Mixed Gender Team (dummy)	,20	,404	392
Team Size	2,13	1,308	392

### 4.7.1. Interpretation of the outputs

The R-squared indicates the proportion of the variance related to the dependent variable. This variance can be justified by the independent variables. More than one independent variable is used, therefore the focus lies on the adjusted R-squared, which rectifies positive bias in order to provide a value that would be expected in the population of interest. The table below shows a slight difference between the two values, R-squared > Adjusted R-squared. Nevertheless, the independent variables explain to 16% of the variability of the dependent variable. With  $F = 16,961$   $p < 0.000$ , it can be said that the model implemented can statistically significantly predict the dependent variable ID code.

Table 32: Linear regression – Model summary

Model Summary				
Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate
1	,409 <sup>a</sup>	,168	,157	2,106

Table 33: Linear regression – ANOVA table

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	344,744	5	68,949	15,542	,000 <sup>b</sup>
	Residual	1712,358	386	4,436		
	Total	2057,102	391			

a. Dependent variable: Quality

b. Predictors: Mixed Gender Team (dummy), Spread of age, Number of Departments, Novelty, Team Size

Table 34: Linear regression output

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std.-Error	Beta		
1	(Constant)	9,416	,920		10,236	,000
	Number of Managers	,111	,170	,040	,650	,516
	Number of Departments	,110	,207	,039	,533	,594
	Spread of age	-,052	,028	-,100	-1,842	,066
	Mixed Gender Team (dummy)	-,502	,311	-,088	-1,612	,108
	Team Size	,653	,143	,372	4,573	,000

a. Dependent Variable: Quality

The control variable, team size, indicate a significant correlation to the dependent variable. As a result, a unit change in team size would generate an increase in the quality of the idea submitted. However, spread in age, the number of managers and the number of departments do not show a significant correlation.

Considering, that most of the problem statements proposed by the organization were related to digitalization, the reason why the number of departments does not show a significant relationship to the quality of submitted ideas may be, that the organization focuses on Information Technology. As a result, it hires people who have a passion for IT. Regardless of the education they have, or in which department they are working, a certain level of IT knowledge is indispensable. In addition, this organization expects analytical skills and logical thinking from all its employees. It can be therefore assumed that all employees have a basic knowledge of IT. Nevertheless, those with an educational background in IT might have more experience and knowledge than the others.

A possible explanation for number of managers not to be significant can be the low presence of managers within the teams as found in the previous paragraph. In regards to age, it seems possible that this result is due to the fact that the sample consists of rather young participants, which explains the modest spread in age. The result could look different with a greater age difference between the participants.

In the interest of detecting a possible correlation between the variables of interest and the specific indicators for quality, a second linear regression was conducted. The independent variables for this regression are a number of managers, number of departments, age, and mixed gender. The control variable remains the same and the dependent variable is now value creation.

Table 35: Linear regression – descriptive statistics

<b>Descriptive Statistics</b>			
	Mean	Std.-Deviation	N
Value Creation	2,17	,790	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Age	30,52	4,410	392
Mixed Gender Team (dummy)	,20	,404	392
Team Size	2,13	1,308	392

#### **4.7.2. Interpretation of the outputs**

As can be seen from the tables below, the independent variables explain to 5% of the variability of the dependent variable. With  $F = 16,961$   $p < 0.000$ , it can be said that the model implemented can statistically significantly predict the dependent variable value creation.

Table 36: Linear regression – Model summary

<b>Model Summary</b>				
Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate
1	,256 <sup>a</sup>	,066	,053	,769

a. Predictors: (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 37: Linear regression – ANOVA table

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean of Squares	F	Sig.
1	Regression	16,004	5	3,201	5,414	,000 <sup>b</sup>
	Residual	228,218	386	,591		
	Total	244,222	391			

a. Dependent Variable: Value Creation

b. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 38 presents the outcome of the regression. Only two variables show a significant correlation to the dependent variable ( $p = 0.034$ ;  $p = 0.004$ ). As in the previous study, team size is again positively related to value creation and therefore a unit increase in team size would lead to an increase in the dependent variable. It is interesting to note that the dummy variable, mixed gender team indicates a significant correlation to value creation. A unit increase in mixed gender would result in a decrease in value creation. What is surprising is, that this correlation is negative. It is surprising in so far, as it was observed that some of the winning teams consisted of members of different genders. However, it seems possible that this result is due to the fact that these mixed-gender teams were disproportionate. Mixed teams that won were mainly male-dominated whereas only one mixed gender team was female-dominated.

Contrary to expectations, this regression did once again not find a significant relationship between the number of managers, the number of departments, spread in age, and value creation. It can be assumed that this result derives from the same reasons as discussed above.

Table 38: Linear regression output

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std.-Error	Beta		
1	(Constant)	2,198	,336		6,545	,000
	Number of Managers	,028	,062	,030	,456	,648
	Number of Departments	,020	,075	,021	,272	,786
	Age	-,012	,010	-,065	-1,132	,258
	Mixed Gender Team (dummy)	-,242	,114	-,124	-2,130	,034
	Team Size	,151	,052	,250	2,894	,004

a. Dependent Variable: Value Creation

## 4.8. Phone Interview

I had the pleasure to conduct a phone interview with one of the former participants of the innovation contest, discussed in the previous paragraphs. The respondent was a woman who worked for more than two years in the organization that organized these contests. The interview lasted thirty minutes and was carried out in order to get more information about the composition of the teams, the interaction, and communication between the different members and the impact it had on the team performance.

In regards to innovation contests, she is of the opinion that on the one hand, it is a great opportunity that organizations offer to their employees as it allows them to work on another project together with high-qualified people. On the other hand, it stimulates employees to leave the company in order to work further on their own project (e.g. creation of startups), as she did. Due to this, companies are losing highly qualified employees.

The respondent worked on an idea proposed by one of her male colleagues. Later, a third person, who was also male, joined the group. Three other people helped from time to time. She did not choose her team members and even though her collaboration was relatively successful, she would never want to be part of such a team again, as she felt that she and her team members were too different.

The three main team members were from different departments and of different ages (26, 30 and 40). One of her partners was an IT manager, while the other was from the Strategic Department. She, in contrast, was new to the company and had less professional experience than the two others. According to her, working with a manager has a positive impact on the performance, as it stimulates the ambition and allows to acquire knowledge from an experienced person. Further, she claimed that the fact that all of them were from different departments, and the different educational backgrounds were an additional advantage for the team. However, personal characteristics such as talkativeness, team player, and others, were more significant and complicated the collaboration. Disagreements within the team resulted in creative solutions that the team would otherwise not have come up with.

Finally, she believes that diversity is important in organizations since it increases creativity in terms of problem-solving. Companies should, therefore, promote diversity. However, care should be taken to ensure that all employees have the same approach and that there is a clear indication of who will take the final decision, in order to avoid discussions and save time. In addition, team members should know each other well enough (habits, what they like or dislike, etc.) to better understand the different behaviors as this may help in managing diverse teams.



## 5. Conclusion

This paper has argued that diversity in age, gender, education, and knowledge within work teams has an impact on innovation, which is related to the teams' performance. The following conclusion can be drawn from the present study:

The results of this investigation show that diversity in gender is the only variable that indicates a significant but negative correlation in regards to value creation. These result is consistent with those of Horwitz (2007) and suggests a negative correlation between gender and collaboration.

Contrary to expectations, this study did not find a significant correlation between diversity in age, education and knowledge and the quality of submitted ideas.

In regards to diversity in age, the result corroborates to some extent with the findings of the quantitative research conducted by Cady and Valentine (1999), and Østergaard (2011) that have shown that age has no or only a negative impact on innovation.

It is interesting to note that the number of managers and the number of departments which indicate diversity in education and knowledge do not present a significant relationship to the dependent variable. This is in so far interesting since many researchers, like for instance (2011) Bantel and Jackson (1989) argue that diversity in education has a stronger positive correlation to performance than diversity in gender and age. Similarly, Taylor and Greve (2006) state that diversity in knowledge is positively related to performance, as it leads to original outcomes.

One of the more surprising findings to emerge from this study is, that the results of both regressions show a positive and significant correlation between team size and the dependent variables. Further, it is interesting to note, that by running regressions with one of the indicators of quality (novelty, feasibility, value creation, and specificity) as the dependent variable and by retaining the same independent variables, team size always revealed to be positively related to the respective dependent variable (the results and tables can be found in the Appendix).



Taken together, it can be said, that diversity is inevitable in organizations. Companies should, therefore, engage the extent to which diversity is present in the workplace in order to manage it appropriately and to profit from the advantages of diversity. Heterogenous teams should be managed differently than homogenous teams. Considering that several studies, which were discussed in the previous paragraphs surprisingly indicate that diversity in age tends to have a negative impact on performance, it is advisable to ensure that the age difference between group members is not excessive. Nevertheless, a certain level of cooperation between the different age groups should not be avoided, allowing different perspectives and experiences to be exchanged, which can be relevant to the group. In regards to gender diversity, even if some studies have found out that diversity in gender is rather negative, a positive influence cannot be excluded, as it may influence the innovation performance positively Østergaard (2011).

Regarding education and knowledge, only people whose knowledge is related to the subject of interest should work together. This includes the presence of top managers and employees from different departments. As a result, problems in communication, disagreements and the creations of groups (in -groups and out- groups) which in turn will have a negative impact on the overall team performance can be avoided.

In summary, it can be stated that diversity in work teams can have a positive impact on innovation as long as it is first, well governed by the organization through, for instance, selecting one person who will be in charge of taking essential decisions, clear guidelines, regular feedback session, and others. Second, care should be taken that the size of these diverse work groups is not too large, as a high level of diversity within a team is more disadvantageous than advantageous. Finally, all team members should share the same goal and objective.

### **5.1. Limitation and implication for future research**

The findings in this report are subject to at least three limitations. First, the regressions provide an R-square close to 0, which means that there are other omitted variables that explain the dependent variable. Further studies, which take these variables into account, will need to be undertaken. Second, the current study was not specifically designed to evaluate the reasons that cause the different correlations. Further research in this field would be of great help in understanding the obtained results and how negative correlations can be changed. Thirdly, the study was limited by only one phone interview with a former participant. It would be interesting to compare the experiences of individuals who got involved in innovation contests.



# Appendix

## Mixed gender Team

Table 9: Post-Hoc-Test – Mixed Gender Team – Quality of idea submitted

Multiple Comparisons									
Dependent Variable		(I) Year	(J) Year	Mean Difference(I -J)	Std.-Error	Sig.	95%-Confidence interval		
							Lower Bounder	Upper Bounder	
Novelty MB	Scheffé-Procedure	2014	2015	-,120	,110	,550	-,39	,15	
			2016	-,004	,114	,999	-,28	,28	
		2015	2014	,120	,110	,550	-,15	,39	
			2016	,116	,120	,631	-,18	,41	
		2016	2014	,004	,114	,999	-,28	,28	
			2015	-,116	,120	,631	-,41	,18	
	LSD	2014	2015	-,120	,110	,275	-,34	,10	
			2016	-,004	,114	,971	-,23	,22	
		2015	2014	,120	,110	,275	-,10	,34	
			2016	,116	,120	,338	-,12	,35	
		2016	2014	,004	,114	,971	-,22	,23	
			2015	-,116	,120	,338	-,35	,12	
	Feasibility MB	Scheffé-Procedure	2014	2015	-,135	,090	,329	-,36	,09
				2016	-,109	,094	,508	-,34	,12
2015			2014	,135	,090	,329	-,09	,36	
			2016	,025	,099	,968	-,22	,27	
2016			2014	,109	,094	,508	-,12	,34	
			2015	-,025	,099	,968	-,27	,22	
LSD		2014	2015	-,135	,090	,136	-,31	,04	
			2016	-,109	,094	,245	-,29	,08	

	2015	2014	,135	,090	,136	-,04	,31	
		2016	,025	,099	,798	-,17	,22	
	2016	2014	,109	,094	,245	-,08	,29	
		2015	-,025	,099	,798	-,22	,17	
Value Creation MB	Scheffé- Procedure	2014	2015	,009	,095	,995	-,22	,24
			2016	-,023	,099	,974	-,27	,22
		2015	2014	-,009	,095	,995	-,24	,22
			2016	-,032	,104	,954	-,29	,22
		2016	2014	,023	,099	,974	-,22	,27
			2015	,032	,104	,954	-,22	,29
	LSD	2014	2015	,009	,095	,922	-,18	,20
			2016	-,023	,099	,818	-,22	,17
		2015	2014	-,009	,095	,922	-,20	,18
			2016	-,032	,104	,759	-,24	,17
		2016	2014	,023	,099	,818	-,17	,22
			2015	,032	,104	,759	-,17	,24
Specificity MB	Scheffé- Procedure	2014	2015	,269*	,101	,030	,02	,52
			2016	,296*	,105	,020	,04	,55
		2015	2014	-,269*	,101	,030	-,52	-,02
			2016	,027	,111	,971	-,25	,30
		2016	2014	-,296*	,105	,020	-,55	-,04
			2015	-,027	,111	,971	-,30	,25
	LSD	2014	2015	,269*	,101	,008	,07	,47
			2016	,296*	,105	,005	,09	,50
		2015	2014	-,269*	,101	,008	-,47	-,07
			2016	,027	,111	,809	-,19	,25
		2016	2014	-,296*	,105	,005	-,50	-,09
			2015	-,027	,111	,809	-,25	,19

\*. Die Differenz der Mittelwerte ist auf dem Niveau 0.05 signifikant.



## **Phone Interview – Questions**

1. What is your overall impression of innovation contests?
2. Did you work in a team? If No, why?
  - a. If yes, why? How many people were in the team?
  - b. Why did you choose to work with these people?
  - c. Was there any kind of difference within the team ( age, gender, educational background), if yes do you think that these/this difference(s) had an impact on your Team performance?
  - d. Did you deal with any difficulties/ problems (e. g. communication problems, disagreements...)? According to you, what were the reasons why these problems occurred? (Do you think that these difficulties are due to the differences within your group?)
3. What is your opinion on diversity in work groups? Do you think that managers should promote diversity?



## Linear regression – additional analysis

Table 40: Linear regression – descriptive statistics (Novelty)

Descriptive Statistics			
	Mean	Std.-Deviation	N
Novelty	2,20	,915	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Age	30,52	4,410	392
Mixed Gender Team (dummy)	,20	,404	392
Team Size	2,13	1,308	392

Table 41: Linear regression – Model summary (Novelty)

Model Summary				
Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate
1	,447 <sup>a</sup>	,200	,189	,823

a. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 42: Linear regression – ANOVA table (Novelty)

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	65,340	5	13,068	19,272	,000 <sup>b</sup>
	Residual	261,739	386	,678		
	Total	327,079	391			

a. Dependent Variable: Novelty

b. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments



Table 43: Linear regression output (Novelty)

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std.-Error	Beta		
1	(Constant)	2,143	,360		5,957	,000
	Number of Managers	,123	,067	,110	1,842	,066
	Number of Departments	,074	,081	,065	,911	,363
	Age	-,021	,011	-,100	-1,873	,062
	Mixed Gender Team (dummy)	-,127	,122	-,056	-1,047	,296
	Team Size	,239	,056	,342	4,286	,000

a. Dependent Variable: Novelty

Table 44: Linear regression – descriptive statistics (Feasibility)

Descriptive Statistics			
	Mean	Std.-Deviation	N
Feasibility	2,45	,755	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Age	30,52	4,410	392
Mixed Gender Team (dummy)	,20	,404	392
Team Size	2,13	1,308	392

Table 45: Linear regression – Model summary (Feasibility)

Model Summary				
Model	R	R-Square	Adjusted R-Square	Std. Error of Estimate
1	,232 <sup>a</sup>	,054	,042	,740

a. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 46: Linear regression – ANOVA table (Feasibility)

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12,053	5	2,411	4,407	,001 <sup>b</sup>
	Residual	211,121	386	,547		
	Total	223,173	391			

a. Dependent Variable: Feasibility

b. Predictors: (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 47: Linear regression output (Feasibility)

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std.-Error	Beta		
1	(Constant)	2,580	,323		7,987	,000
	Number of Managers	-,008	,060	-,009	-,138	,891
	Number of Departments	-,066	,073	-,070	-,910	,364
	Age	-,011	,010	-,064	-1,104	,270
	Mixed Gender Team (dummy)	,013	,109	,007	,117	,907
	Team Size	,150	,050	,259	2,985	,003

a. Dependent Variable: Feasibility

Table 48: Linear regression – descriptive statistics (Specificity)

<b>Descriptive Statistics</b>			
	Mean	Std.-Deviation	N
Specificity	2,55	,854	392
Number of Managers	,75	,823	392
Number of Departments	1,59	,804	392
Age	30,52	4,410	392
Mixed Gender Team (dummy)	,20	,404	392
Team Size	2,13	1,308	392

Table 49: Linear regression – Model summary (Specificity)

<b>Model Summary</b>				
Modell	R	R-Square	Adjusted R-Square	Std. Error of Estimate
1	,214 <sup>a</sup>	,046	,033	,840

a. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 50: Linear regression – ANOVA table (Specificity)

<b>ANOVA<sup>a</sup></b>						
Model		Sum of Square	df	Mean Square	F	Sig.
1	Regression	13,070	5	2,614	3,708	,003 <sup>b</sup>
	Residual	272,104	386	,705		
	Total	285,173	391			

a. Dependent Variable: Specificity

b. Predictors : (Constant), Team Size, Age, Mixed Gender Team (dummy), Number of Managers, Number of Departments

Table 51: Linear regression output (Specificity)

Coefficients <sup>a</sup>						
Model		Unstandardized Coefficients		Standardized Coefficient	T	Sig.
		B	Std.-Error	Beta		
1	(Constant)	2,495	,367		6,805	,000
	Number of Managers	-,032	,068	-,031	-,474	,636
	Number of Departments	,082	,082	,077	,996	,320
	Age	-,009	,011	-,045	-,774	,440
	Mixed Gender Team (dummy)	-,145	,124	-,069	-1,171	,242
	Team Size	,113	,057	,173	1,987	,048

a. Dependent Variable: Specificity



## References

- Bantel, K. A., & Jackson, S. E. (1989). Top management and innovations in banking: Does the composition of the top team make a difference? *Strategic management journal*, 10(S1), 107-124.
- Boudreau, K. J., Lacetera, N., & Lakhani, K. R. (Boudreau et al.). Incentives and problem uncertainty in innovation contests: An empirical analysis. *Management science*, 57(Bantel & Jackson), 843-863.
- Brown, E. L. (2013, July 18). The longitude problem: how we figured out where we are.
- Business Dictionary. (n.d.). Innovation. Retrieved from <http://www.businessdictionary.com/definition/innovation.html>
- Hendriks, P. d. (2017). Introduction to classic thought on strategic management.
- Knowledge@Wharton. (2014, February 20). *Why Some Innovation Tournaments Succeed and Others Fail*. Retrieved from Knowledge@Wharton : <http://knowledge.wharton.upenn.edu/article/innovation-tournaments-succeed-others-fail/>
- Business Dictionary. (n.d.). Innovation. Retrieved from <http://www.businessdictionary.com/definition/innovation.html>
- Cady, S. H., & Valentine, J. (Cady & Valentine). Team innovation and perceptions of consideration: What difference does diversity make? *Small Group Research*, 30(Boudreau et al.), 730-750.
- Christian, J., Porter, L. W., & Moffitt, G. (Christian, Porter, & Moffitt). Workplace diversity and group relations: An overview. *Group Processes & Intergroup Relations*, 9(Bantel & Jackson), 459-466.
- Coad, A., Amoroso, S., & Grassano, N. (Coad et al.). Diversity in one dimension alongside greater similarity in others: evidence from FP7 cooperative research teams. *Journal of Technology Transfer*, 42(Bantel & Jackson), 1170-1183. doi:10.1007/s10961-017-9563-2
- Galia, F., & Zenou, E. (2013). *Does board diversity influence innovation? The impact of gender and age diversity on innovation types*. Paper presented at the XXII Conference Internationale de Management Strategic.
- Guillaume, Y. R. F., Dawson, J. F., Otaye-Ebede, L., Woods, S. A., & West, M. A. (2017). Harnessing demographic differences in organizations: What moderates the effects of workplace diversity? *Journal of Organizational Behavior*, 38(2), 276-303. doi:10.1002/job.2040
- Haller, J. B., Bullinger, A. C., & Möslin, K. M. (Boudreau et al.). Innovation contests. *Business & Information Systems Engineering*, 3(Bantel & Jackson), 103-106.
- Horwitz, S. K., & Horwitz, I. B. (Coad et al.). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of management*, 33(Boudreau et al.), 987-1015.
- Jackson, S. E. (1996). The consequences of diversity in multidisciplinary work teams. *Handbook of work group psychology*, 53-75.
- Jackson, S. E., May, K. E., & Whitney, K. (1995). Understanding the dynamics of diversity in decision-making teams. *Team effectiveness and decision making in organizations*, 204, 261.
- Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field

- study of diversity, conflict and performance in workgroups. *Administrative science quarterly*, 44(4), 741-763.
- Laughlin, P. R., & Adamopoulos, J. (1980). Social combination processes and individual learning for six-person cooperative groups on an intellectual task. *Journal of Personality and Social Psychology*, 38(6), 941.
- Kearney, E., Gebert, D., & Voelpel, S. C. (Kearney, Gebert, & Voelpel). When and how diversity benefits teams: The importance of team members' need for cognition. *Academy of Management journal*, 52(Bantel & Jackson), 581-598.
- Kozlowski, S. W., & Bell, B. S. (Coad et al.). Work groups and teams in organizations. *Handbook of psychology*, 333-375.
- McMahon, A. M. (Coad et al.). Does workplace diversity matter? A survey of empirical studies on diversity and firm performance, 2000-09. *Journal of Diversity Management*, 5(Bantel & Jackson), 37-48.
- Ng, T. W., & Feldman, D. C. (Coad et al.). Age and innovation-related behavior: The joint moderating effects of supervisor undermining and proactive personality. *Journal of Organizational Behavior*, 34(Bantel & Jackson), 583-606.
- Ozturk, S. Diversity at Workplace....
- Østergaard, C. R., Timmermans, B., & Kristinsson, K. (2011). Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, 40(3), 500-509.
- Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (Cady & Valentine). Exploring the black box: An analysis of work group diversity, conflict and performance. *Administrative science quarterly*, 44(Bantel & Jackson), 1-28.
- Taylor, A., & Greve, H. R. (2006). Superman or the fantastic four? Knowledge combination and experience in innovative teams. *Academy of Management Journal*, 49(4), 723-740.
- Terwiesch, C., & Ulrich, K. T. (Coad et al.). Picking the Winners. *International Commerce Review*, 9(Bantel & Jackson), 10-21.
- The effects of team diversity on team outcomes: A meta-analytic review of team demography. (2007). *Journal of management*, 33(6), 987-1015.
- Van der Vegt, G. S., & Janssen, O. (Coad et al.). Joint impact of interdependence and group diversity on innovation. *Journal of management*, 29(Bantel & Jackson), 729-751.
- Weiermair, K. (Coad et al.). Product improvement or innovation: What is the key to success in tourism. Paper presented at the Innovations in tourism UNWTO conference.
- Williams, K. Y., & O'Reilly III, C. A. (1998). Demography and. *Research in organizational behavior*, 20, 77-140.
- Why Some Innovation Tournaments Succeed and Others Fail. Knowledge@Wharton (2014, February 20). Retrieved from <http://knowledge.wharton.upenn.edu/article/innovation-tournaments-succeed-others-fail/>