MASTER

Leadership in open innovation teams
how to increase team performance through effective leadership behaviour?

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Leadership in open innovation teams: 
How to increase team performance 
through effective leadership behaviour?

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Abstract

Open innovation research and development teams are formed from team members coming from all joining organizations joining in the project. This brings forth high levels of diversity in the team, across both surface- as well as deep-level attributes. This diversity, according to theory, can be an advantage but also an impairment to team performance. We set out to find out what the effects of team diversity on team performance are in the open innovation context, what leadership can do to increase performance and to find out what role there is for processes of information elaboration and team identification. Based on a survey study among 18 project teams operating in the Dutch polymer industry, we found that team diversity has a negative relation with information elaboration, but that functional diversity has a positive relation to team performance. Thus showing evidence for both sides of the theory. Also, the importance of leadership has been demonstrated since both studied types of leadership behaviour showed a positive relation with team performance. From the study we can conclude that diversity is a thing that needs to be taken into account when operating in an open innovation environment and that there is an important task for the team leader in managing this.
Acknowledgements

The report you are about to read is the end product of my graduation project of the master Innovation Management at the Eindhoven University of Technology. The road to the start and end of this project has been long, intensive but also a lot of fun. I would like to use this page in my final report to tell you some things about how I got here and give honour to those who deserve it.

It is almost three years ago now since I started with my pre-master for Innovation Management and moved to live in Eindhoven. The move across half of the country helped me develop myself even further and become who I am today. However, I would not have been able to accomplish this without the unlimited support and wise words of my parents, sister and Florentine. Further I would like to thank my fellow students, roommates and members of Industria, who have made me feel right at home here in Brabant.

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Having said all this, rests me nothing more than to wish you a pleasant time reading my thesis.

Derk van Noord
Zoetermeer, July 6th 2014
Management summary

In recent years, companies are more often shifting from a closed innovation strategy towards a open innovation strategy (Chesbrough, 2003) in order to maintain their competitive advantage in the market. This shift towards an innovative climate in which organizations collaborate in new research and development projects, brings forth a lot of opportunities and challenges. Most studies until now have focussed on the strategic advantages of such collaborations. However, Meijer (2012) highlighted the importance of researching open innovation teams at operational level, which provided grounds for conducting this study.

Theory states that the challenges as well as the opportunities towards increasing team performance are primarily caused by team diversity (Mannix & Neale, 2005). Team diversity, therefore, was the main indicator of team performance in this study and this relation was represented in one of our research questions. Theories about the positive effects of diversity mainly focus on the advantages in the larger knowledgebase that a more diverse team offers in comparison to less diverse teams. However, to be able to benefit from this knowledge information in the team must be shared openly (Ancona & Caldwell, 1992). Therefore, we proposed information elaboration as a mediator between diversity and team performance. The negative effects of diversity are primarily based on social phenomena, such as social categorization (O’Reilly et al., 1998). Social categorization, being a cognitive process in which people place themselves and the other members of the team into subgroups, based on some diversity attributes. Therefore, we included team identification as a mediator between team diversity and team performance, since the level of team identification will provide an indication for the presence of these negative effects (Van der Vegt & Bunderson, 2005).
From previous research in the field of open innovation, we found that leadership may play a very important role in determining the effectiveness and performance of these teams. The study by Claessen (2012) concluded that leadership is an critical success factor for open innovation teams. Therefore we included it as one of the main subjects in our study and focussed a research question on the role of the leader in the open innovation research and development team.

Both of the mediator variables, which we include in the study, can be influenced through the behaviour of the team leader. In our model we focussed on two types of leadership, being; Transformational leadership and Pro-diversity leadership. Both leadership styles affect different variables through which the effect of the mediating variables is altered. A key asset of transformational leaders is their ability to get team members to commit to a collective goal for the team through their charismatic attitude (Bass, 1999). Therefore, transformational leadership is expected to increase the level of shared goals in the team.

Pro diversity leadership on its turn, has as main goal to increase the level of diversity beliefs within the team (van Knippenberg et al., 2004). Where diversity beliefs are hypothesized to help decrease the negative effects of diversity through increasing members’ beliefs that diversity can be an asset and is valuable for open innovation.

In total, 18 open innovation research and development teams participated in the study. The data was collected through an online questionnaire, which was filled in by the team leaders of the involved teams. From the results we were able to draw some conclusions and provide answers to the research questions. The impact of team diversity on team performance was not directly visible from the results. However, we did find that team diversity has a negative relation with information elaboration. Indicating that the higher levels of diversity in the open innovation teams, in accordance with what was found in previous research (van Knippenberg et al., 2004), do provide challenges when managing internal team processes. These are challenges that team leaders need to keep in mind when working with open innovation R&D teams. Through adequate handling of the team processes and involving the whole team in the process of increasing team performance, possible problems might be avoided.
The role of information elaboration and team identification did not become completely clear, as we only found results about information elaboration in relation to other variables in the study. We found that shared goals were positively related to information elaboration. Confirming the theory that having a shared goal to work towards has a positive impact on the willingness of team members to share information. Although information elaboration did show any significant relation with team performance in our study, the importance of information elaboration has already been shown in previous studies (Ancona & Caldwell, 1992). Especially in open innovation research and development, it is important to stimulate the exchange of information between the members of the team. For team managers, it is thus important to set goals to which all members of the team commit. Next to this it is important to get the goals for all participating organizations, with regards to the project, aligned. This can help create a better team climate and make team members more comfortable to share information.

Finally, we found that leadership indeed is a very important factor in determining success for the project. Both leadership styles that we examined proved to be significantly positively related directly to team performance. Meaning that team leaders do have a very important role in open innovation research and development teams. We were not able to find the mediating mechanisms, but this might be the result of our relatively small sample. However, we were able to generate solid advice for open innovation teams operating in the Dutch polymer industry on open innovation projects with a vertical (down the value chain) collaboration orientation.
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1 Introduction

Over the past decades, the technological environment has been changing fast alongside the new technologies developed. Companies can no longer sustain without making progress on technologies or business strategies. Here the need for innovation has become clear. Innovation is “a process that covers the creation and use of knowledge for the development and introduction of something new and useful” (Wallin & Von Krogh, 2010 p.p. 145). This announced the start of an era in which companies strive to be the best in their business and try to keep ahead of competition by innovating. This form of innovation is marked as closed innovation and is formed by the philosophy that ‘successful innovation requires control’ (Chesbrough, 2003). Closed innovation acts within the boundaries of the innovating company, focussing on generating in-house knowledge without the use of external parties. All new products are to be fully developed internally and collaborations should only be sought for further down the value chain. This allows for a very good IP protection and first mover advantage in new markets, creating a virtuous circle in which companies innovate to be able to innovate further. This model worked well through a large part of the 20th century with a lot of success stories as a result (Chesbrough, 2003).

However, this focus on in-house development and knowledge protection has led to a focus on incremental innovation, improving the productivity performance of firms (Belderbos et al., 2004). In today’s fast moving markets, such a strategy is no longer feasible for companies and more radical innovations are necessary in order to enter new markets and keep ahead of the competition. During the 90’s more and more companies started collaborating to come up with new ideas for new products/ product innovation (Wissema & Euser, 1991), acting against the ‘classical’ approach of innovation, which focuses on IP protection and in-house developments (Wallin & Von Krogh, 2010). This new concept in innovation has become known as ‘Open Innovation’ and is described through a set of definitions, all with knowledge at its core. Chesbrough (2003, p.p 37) defines open innovation a process in which “a company commercializes both its own ideas as well as innovations from other firms and seeks ways to bring its in-house ideas to market by deploying pathways outside its current business.”
This definition is supported by Wallin and Von Krogh (2010), who describe open innovation as a way to integrate internal and external knowledge to the advantage of new product development. Companies now use the open innovation strategy for increasing their competitive advantage, by gaining knowledge from outside firm boundaries. “This in turn means the old debates about firm-size, market structure and innovation are becoming out-dated, as the boundaries of the firm are becoming increasingly ‘fuzzy’” (Tether, 2002 p.p. 947). In order to gain this knowledge advantage, companies need to work together on a horizontal scale (intra-industry) and more intensive on a vertical scale (inter-industry).

The ‘innovation funnel’ (Chesbrough, 2003), shows the possibilities for companies to gain external knowledge or share their own knowledge with others throughout the whole new product development process.

Figure 1 - The open-innovation funnel (Chesbrough, 2003)

By examining the innovation funnel (figure 1), the differences between open and closed innovation are best described by the ‘Boundary of the firm’. When a company practices closed innovation, this boundary is used to keep all knowledge about new developments in-house and protected. In contrary, companies using an open innovation strategy use the boundaries to find their own limitations and cross them to keep ahead of the competition. Crossing these boundaries and starting to collaborate in strategic R&D alliances has been proven to enhance the innovative performance of the joining firms (Stuart, 2000). The performance increases are mostly related to the acquiring of knowledge and skills. This can be knowledge coming from competing firms working in the same industry (horizontal collaboration), but also from firms operating down the value chain (vertical collaboration).
Open innovation has been setting the trend for more than a decade now and has become an important tool for companies trying to innovate radically. Sharing and combining knowledge between collaborating companies has proven to be the key to a successful open innovation project (Wallin & Von Krogh, 2010). Although open innovation collaborations look appealing and seem to be win-win situations, they are often plagued by complications. Different corporate interests, business cultures, opinions on priorities and legal contracts are, among others, factors that disrupt a possibly smooth collaboration (De Man, 2005). These problems cause a lot of promising collaborations to fail in execution. In fact, approximately 60% of all alliance projects (Zoogah et al., 2011) and over 50% of all joint ventures (De Man, 2005) fail. This may mean that the open innovation process grinds to a halt or that the created product does not fit in the market and fails to generate turnover. Thus, what may seem a successful collaboration on paper and in the contracts can end up as a failure because of the effects on the team level, the team process.

Working with teams to tackle large innovative projects has long been known to be successful. De Dreu (2007) states that teams have become the building blocks for organizations. Teamwork is a very dynamic process and is influenced by a lot of different factors, ranging from team composition to leadership styles. When composing an innovation/R&D team, there are some factors that have a strong influence on the performance of that team. If the project is large and contains complicated interrelated tasks, the choice for a cross-functional team is the best, according to Ancona and Caldwell (1992). Constructing a team with members from different departments within the firm has proven to have a strong positive impact on the productivity and performance of the team. The different functional backgrounds of the team members will allow them to give different inputs to the project, thus stimulating the creative process. Next to the stimulation of the creative process, the vertical integration of departments throughout the company value chain increases the new products’ chances for success. This because knowledge integration between different team members with different functional backgrounds helps stimulate the innovative processes of creating relevant knowledge (Wallin and Von Krogh, 2010). These effects have led to the assumption that diversity in teams is positively related to the performance of R&D teams (Zoogah et al., 2011).
However, next to these positive effects of diversity on the performance of cross-functional teams, other studies show that high levels of diversity may result also in negative effects for teams. Research by van Knippenberg, De Dreu, and Homan (2004) has shown that high levels of team diversity can result in a lower levels of knowledge transfer and to the formation of subgroups within the team. This may be applicable to open innovation teams as well, since combining team members coming from different organizations in a team, increases the diversity even further. With this transition to higher levels of diversity among team members, the diversity in opinions, norms, values and culture may result in problems. For instance, reducing the amount of knowledge transfer within the team that may disrupt the process of open innovation. This may decrease the chances for success, thus creating problems for companies joining in open innovation projects.

In general, prior studies of open-innovation collaborations have been focussed on the advantages of these alliances on the macro level (Zoogah et al., 2011), emphasizing the strategic advantages, which these open-innovation collaborations offer to joining companies. Alliances are described in literature as “long-term collaborative arrangements between two or more firms to execute specific transactions for mutual gain and to maximize performance through cost reduction, knowledge acquisition, and/or market expansion” (Zoogah et al., 2011). When we speak of alliances, we only think of collaborations for knowledge transfer/acquisition, since this is the objective in open innovation projects. The study by Stuart (2000), offers evidence to the assumption that strategic alliances can improve firm performance. They found that in basis, technology alliances with large and innovative partners improved baseline innovation and growth rates but that collaborations with technologically weaker firms had no effect on performance. Their results also suggest that such alliances are more than ways for sharing resources and knowledge, but instigate that they can also be influenced through social factors. Suggesting that improved social connections between firms can improve the exchange of resources and knowledge. Influencing this social dimension may thus help improve firm performance
However, little attention has been paid to this micro level perspective, the operational level of the alliance and thus the effects of diversity on the performance of such teams. Meijer, (2012) has taken a step into this field of research by conducting a quantitative study among 39 alliance teams through a micro-level perspective and assessing the determinants for alliance performance on this level. She, found that one of the determinants of alliance success, is team identification. According to her research it is very important for members of an alliance team to identify themselves with each other and the team in order to be able to form a successful team.

Next to this study, Claessen (2012) conducted a qualitative study among three open-innovation teams in the high tech sector to identify critical success factors for open-innovation teams. He identified leadership as an important driver for successful open innovation research and development teams. He found that; employing effective leadership is necessary for having clear and shared innovation goals. And since having shared goals is a way of increasing team identification (Vegt and Janssen, 2003), this places the team leader into a position for increasing team identification and thus team performance.

From these previous studies we learn that it is important for the open-innovation process to create a well-integrated team, which efficiently exchanges information, and that leadership might be the tool for creating such a team. However, no previous studies have gone this deep into the team process of open innovation. In the team process, diversity can have positive as well as negative effects and needs to be managed correctly for a team to be able to experience the benefits. Since effective leadership seems to be essential to managing these processes, we are investigating the effects of leadership practices on team processes of information elaboration and team identification. With this, we have developed the following research questions for the study;

1. What are the effects of team diversity on the performance of open innovation research & development teams?

2. Do transformational and pro-diversity leadership practices help increase team performance of open innovation research & development teams?

3. What is the role of team identification and information elaboration in the team process of open innovation research & development teams?
The aim for this study is to gain insight in the effects of critical leadership practices on team performance in the open-innovation context. With the results, we want to help team leaders increase the performance of their teams. This helps increase the practical relevance and usability of the results of this study. Therefore, we attached the following design ‘assignment’ to the study.

*Formulate clear advice for leaders of open-innovation research & development teams, which helps them gain insight in the dynamics of their team and may help increase team performance.*
2 Theory and Hypotheses

2.1 Team diversity

Diversity is simply defined as “being different”: the more people differ from each other, the higher the level of diversity within the team (Milliken & Martins, 1996). A lot of studies have been focused on the effects of diversity on the performance of teams (e.g. Ely & Thomas, 2001; Pelled et al., 1999; Mannix & Neale, 2005; Jehn et al., 1999) and have focused on the possible positive as well as on the possible negative effects of workgroup diversity. Where positive effects of diversity are mostly related to the diversity in functional backgrounds of the participants in a workgroup, through the variety in perspectives and approaches towards problem solving (Mannix & Neale, 2005). This positive view on team diversity can best be pictured through the information/decision making theory as described by O’Reilly, Williams and Barsade (1998) who argue that heterogeneous groups will outperform homogeneous groups due to their broader knowledgebase. Supporting this, Hülsheger, Anderson and Salgado (2009) found that job-relevant diversity is positively related to innovativeness. However, these studies only focus on functional diversity, which is most relevant in cross-functional teams operating within a company. When we transform the team setting to the open innovation setting, other dimensions of diversity may overtake the positive impact of the functional diversity.

2.2 Team diversity – performance relationship

When organizations are collaborating in an open innovation project, a project team is formed that contains people from all joining organizations. These teams can be compared to a ‘standard’ cross-functional work team in the sense that it contains people with different expertise backgrounds and people that are coming from different departments in the companies. The diversity in open innovation teams, however, often goes beyond these characteristics. Since people are coming from different organizations, they tend to differ even more from each other. Different business cultures, geographical locations and a larger diversity in functional backgrounds are combined in open innovation teams. This may render the development of team identification and information elaboration even more problematic, thereby increasing the negative effects of diversity on team performance.
Previous studies have elaborated on the possible negative effects of team diversity on team performance, for example, by stating that differences in functional background may lead to task conflicts (Pelled et al., 1999). The extent to which people differ from each other has significant impact on their mutual relations and understanding, causing problems in the cooperation through processes of categorization and conflict (Mannix & Neale, 2005). These studies have all been done in an intra-firm setting in multidisciplinary teams. We expect the levels of diversity to be higher in open innovation team than in a regular single-company setting, increasing the risk for negative effects to occur. From this, we developed our first hypothesis.

**Hypothesis 1** – High levels of team diversity relate to lower levels of team performance within the open innovation R&D team.

### 2.3 Mediators of the team diversity – performance relationship

When going deeper into the effects of team diversity on team performance, we examine two mechanisms through which diversity can impact team performance. The first mechanism that has been identified to impact team performance is team identification. The second is information elaboration. Next we will explain the role these mediators have in the relation between team diversity and team performance.

#### 2.3.1 Collective team identification

Prior research has identified team identification as a success factor for team performance (Harrison et al., 2002; Meijer, 2012; van Knippenberg et al., 2004), where higher levels of team identification have been related to higher levels of team performance. This because when a group of people see themselves as a team, they might feel more commitment towards each other and may be more willing to share information. In the open innovation context, this can prove even more important when the alliances have the objective of exchanging knowledge. The impact that team diversity has on the team identification can be best found in sub processes of categorization, since diversity can create social divisions within a team (Mannix & Neale, 2005) and cause different types of conflict (Pelled et al., 1999).
Social categorization may be considered as the opposite of collective team identification since social categorization is about creating subgroups within the team (O’Reilly et al., 1998) and collective team identification aims to generate unity in the team (Van der Vegte & Bunderson, 2005). Leading to our assumption that higher levels of diversity can be harmful for the level of team identification. The next two hypotheses are created to investigate the impact of diversity on team identification and the impact of team identification on team performance.

**Hypothesis 1a** – *There is a negative relation between levels of team diversity and levels of collective team identification*

**Hypothesis 1b** – *There is a positive relation between levels of collective team identification and team performance.*

2.3.2 Information elaboration

The second mechanism through which team performance may be affected by team diversity is information elaboration. Diversity is said to increase the possibilities for the elaboration of task-relevant information and expertise within workgroups, since the diversity in the team offers better access to new sources of information and a potentially larger knowledgebase (Ancona & Caldwell, 1992). This theory has been used by Van Knippenberg and colleagues (2004) in their CEM (Collaboration Elaboration Model) model, where they state that functional diversity within a team can enable the process of information elaboration. However, in an open innovation context this may not be as applicable as they state. Because multiple organizations are joining into a single team too develop a new product or technology, there are more differences between team members and their companies interests. Despite the agreements that may have been made and written up in contracts, the high levels of diversity may still make team members reluctant to share information freely with the other partnering organizations. This can lead to reduced team performance, since the results of these collaborations rely on project relevant knowledge being shared between joining organizations. We will test these assumptions with the following two hypotheses.

**Hypothesis 1c** – *There is a negative relationship between levels of team diversity and levels of information elaboration within the open innovation R&D team.*

**Hypothesis 1d** – *There is a positive relationship between levels of information elaboration and team performance.*
2.4 The role of Leadership

Going back to the concept of team effectiveness, Zaccaro, Rittman, and Marks (2001) state that this derives from a set of fundamental characteristics, one of which is team leadership. Most teams have one person who is responsible for coordinating the work, setting goals for the team and for making sure that these goals are met whilst the team functions smoothly. Zaccaro and colleagues (2001) argue that effective leadership processes may well represent the most critical factor in the success of organizational teams. This is further supported by Zoogah et al., (2011), who state that the effects of all diversity factors are moderated by team coordination and can thus be influenced through leadership. For this study, we chose two known leadership styles that have integral attributes related to managing diversity. First there is the well-known concept of transformational leadership, which is based around an inspiring leader who sets clear objectives and goals for the project. This leadership style is known to increase levels of team identification through setting examples and working collectively towards a team goal. Second, there is the less well-known principle of pro-diversity leadership. This is a leadership style that is completely focussed on increasing the awareness of diversity as an asset to the team, thereby contributing to the acceptance of diversity within the team.

2.4.1 Pro-diversity leadership

A recent notion within the field of diversity research is that team members’ beliefs about the possible value of the diversity within their team may have a positive influence on the team process. Diversity beliefs are defined as being the beliefs that individuals hold about diversity itself (Dick et al., 2008; Homan et al., 2007; van Knippenberg et al., 2007). These beliefs are often based on previous work experiences, stereotypes and the effects this has on team functioning. Van Knippenberg et al., (2007) have studied the effects of diversity beliefs within workgroups as a moderator for team identification and have found the effect to be positive. In the study they conducted among 220 working business students from the Netherlands, they studied the effects of diversity beliefs on work group identification. They found that when students believed more in the value of diversity, the relation between diversity and team identification was more positive. This resulted in the conclusion that diversity beliefs help with team identification, an important mean for creating more social integration.
This research has been extended by Homan et al., (2007) to the impact that diversity beliefs hold on diversity faultlines and the information elaboration within teams and sub-groups. From this study, the researchers found that diversity beliefs positively moderated the relation between informational diversity and performance, this through the reduction of faultlines. Thus, when a diverse team holds more beliefs in the value of diversity, the formation of sub-groups is reduced en team performance increases. Since increasing levels of diversity beliefs can be accomplished through communication and providing information about the subject (Homan et al., 2007), this is best to be done by the team leader. Leaders are in the ideal position to try to increase levels of diversity beliefs since they are responsible for supporting team processes of communication (Zaccaro et al., 2001).

Countering the negative effects of diversity on the information elaboration and team identification within the open innovation team can be seen as a task for the team leader. The study by Claessen (2012) showed that leadership can be seen as a critical success factor for open innovation team success. Since the leader can have great influence on the performance of the team, the leadership behaviour exerted by the team leader can impact the performance of the team. One leadership style that provides useful attributes for this context is pro-diversity leadership. This theory is based around the idea that team leaders, due to their influential power may play a key role in promoting pro-diversity beliefs among team members (Rispens, Homan, & Dijkstra, 2012). Using the concept of diversity beliefs, as introduced by van Knippenberg et al. (2007), the pro-diversity leadership theory describes leadership behaviour that can promote an increase in diversity beliefs within the team. The role of the pro-diversity leader, is to “explain to the team how the task performance can benefit from the different perspectives and information present in the team”, thus communicating their own belief in the possible value of diversity for the team (Rispens et al., 2012). Through these beliefs, the leader aims to prevent the team from breaking up into competitive subgroups, which has negative effects on team performance (Homan et al., 2007). When team members see the value of their diversity, the team identification among them might also increase. They can embrace their differences and use them to the advantage of the collective. This also relates to the information elaboration within the team, where team members might be more willing to share information when they value the different knowledge positions of others in the team.
To investigate the effects of pro-diversity leadership, the effect of diversity beliefs on the relations between team diversity and team identification and between team diversity and information elaboration, we have constructed the following hypotheses.

**Hypothesis 2 – Pro-diversity leadership has a positive effect on the level of diversity beliefs within the team**

**Hypothesis 2a – High levels of diversity beliefs within the team have a positive moderating effect on the relation between team diversity and the level of information elaboration within the team, such that the negative relation between team diversity and information elaboration is weaker with higher levels of diversity beliefs.**

**Hypothesis 2b – High levels of diversity beliefs within the team have a positive moderating effect on the relation between team diversity and team identification, such that the negative relation between team diversity and team identification is weaker with higher levels of diversity beliefs.**

### 2.4.2 Transformational leadership

Open-innovation teams can be seen as teams with a high level of task interdependency, since technologies or knowledge has to be shared within the team to be able to gain the strategic advantage, which is often the basis for the collaboration. When task interdependency is high in teams, it is important for team members to share high perceived levels of goal interdependence, as concluded by Vegt and Janssen (2003). They state that in teams where heterogeneity is high, team members need to have goal interdependence in order to be more innovative. Supporting this is the research by (Claessen, 2012), where he states that, when two or more companies agree to collaborate in an open innovation project, they have to adopt a shared innovation goal in order to innovate successfully. This argument is further investigated by De Dreu, (2007) using the theory of ‘cooperation and competition’. This theory suggests that people in groups view their goals and those of others either cooperatively or competitively linked. When people’s goals are linked more cooperatively, team members have higher trust and are more likely to experience psychological safety (De Dreu, 2007). This is also supported by Tjosvold and colleagues (2004), who find that cooperative rather than competitive goals result in higher levels of innovation. Creating this environment where there is a single goal for the whole team can also be a task for the team leader. As stated by Zaccaro et al. (2001), the team leader has an important role in setting clear and challenging goals for the team.
Leadership behaviour that supports this is best found in the transformational leadership style. One theory about a set of important attributes is the Transformational Leadership theory as by Bass (1999). When a team is composed with members from different organisations, “the interests of the organization and its members need to be aligned. Such is a task for the transformational leader” (Bass, 1999 p.p. 9). Transformational leadership is a theory that is currently very popular in use on heterogeneous teams (Kearney & Gebert, 2009). It is based on the leaders ability to make a change through example, the presentation of an inspiring vision and setting challenging goals for the project (Kearney & Gebert, 2009). Transformational leadership builds on the idea that a leader needs to be an example for the team in such way, that team members want to identify with his/her behaviour. The leader does this by intellectual stimulation, which involves helping team members to become more innovative and creative (Bass, 1999). The transformational leader also facilitates in the team climate, making team members care for, intellectually stimulate and inspire each other. Next to this, the task for the leader is to have team members identify with the goals set for the team (Bass, 1999).

We therefore, first argue that higher levels of transformational leadership behaviour of the team leader relates positively to the level of shared goals in the team (H3). Next to this, we argue that setting clear goals for the team can help increase levels of team identification and also stimulate the elaboration of information within the team. Since previous research on the psychological effects of having a shared outcome interdependence, showed that team members experienced higher levels of trust and psychological safety. These higher levels of trust might make it easier for team members to be willing to share information openly with each other (H3a). Through these same psychological processes, having a shared goal to work towards may also be responsible for higher levels of team identification.
These hypotheses examine the effects of the goal setting attribute of transformational leadership in the open innovation team on the relations between team diversity and team identification (H3b) and between team diversity and information elaboration (H3a).

**Hypothesis 3** – Transformational leadership behaviour has a positive effect on the level of shared goals within the team.

**Hypothesis 3a** – High levels of shared goals within the team have a positive moderating effect on the relation between team diversity and the information elaboration within the team, such that the negative relation between team diversity and information elaboration is weaker with higher levels of shared goals.

**Hypothesis 3b** – High levels of shared goals within the team have a positive moderating effect on the relation between team diversity and the level of team identification, such that the negative relation between team diversity and team identification is weaker with higher levels of shared goals.

**2.4.3 The relationship between leadership and team performance**

Like the previous hypotheses that we developed, most other studies on team performance use different types of leadership behaviour as moderating factors in research models (Zaccaro et al., 2001). However, the study by Zaccaro and colleagues (2001), showed more direct effects leadership behaviour on the effectiveness of a work team. They state that team leaders are responsible for a number of cognitive internal team processes, which need to be managed correctly to enhance team performance. Leadership can also be defined as ‘social problem solving’ in some situations (Zaccaro et al., 2001), thus it can be important for leaders to have a strong personality with clear leadership characteristics. We thus argue that strong team leaders have more influence on their team members and may be more likely to enhance the teams’ performance directly through their leadership behaviour. In our model, we focus on two types of leadership behaviour, transformational and pro-diversity. We state that both of these can have a direct relation with team performance. Therefore, we have formulated the following hypotheses.

**Hypothesis 4a** – High levels of transformational leadership behaviour have a positive effect on the performance of the team.

**Hypothesis 4b** – High levels of pro-diversity leadership behaviour have a positive effect on the performance of the team.
2.5 The research model

All relations we have described in the above section of ‘theory and hypotheses’ are combined into a single research model, which is displayed below in figure 2. All variables in the model will be included into the questionnaire and used in the analysis.

![Figure 2 - Research model](image)

All hypothesized relations in the model will all be tested. The measures used and the procedure for testing will be discussed in the next chapter.
3 Method

This study has been developed as a descriptive study. Since previous research by e.g. (Claessen, 2012; Meijer, 2012; Schilderman, 2011), has given hints towards the importance of some of the variables in our model for team performance, we were able to build a set of clearly stated hypotheses that helped us discover the relations between the variables in the model. We have examined these relations through a cross-sectional survey study, using an online survey system for data gathering.

For this study I have collaborated with the Dutch Polymer Institute Value Centre (DPI-VC). The DPI-VC supports entrepreneurs and SME’s (Small or Medium sized Enterprise), in finding partners for creating innovative products, services or materials in the polymer industry. They use their extensive company contact network to connect large multinational companies to the SME’s and universities. Their project portfolio was a starting point for me in gathering the project teams I needed for the analysis.

Value Chain Projects

The value chain projects have been initiated by the DPI-VC in order to enhance the innovative capabilities of companies. At the start of the projects they introduce possible partners to each other and help them to gain a competitive advantage together. Next to this, the DPI-VC initiates meetings for the project teams to exchange experiences and learn from each other.

These projects often consist of about 4 or 5 companies working together. These companies are not competitors but companies operating throughout the value chain of products. The projects can be seen as typical, vertically oriented open innovation projects since all joining organizations add value to the product through their own expertise.

The first projects have been initiated in 2011 and some of them have finished, making the average duration of the project between 2 to 3 years.
3.1 Data collection

I collected the data for this study through the network of the DPI value centre. Using their extensive business network and the projects they have been supporting over the last years. These projects are termed as value chain projects, since organizations throughout the value chain collaborate in the new product development project. The goal of these collaborations is to develop a product and bring it to market. The role of the DPI Value Centre is a supporting one. Next to bringing the companies together in the early stages of the projects, the DPI provides informational support and advice to the project teams. Through this channel I was able to include 18 project leaders into the study, which are working on different products but in similar teams (Each project leader represented one team).

In addition to the team leaders I gathered at the DPI Value Centre I contacted the ISPT (Institute for Sustainable Process Technology) Innovation Academy, who were also willing to provide their support for this study. The ISPT Innovation Academy supports open innovation projects in the process technology sector by providing education to young researchers and professionals helping them to deal effectively with the implementation of innovation. Next to this, the Innovation Academy strives to spread the latest knowledge about research on successful competences in innovation and open innovation. Through the academy, I gathered the contact details of another 42 project leaders who are currently active in an open innovation project (Each project leader represented one team).

The teams participating in the study all had to comply to a set of pre-defined team characteristics before they were invited to join. First, since we were studying leadership behaviour, every team needed to have one assigned team leader. Next to this, the team needed to include members from at least two different organizations to ensure an inter-firm collaboration project was taking place. Finally, the team had to consists of at least three team members next to the team leader to be able to create aggregated data on all variables.
In total I had a list of 60 project leaders, leading teams with differing sizes coming from both the DPI VC and ISPT networks. Because all participants are entrepreneurs or working at larger companies, I chose to send out an online survey in order to reduce the amount of effort for the participants. Since the study had been pre-announced through official channels of both the DPI VC and ISPT, the expected return rate of the survey was high. To further stimulate the response by the team leaders, reminders were sent out and I personally contacted them all on the phone.

3.2 Sample and procedure

In order to be able to investigate the constructed hypotheses, a quantitative analysis based on an extensive web-based survey, containing all necessary variables from the research model and some control variables, has been conducted. The item sets per variable were constructed from previous studies in the field of innovation management. From these item sets one questionnaire was constructed, which would be sent out to the team leaders. One part of the questionnaire was set up to gain a good insight into their leadership styles and practices as well as to get a measurement for the teams’ performance and the other part of the questionnaire was aimed at the internal team processes. For the analysis of the data from the survey, SPSS Statistics 22 for Mac was used.

Despite repeated efforts to motivate the team leaders to cooperate in the study, only 21 of them completed the first half of the survey. Resulting in a response rate of 35%. The second half of the study has been completed by 18 team leaders, which resulted in a final response rate of 30%.
3.3 Measures

In order to assure a quality measurement of all variables in the study, we have only used scales that were previously confirmed to provide good results in previous studies, as evidenced by the Cronbach’s alpha’s.

3.3.1 Team diversity

The level of team diversity was measured by questioning the team leaders on the characteristics of the team. To be able to create a measure for the diversity in the team, they were asked about; the size of the team, the amount of different functional backgrounds present in the team, the amount of different spoken languages in the team present in the team and the amount of different cultures present in the team. The degree of diversity of the team on each attribute is then calculated by dividing the amount of the attribute present by the number of team members. For example, we questioned the team leaders on the amount of different functional areas that were represented in the team. We then divided this amount by the total number of team members. This provided us with a ratio of diversity on each attribute, ranging from 0 (all members are the same) through 1 (all members are different). As a final indicator for diversity, the team leaders were questioned on the geographical dispersion of the team members on a scale ranging from 1 (All members of the team coming from the same region) through 5 (All members of the team coming from different regions). From this data, we created the Team diversity variable by adding the ratio’s on the attributes to the level of geographical dispersion and to the number of organizations involved in the project.

3.3.2 Team identification

Collective team identification, as defined by Van der Vegt & Bunderson (2005) to be “the emotional significance that members of a group attach to their membership in that group”. This variable measures the attachment that team members have towards the team as a whole. When measuring the level of collective team identification, we follow the strategy used by Van der Vegt & Bunderson (2005). Introducing a four item question set, created to measure levels of “identification with, involvement in, and emotional attachment to the collective” (Van der Vegt & Bunderson, 2005).
In the items, we ask the team members to assess the extent to which members of their team “feel emotionally attached to their team,” “feel a strong sense of belonging to their team,” “feel as if the team’s problems are their own,” and “feel like part of the family in their team.” The answers are collected on a 7-point likert scale, ranging from ‘not at all’ to ‘completely’. Using this scale in our study has resulted in a Cronbach’s alpha of 0.69.

3.3.3 Information Elaboration
In order to measure the degree of information elaboration within the team, we follow the strategy followed by Kearney and Gebert (2009) and use the four-item measure that they have developed based on literature. The response is measured on a 5-point scale ranging from 1 (not at all) to 5 (completely). The four items are constructed as; “The members of this team complement each other by openly sharing their knowledge”; ”The members of this team carefully consider all perspectives in an effort to generate optimal solutions”; “The members of this team carefully consider the unique information provided by each individual team member”; “As a team, we generate ideas and solutions that are much better than those we could develop as individuals.” Using this scale in our study has resulted in a Cronbach’s alpha of 0.87.

3.3.4 Pro-Diversity Leadership behaviour
When measuring the level of Pro-Diversity leadership behaviour, we followed the strategy as used by Rispens et al. (2012). We measured the level of pro-diversity leadership through six items with a response ranging from 1 (totally not) through 5 (completely). The items included, “I clarify the value the diversity in this team to the team members” and “I clearly explain why diversity is needed for new product development”. Using this scale in our study has resulted in a Cronbach’s alpha of 0.85.
3.3.5 Diversity beliefs
The amount of diversity beliefs present in the team will be measured, using a four-item measure developed by Van Knippenberg et al. (2007) combined with a four item measure developed by Rispens et al. (2012). The scale consists of items that ask team members about the value of diversity within the team. Items include, “I believe that diversity is a good thing” and “I think that teams should contain people with similar backgrounds” (reversed). The response is measured on a seven point likert scale, asking people to what extend they agree with the statements. Responses were ranging from 1 (totally not) through 7 (completely). Using this scale in our study has resulted in a Cronbach’s alpha of 0,68.

3.3.6 Transformational leadership behaviour
To be able to measure the degree of transformational leadership behaviour and especially the level of shared goal setting, we will follow the strategy as used by Kearney and Gebert (2009) and measure this with 12 items from the Multifactor Leadership Questionnaire. Using a response format ranging from 1 (not at all) through 5 (frequently, if not always). Combining the four scales measuring, idealized influence, inspirational motivation, intellectual stimulation and individualized consideration into a measure for the level of transformational leadership behaviour (Bass, 1990). The scores for the four aspects of transformational leadership were summated into a single score. These scores ranged from 12 (no transformational leadership) to 60 (strong transformational leadership). Using this scale in our study has resulted in a Cronbach’s alpha of 0,91.

3.3.7 Shared goals
In order to find out to what extend the goals of the collaborating parties are congruent with each other, we take two steps. The first step is to find out if all organizations in the team share the same goals for the project. For measuring this, we follow the method by as executed by Whipple & Frankel (2000), who identified goal clarity as a success factor for strategic alliances and used their five item scale on goal clarity. Items included; “My firms’ goals and objectives regarding this project are consistent with those of the partnering firms” and “The partnering firms regularly meet to set strategic goals for the project”.
Next to this, we follow Aubé and Rousseau (2005) and apply their three item scale for team goal commitment, to find to what extent the team members feel committed to the goals of the whole team. Items included, “We are committed to pursuing the team’s goal” and “We really care about achieving the team’s goal”. Responses on both scales were based on agreement on statements and ranged from 1 (totally not) through 7 (completely). We combined the two scales in our survey to measure the variable shared goals, using all eight variables. Using this scale in our study has resulted in a Cronbach’s alpha of 0,82.

**3.3.8 Team performance**

Team performance was measured using a combination of two scales, coming from previous research by De Dreu (2007) and Aubé and Rousseau (2005). In his study, De Dreu used a measure for team effectiveness, consisting of five items, which had been used in several other studies before. From this scale we used three items, best fitted to the open innovation context. Items include, ‘This team is good in coming up with ways to complete their tasks’, ‘This team effectively deals with uncertainty and unexpected events’ and ‘At times, this team fails to approach its tasks adequately’ (reverse coded) (De Dreu, 2007). Next to these items, we added three items from the scale used by Aubé & Rousseau (2005) for measuring team performance. Items include, ‘The members of this team attain their assigned performance goals’, ‘The members of this team produce quality work’ and ‘This team is productive’ (Aubé & Rousseau, 2005). The response was measured on agreement to the statements ranging from 1 (totally not) through 7 (completely). Using this scale in our study has resulted in a Cronbach’s alpha of 0,82.
3.3.9 Control variables

Since all projects in the sample have different characteristics, we added variables to control for this. Due to the different starting points of all projects, not all project teams have been together for the same amount of time. This can, according to the study by Harrison and colleagues (2002), have effects on the impact of surface- and deep-level diversity on team performance. More specific, when teams are working together for a longer period of time, the effects of surface level diversity decrease whilst the effects of deep-level diversity increase. Therefore we added a control for the time that the project team has been operational (categorical variable). The type of innovation project that a team is working on, being an incremental innovation, a product improvement or a radical innovation, can be the cause for higher or lower levels of knowledge transfer in the team. Since not all types of projects require the same level of information elaboration and firm investment, outcomes of team performance can differ. For instance, when firms try to achieve a radical innovation, this requires far more commitment, a larger investment and more effort than when a product is improved or a incremental innovation is attempted (Laursen & Salter, 2006). Therefore we included the innovativeness of the project as a control variable (categorical).

3.4 Validity and reliability

The external validity of the study, the degree to which results can be generalized among the whole population, is limited to open innovation projects that are collaborating on a vertical scale. In our sample, worked with project teams that were collaborating down the value chain instead of with competitors. The results of this study might therefore only be used to generalize among this type of open innovation research and development projects.

We managed the internal validity of the study by using only scales that were previously used in similar studies in different contexts. Therefore we were able to make sure that the results provided us with the correct representation of the constructs that were measured.

The reliability of the study has been guaranteed by doing a reliability analysis on all constructs and reporting on the Cronbach’s alpha’s found.
3.5 Analysis

After the data had been gathered, I followed a number of statistical procedures to investigate the hypotheses. This paragraph explains the steps I have taken in this process, using the SPSS software in which we loaded the responses from the online questionnaire.

3.5.1 Preparing the data

After loading the data into SPSS I started by checking for missing data and strange outliers by examining the data file and descriptive statistics. The data appeared to be in good shape and no cases needed to be deleted from the dataset. The next step was to reverse-code the items that were stated opposite to the other items in the survey. When all items were correctly coded an exploratory factor analysis was performed, per measure, to check the internal consistency of the measures that were used. From these results we determined which items to exclude from the analysis and with which we continued. A score for each variable, that was measured using scale items, was constructed by calculating the mean score over the items that remained in the variable after the exploratory factor analysis.

3.5.2 Further analysis

First, an overall correlations table (bivariate correlations, Spearman) was created to get a general overview of the relations that were present in the model. Since we were working with a small dataset (n=18), we decided to use the non-parametric correlations. Because this procedure is based on fewer assumptions about the properties of the data (e.g. the test does not assume that the outcome is approximately normally distributed), we were able to get a better picture of possible existing relations. The non-parametric correlations were used to investigate the hypotheses that described a direct relation between two variables.

The model also includes a set of moderating relations between variables, as seen in figure 3. To investigate these relations, we used the moderator analysis as described by Baron & Kenny (1986). We mean-centred the variables (A and C in figure 4) that needed to be analysed and with these centred variables, the interaction variables were created from the independent and the moderating variable (new variable to be A x C). Variables A, C and A x C were inserted in a multiple regression analysis with variable B as the dependent.
Next to moderating relations, the research model contains some mediating relations. To investigate these interaction effects we applied a path analysis as described by Preacher and Hayes (2004). The path analysis provides the relative importance of the interaction effect when compared to the direct relation. The standard model for mediating relations is pictured in figure 4. The relative importance of B in the relation between A and C was determined by first finding the beta values for the direct relations between the variables (β1, β2 and β3) by using linear regression analyses. We then used the following equations to determine the interaction effect (IE) and the relative importance of the interaction effect, the relative interaction effect (RIE).

\[ IE = \beta_4 \times \beta_3 \]

\[ RIE = \frac{|IE|}{|IE| + |\beta_2|} \times 100\% \]

The results of the steps described in this paragraph can be found in the next chapter, followed by the analysis and discussion of the relations found.
4 Results

In this section, we will present the results of the analyses performed to test the hypotheses we formulated earlier. Besides non-parametric correlations, we used scatterplots with regression lines to provide insight into the relationships between study variables. Other effects are analysed using the procedures explained in section 3.4.

Table 1 - Non-parametric correlations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Range</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Innovativeness</td>
<td>3</td>
<td>0.97 1-4</td>
<td>1.00</td>
<td></td>
<td></td>
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<tr>
<td>2. Project phase</td>
<td>3.72</td>
<td>1.13 1-5</td>
<td>0.52*</td>
<td>1.00</td>
<td></td>
<td></td>
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<tr>
<td>3. Team diversity</td>
<td>14.51</td>
<td>3.33 3-</td>
<td>0.24</td>
<td>0.11</td>
<td>1.00</td>
<td></td>
<td></td>
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<tr>
<td>4. Functional diversity</td>
<td>0.13</td>
<td>0.2 0-1</td>
<td>0.02</td>
<td>-0.05</td>
<td>-0.13</td>
<td>1.00</td>
<td></td>
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</tr>
<tr>
<td>5. Lingual diversity</td>
<td>0.34</td>
<td>0.17 0-1</td>
<td>0.06</td>
<td>-0.47</td>
<td>0.01</td>
<td>-0.14</td>
<td>1.00</td>
<td></td>
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</tr>
<tr>
<td>6. Geographical diversity</td>
<td>3.33</td>
<td>1.28 1-5</td>
<td>0.08</td>
<td>-0.04</td>
<td>.84**</td>
<td>0.19</td>
<td>0.17</td>
<td>1.00</td>
<td></td>
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<td></td>
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<tr>
<td>7. Team identification</td>
<td>4.9</td>
<td>0.97 1-7</td>
<td>-0.18</td>
<td>-0.16</td>
<td>-0.24</td>
<td>-0.14</td>
<td>0.06</td>
<td>-0.12</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>8. Information elaboration</td>
<td>3.81</td>
<td>0.68 1-5</td>
<td>-0.04</td>
<td>-0.12</td>
<td>.47*</td>
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<td>-0.16</td>
<td>-0.39</td>
<td>0.11</td>
<td>1.00</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>9. Shared goals</td>
<td>5.33</td>
<td>1.19 1-7</td>
<td>0.08</td>
<td>0.27</td>
<td>0.03</td>
<td>-0.15</td>
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<td>-0.08</td>
<td>0.24</td>
<td>.53*</td>
<td>1.00</td>
<td></td>
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<td></td>
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<tr>
<td>10. Diversity beliefs</td>
<td>5.78</td>
<td>0.87 1-7</td>
<td>-0.02</td>
<td>0.02</td>
<td>0.31</td>
<td>0.06</td>
<td>-0.19</td>
<td>0.25</td>
<td>.48*</td>
<td>0.02</td>
<td>0.16</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11. Pro-diversity leadership</td>
<td>5.17</td>
<td>1.21 1-7</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.25</td>
<td>.47**</td>
<td>-0.15</td>
<td>-0.09</td>
<td>0.10</td>
<td>0.13</td>
<td>0.20</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Transformational leadership</td>
<td>40.89</td>
<td>7.58 5-60</td>
<td>-0.13</td>
<td>-0.18</td>
<td>0.18</td>
<td>0.24</td>
<td>-0.17</td>
<td>0.19</td>
<td>-0.37</td>
<td>0.25</td>
<td>0.26</td>
<td>.73**</td>
<td>.55*</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Team performance</td>
<td>5.28</td>
<td>0.6 1-7</td>
<td>0.00</td>
<td>-0.12</td>
<td>0.00</td>
<td>.49*</td>
<td>-0.36</td>
<td>-0.05</td>
<td>0.24</td>
<td>0.30</td>
<td>0.17</td>
<td>0.44</td>
<td>.73**</td>
<td>.71**</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 1 presents the descriptive statistics of all study variables, as well as their non-parametric correlations. Significant correlations have been highlighted and the level of significance is indicated through added symbols. From table 1, it is visible that the teams of the team leaders that participated in the study are functional diverse (M = .61), contain different languages (Lingual diversity: M = .34) and are geographically dispersed (M = 3.33). The average project team joining in the study is nearing the end of the project (Project phase, M= 3.72) and is working on projects that score mediocre on innovativeness. From the table we see that the control variables, ‘Innovativeness’ and ‘Project phase’ only significantly correlate with each other, meaning that the controls are not completely isolated and could compromise the internal validity of the results when used. Therefore, we do not use the control variables in the further analysis.

In the following paragraphs, we will present the results of the analysis and link these results to the previously stated hypotheses.
4.1 Team diversity and team performance

In hypothesis 1, we have predicted a negative relation between team diversity and team performance. From the analysis, we did not find any evidence for this direct relation between team diversity and team performance. However, we did find a significant positive relation between one of the attributes of team diversity that were investigated, functional diversity, and team performance ($r = .49 \ p < .05$). Although we did find a significant positive relationship between functional diversity and team performance, this however does not provide us with enough evidence to support hypothesis 1.

Hypotheses 1a and 1b hypothesize that team diversity has a negative effect on the team identification (H1a) and that team identification in turn has a direct positive effect on the performance of the team (H1b). The data from the correlations table, table 1, shows no evidence for a direct relation between team diversity and team identification ($r = -.24 \ p = .34$). Also, the data did not show evidence of the direct positive relationship between team identification and team performance that was hypothesized in H1b ($r = -.24 \ p = .34$). Based on these findings, we were not able to support hypothesis 1a and hypothesis 1b.

In hypothesis 1c and 1d we stated that functional diversity has a negative effect on information elaboration (H1c) and that information elaboration in turn has a direct positive effect on team performance (H1d). H1c states that there should be a negative relation between team diversity and information elaboration. In the correlations table we can see that this direct relation is indeed negative and significant ($r = -.47 \ p = .05$), this is supported by the scatterplot produced (see figure 5 on next page). With these findings we were able to provide support for hypothesis 1c.
In hypothesis 1d, a positive relation between ‘Information elaboration’ and ‘Team performance’ is hypothesized. The correlations in table 1, did not show any evidence for such a relation ($r = .29$ $p = .32$). Based on these findings we were not able to support hypothesis 1d.

Due to the structure of the research model, we also investigated the indirect effects of information elaboration and team identification on the relation between team diversity and team performance, to see if there are any effects that are not captured in the correlations table. We did this according to the method as described in section 3.4. Both interaction effects have first been modelled (see figures 6 and 7) and than calculated.
The path analysis of the variables in the model in figure 7, produced the following values for the betas; $\beta_2 = -0.84, \beta_3 = -0.19, \beta_4 = -0.33$. These values resulted in a RIE of 6.95%, providing no grounds for any further investigation, since the relative importance of the interaction effect is low.

The path analysis of the variables in the model in figure 7, produced the following values for the betas; $\beta_2 = -0.84, \beta_3 = 0.25, \beta_4 = -0.52$. These values resulted in a RIE of 13.4%, providing no grounds for any further investigation, since the relative importance of the interaction effect is low.
4.2 The role of pro-diversity leadership

Hypothesis 2 is focussed on the direct results of pro-diversity leadership on the levels of diversity beliefs within the team. We stated in H2, that there should be a direct positive effect between levels of pro diversity leadership and diversity beliefs. However, from the correlations table, we did not find any evidence for such an relationship between the variables (r = .20 p = .42). Hence, we do not have any evidence to support hypothesis 2.

Further, hypothesis 2a states that there should be a positive moderating effect of diversity beliefs on the relation between team diversity and information elaboration. We performed a moderator analysis as described in section 3.4. Although the complete model is significant (p = .03), the results provided no significant relationship between the team diversity and information elaboration (β = -.38, p = .14) as well as no significant relationship between diversity beliefs and information elaboration (β = -.02, p = .95). Also, the interaction term that was created had no significant effect (β = .47, p = .11). This provided us with no evidence to support hypothesis 2a. The complete results of the moderator analysis can be found in table 2 on the next page.

<table>
<thead>
<tr>
<th>Model</th>
<th>Independent</th>
<th>Beta</th>
<th>Sig.</th>
<th>R square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diversity beliefs</td>
<td>-0.02</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team diversity</td>
<td>-0.38</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diversity beliefs * Team diversity</td>
<td>-0.47</td>
<td>0.11</td>
<td></td>
<td></td>
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</tbody>
</table>

Dependant: Information elaboration
In hypothesis 2b we assume that diversity beliefs has a positive moderating effect on the relation between team diversity and team identification. The moderator analysis, however, resulted in a model that was not significant (p = 0.15), making it impossible to further interpret the results of the analysis. The analysis did not provide evidence for the support of hypothesis 2b. The complete result of the moderator analysis on H2b is shown in Table 3.

<table>
<thead>
<tr>
<th>Table 3 - Results moderator analysis H2b</th>
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<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
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</tbody>
</table>

Dependant: Team identification

4.3 The role of Transformational leadership

In hypothesis 3, we have proposed that higher levels of transformational leadership which results in higher levels of shared goals within the team. The correlations table, as presented in Table 1, does not show a significant relation between transformational leadership and shared goals (r = .257 p = .303). Hence, no support was found for hypothesis 3.

In the next two sub hypotheses, we described the effects of having shared goals in the team on different relations in the model. Hypothesis 3a, we described a positive moderating effect of shared goals on the relation between team diversity and information elaboration. To examine the hypothesized interaction effect, we performed a moderator analysis. From this analysis on H3a, we found that the model was significant (p <0.05) but that the interaction effect did not have a significant effect on information elaboration (β = -.90 p = .60). This result thus provides no evidence to either support or to reject hypothesis 3a. The complete results of the analysis on H3a can be found in Table 4.

<table>
<thead>
<tr>
<th>Table 4 - Moderator analysis for H3a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Dependant: Information elaboration
However, in this analysis, a significant direct relationship between shared goals and information elaboration was found. This relation is also clearly visible in the scatterplot, which is presented in figure 8.

![Scatterplot showing the relationship between shared goals and information elaboration](image)

**Figure 8 - Significant positive relation between shared goals and information elaboration**

Hypothesis 3b described the positive moderating effect of shared goals on the relation between team diversity and team identification. From doing the moderator analysis we found that the model was not significant (p = 0.13), thus making it impossible to further interpret this hypothesis. This resulted in a lack of support for hypothesis 3b. The results from the analysis on H3b can be found in table 5.

<table>
<thead>
<tr>
<th>Model</th>
<th>Independant</th>
<th>Beta</th>
<th>Sig.</th>
<th>R square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0,13</td>
<td>0,32</td>
<td>2,19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shared goals</td>
<td>0,15</td>
<td>0,52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team diversity</td>
<td>-0,26</td>
<td>0,26</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shared goals * Team diversity</td>
<td>0,43</td>
<td>0,08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dependant: Team identification**
4.4 The relation between stronger leadership and team performance

In hypotheses 4a and 4b, we described the relationship between specific leadership behaviour and team performance. The correlations table, as presented in table 1, shows a significant positive relation between transformational leadership behaviour and team performance ($r = .71, p < 0.01$). This provided us with evidence to confirm hypothesis 4a. Table 1 also shows a significant positive relation between pro-diversity leadership behaviour and team performance ($r = .73, p < 0.01$). This provided us with evidence to confirm hypothesis 4b.

Further investigation of these positive relations, by means of a linear regression analysis, resulted in a positive model ($p = .01$). With this model, we aimed to see which of the two types of leadership behaviour had the upper hand in our sample. The results show that when the two types of leadership behaviour are being related to team performance combined, transformational leadership presents itself as the best determinant for team performance in our model ($\beta = 0.42, p = .09$).

<table>
<thead>
<tr>
<th>Table 6 - Regression analysis H4a and H4b</th>
</tr>
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<tbody>
<tr>
<td>Model</td>
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</table>

Dependant: Team performance
5 Discussion

5.1 Main findings

The goal of this study was to investigate the relation between team diversity and team performance in open innovation R&D teams. Next to this we investigated the influence of transformational and pro-diversity leadership practices in helping increase performance as well as the role of team identification and information elaboration in the team process. To be able to answer these research questions, we have conducted a survey study using an online questionnaire. This questionnaire was distributed among team leaders of open innovation research and development teams in the Dutch polymer industry. A total of 60 team leaders were approached for participation in the study and 18 of them completed the questionnaire. In this section we will elaborate on the results that were found and place them into the context of open innovation R&D teams.

The results suggest that team diversity has a negative relation with the amount of information elaboration in the team. This is in line with what we had hypothesized based on previous studies (Mannix & Neale, 2005; Pelled et al., 1999; van Knippenberg et al., 2004) that expressed concerns about the impact of team diversity on the underlying social processes in a team, such as social categorization. According to these previous studies, team diversity can impair team from exchanging information efficiently. These theories can be seen as the pessimistic view on the possible effects of team diversity on team performance. Next to this pessimistic view we have also elaborated, earlier on in this thesis, on the optimistic view towards diversity in research and development teams. For this more optimistic view on the effects of diversity, we have also found evidence. From the results we see that one of the attributes of diversity that were studied, functional diversity, shares a positive relation with team performance. This can be related to previous work by Van Knippenberg and colleagues (2004), who also acknowledged that diversity can have a positive impact on team performance through the information and decision making perspective. This perspective relies on the value of the different viewpoints that team members bring to the team.
The results also suggest that there is a positive relation between shared goals and information elaboration. We hypothesized the impact of shared goals as a moderator on the relationship between functional diversity and information elaboration. However, no such moderating effect was found, only the direct positive relation between shared goals and information elaboration, indicating that teams that have high levels of shared goals are also better at sharing task relevant information about the project. We can relate this back to the theory of cooperative outcome interdependence (De Dreu, 2007), which we used to set up the hypotheses. This theory states that when team members perceive more cooperative outcome interdependence, they share more information. Being cooperative outcome interdependent, means that people in groups perceive their goals and those of others in the group to be cooperatively linked. Consequently, people realise that they are all reliant on each other for the completion of the project. Having shared goals implies that all members of the team commit to the same set of goals, which gives them stronger incentive to share information and to put a lot of effort into the project. However, in contrary to what should be expected from the theory by De Dreu (2007), no direct effect from information elaboration on team performance was found. Whilst sharing information between partners in an open innovation project is proven to be one of the most important steps towards successful outcomes in open innovation (Wallin & Von Krogh, 2010).

Next, the results suggest that both pro-diversity as well as transformational leadership have a positive direct effect on the performance of the team. As we hypothesized using the theory by Zaccaro et al. (2001), the strength of leadership behaviour had a direct effect on the performance of the team. The fact that transformational leadership had a significant positive relationship with team performance can mean that this type of leadership is well suited for leaders in open innovation projects. Other than transformational leadership, also pro-diversity leadership had a significant positive relation with the performance of the team. The degree, to which the team leader tries to make the members of the team aware of the possible values of diversity and stimulating them to collaborate, resulted in higher levels of perceived team performance.
Another finding, which is remarkable and not expected in theories on which we based this study, is that transformational leadership and pro-diversity leadership share a large mutual correlation. Meaning that the transformational leaders from our sample are also very aware of the importance of diversity and are trying to stimulate members of the team to accept the diversity and use it to the collective advantage. Because of this strong mutual correlation between the two leadership styles, a reconsideration of the well-known concept of transformational leadership might be in place. At this moment the transformational leadership concept consists of four sets of leadership behaviour, which all rely on the ability for the leader to move followers from their self-interests towards a common mind-set. Transformational leaders, lead by setting a strong example, inspire team members and offer them intellectual stimulation and consideration. This type of behaviour can in fact be in line with the concept of pro-diversity. Since transformational leaders are best at convincing people of certain strategies and getting them on board for the project, they might also be the best persons to set the example about diversity beliefs. Their charisma can be very helpful when trying to make team members aware of the value of their mutual diversity and get them to use this. The results of our study indicate a strong connection between the two types of leadership behaviour, meaning that transformational leaders might be more versatile than is currently thought.
5.2 Synthesis of findings

From the main findings we explained in the previous section, we are now able to synthesize these findings into answers to the main research questions, which we formulated at the start of this project.

At the start of this study, we set out to find out what the effects of the high levels of team diversity on the performance of open innovation R&D teams are. From theory, we found that diversity in teams can provide opportunities for increasing team performance as well as impairments to the internal team processes. The impact that team diversity has on the performance of the open innovation R&D teams that we have studied follows the expectations as stated in previous theory. We found that team diversity negatively influences the information elaboration in the team. Since information elaboration is especially important in gaining a strategic advantage in open innovation, we can say that this relation represents the negative effects of diversity on team performance. However, not all effects of diversity in open innovation R&D teams have to be negative. The functional diversity that the teams that we have studied show, has related positively to the performance of these teams. Therefore showing that the use of different viewpoints from different functional backgrounds can indeed be profitable to team performance. From this we can state that diversity does play an important role in determining the chances for success in open innovation R&D teams, but that it also does provide challenges for the teams’ members en leaders. These challenges, in the form of decreased information elaboration, should be addressed to make full use of the functional diversity present in the teams.

Investigating the relation between team performance and the two types of leadership behaviour, transformational leadership and pro-diversity leadership, resulted in a positive outcome. We found that both transformational leadership as well as pro-diversity leadership have a positive relation with the performance of the studied open innovation R&D teams. Meaning that we found evidence for the importance of leadership in the teams that we studied and that both the attributes from transformational leadership as well as those from pro-diversity leadership are of value to the teams operating in this open innovation context.
Our final research question was about the role of team identification and information elaboration in the team processes in open innovation R&D teams. We found that information elaboration plays a significant role, since it has been proven to be linked to team diversity as well as to shared goals. This positive relation between shared goals and information elaboration might be explained from the viewpoint of the theory of transformational leadership. Although we did not find a significant direct relationship between transformational leadership behaviour and the level of shared goals, we believe that leadership can contribute to this. Since transformational leaders lead by setting examples and providing structure to the project through goal setting, they may still be responsible for the level of shared goals in within the team. Despite the fact that we did not find a relation between information elaboration and the performance of the teams we are able to state, based on our findings and those of previous studies, that it does play a significant role in the team process. Unlike the clear findings that surrounded the concept of information elaboration, we did not find any results that could provide insight into role of team identification in the team process of open innovation R&D teams.
5.3 Theoretical implications

This section will elaborate on the implications, which the results of our study present for currently existing theories and research that has been done. The results that we have found and discussed will be compared to the theories on which we based our hypotheses.

Previous studies have discussed the effects of diversity on the performance of teams extensively. Most studies use underlying social mechanisms, such as social integration (Harrison et al., 2002) or social categorization (Mannix & Neale, 2005) to explain the effects of team diversity. This resulted in two different approaches to the effects of diversity on team performance, first the more positive view that states that diversity provides a broader perspective of knowledge and experience to the team (Homan et al., 2007). Second, there is the more pessimistic view that states that diversity can lead to the formation of smaller social subgroups in the team. From the results of our study, we have confirmed that diversity can be an asset, as well as an impairment, to open innovation research and development teams. This relates to currently existing theories about the possible advantages of having a functionally diverse team (van Knippenberg et al., 2004; Harrison et al., 2002) as well as to the studies presenting the negative effects (Mannix & Neale, 2005). The results of our study are in line with these theories and can thus be seen as an extension of the current knowledgebase on the effects of diversity on open innovation teams.

In theory, information elaboration is seen as a very important tool for teams to increase their performance. Sharing knowledge with other members of the team and thus utilizing the personal expertise of all members in the team, is especially important in research and development teams. Chesbrough (2003) also stated the importance of information elaboration in open innovation teams. The study by De Dreu (2007) already found that having shared goals for the team increases the elaboration of task relevant information. Our study confirms the findings of De Dreu (2007) partially, since we did not find a relation to team effectiveness. However, the results that we found extended the findings by De Dreu (2007) to the open innovation context, thereby broadening the evidence base for this theory.
The theory by Zaccaro and colleagues (2001) on the effects of leadership on team performance, state that effectiveness of teams is largely determined by the leaders’ ability to coordinate and synchronize the individual contributions of the team members. Meaning that strong leadership behaviour can help increase the performance of the team. Our results help support this theory by providing a significant relation between both transformational leadership and pro-diversity leadership behaviour and team performance. We extend the current theories on leadership effectiveness by incorporating the dimension of pro-diversity leadership as a tool for increasing team performance. Also, we confirm the importance of leadership in open innovation teams, which had already been marked as a critical success factor by Claessen (2012).

The last implication for research is that the current assumptions on transformational leadership and pro-diversity leadership might need some reconsideration. Our results show that pro-diversity and transformational leadership are highly correlated, which indicates a strong connection between the two types of leadership behaviour. This means that the two theories about leadership are more or less supplement to each other, where the pro-diversity leadership theory (Rispens et al., 2012) has a primary focus on promoting the value of diversity to teams. Especially in the open innovation context, with high levels of diversity in teams the two types of leadership behaviour might arise simultaneously. Team leaders operating in this field of R&D, where team members are put together from different organizations, may be more aware of the importance of diversity and could be more eager to try and transfer this to the team members.

These implications for research open new possibilities for future research by further investigating the relationships found in our study. Suggestions for future research can be found in the next section.
5.4 Managerial implications

This section contains the implications that the results of our study can have for team leaders in open innovation projects.

When open innovation collaborations are started and teams are formed, these teams should include people from different functional backgrounds. As the results state, teams with higher levels of functional diversity achieve higher performance levels. Thus, it is important that the members of the team represent their companies’ functional expertise. The variation in functional backgrounds will enable the team to come up with better solutions. However, the teams’ diversity in general, which expands the diversity in terms of spoken languages and geographical dispersion, can provide challenges to the team. From our results we can say that these challenges might present themselves in the form of problems with the elaboration of task relevant information. Team leaders need to be aware of this possible problem and should keep communicating with the team members about the importance of information elaboration. This way, the team might be able to prevent the problems from occurring.

From our previous statements about diversity and the general results we found that leadership plays an important role in determining the performance of the open innovation team. Our findings support this by showing direct relations between the two types of leadership that were studied. The practical implication for this is that teams should appoint a leader who is responsible for managing the team and organizing its’ activities. The type of leader that is best suitable for this position, according to our research, is a leader who possesses the characteristics of a transformational leader. Meaning that this should be a leader with a good charisma and ability to get people on board with the goals for the team. Next to this, the leader should know and endorse the value of diversity in a project team so that he can convince the other members of the team of the value of diversity in open innovation. The team leader should use his/her position and qualities to make the members of the team aware of issues that can arise due to the team dynamics in open innovation R&D teams, so that these can be addressed if necessary.
The final implication for management is also related to the behaviour and responsibility of the team leader. Since the team leader has the task of setting goals and deadlines for the project team, he/she needs to make sure that all members share the same goal for the project. Our results show that shared goals are necessary to increase the elaboration of task relevant information within open innovation R&D teams. Therefore, team leaders should focus on getting all members of the team on the same page as regards to the goal for the project. Since these open innovation teams consist of people coming from different companies, the goals of the organizations with regard to the open innovation project, need to be aligned. Although we think that this is mainly a task for the team leader; we must acknowledge that the members of the team also have an important part to play in this. The involved organizations need to be open to suggestions and should actively participate in setting the goals for the project. This interaction between team members and the team leader might prove to be essential.
5.5 Limitations and future research

As to be expected from any study, ours has some limitations that should be understood when interpreting the results. First, the relative small sample size of only 18 teams provided limitations to the statistical power and the possible generalizability of the results. The small sample size also increases the chances for type II errors in the analysis of the data, since relations that possess’ only small correlations may not be found statistically significant. Also due to the small sample size, the impact of outliers becomes much greater.

This limitation provides opportunities for future on open innovation R&D teams, since a study with a larger sample size would drastically increase the generalizability of the results that we have already found. The effect of team diversity on team performance might be better studied by using a multilevel survey study, creating an objective measure for the diversity present in the team. This type of survey could also enable researchers to investigate more surface- or even deep-level attributes of diversity.

The second limitation of this study is presented by the way we gathered our data. We asked the team leaders to rate their own behaviour as well as the teams’ processes and performance. Using self rating on negative aspects of personal or team performance, increases the chances for common method or response bias (Podsakoff et al., 2003). This bias increases the chances for a type I error in the results. Driedonks and colleagues (2014), for example, show in their study on strategic sourcing teams, that team leaders may not be the best to judge the internal team processes. They conducted a multilevel survey study and compared objective results (on the effects of diversity on team performance) provided by team members, to this relation as perceived by the team leaders. The objective results showed a positive relation between functional diversity and the performance of the sourcing teams. The results from the team leaders however, showed the complete opposite of what was found. These results provide evidence that team leaders might not be the best instrument to measure the performance, let alone the internal processes of the team.
These results would mean that our results would be questionable at the least. However, in their study Driedonks et al. (2014) worked with teams that had little contact with their team leader (partially self managing teams). The team leaders from our sample were much more involved in the team process and were often the founders of the project and had hand picked the partners. Their close involvement in the project gives them a much better viewpoint, decreasing the impact of this limitation.

The importance of leadership has been clearly found in our study. This provides opportunities for future research in the field of team leadership, since we found a inter correlation between transformational leadership and pro-diversity leadership. This mutual relation should be further investigated and some existing theories might need to be revised. Also, we did not uncover the mechanism through which leadership has this positive relation with team performance. Future studies could go deeper into the team dynamics and try to uncover these mechanisms.

The final limitation to our study is the fact that we did not test our research model as a whole. By only analysing the direct correlations between variables and chopping the model into smaller parts to analyse the moderating and mediating relations, we might have missed some interaction effects and were not able to generate a full picture of the relations between team processes.

The way we measured the internal team processes and performance of the team also provide opportunities for future research. The multilevel survey might also be an important tool for acquiring better results and more clarity on the relations between the internal team processes. Although we did get an idea about the role of Information elaboration in the teams, we were not able to relate this with the performance of the team. Other studies have found evidence this relation in other contexts, therefore the further role of information elaboration in open innovation R&D teams should be investigated in future research. This also goes for the role of team identification, for which we did not find any evidence in our study.
6 Recommendations

Next to the theoretical aims of this study, we set out to provide practical advice to the team leaders in open innovation teams in the Dutch polymer industry, to help them gain insight in useful practices for performance enhancement.

From the results of our study, we can provide advice about the effectiveness of an open innovation collaboration strategy in the Dutch polymer industry. Since we have found that the teams that we have studied scored a mean of 5.28 (on a 1-7 scale) on team performance, we could say that the teams performed quite well. Providing grounds for the further stimulation of these types of collaboration with a vertical orientation within the industry. Whilst gathering the data for this study, we also received a comment from one of the team leaders.

“I think that there is still a lot to lose within the chemical sector if competitors are able to see inside each others kitchen. At this time at least, the losses seem greater than the possible profits of open innovation. I can’t say if this is the right way to go for the future, but I am convinced that we are missing out on some opportunities...”

When we combine this with the knowledge we have from the results of the study, we could conclude that managers and companies in the polymer industry can gain a lot of advantage by collaborating on in a vertical orientation, down the value chain of the project. By keeping stimulating these types of collaborations in the future, the DPI Value Centre can play an important role in the innovation processes in the Dutch polymer industry.

Next to the continuation of this type of innovation stimulation, the DPI VC might be able to help the project teams even better if they intensified the already present annual meetings between the different project teams. These meetings could also be used as a reflection and training moment for team leaders. Although the participating teams in our study scored high on information elaboration (m = 3.81 on a 5 point scale), we still found the relation between team diversity and information elaboration to be negative. Therefore, the meetings could be used to start a discussion about best practices around the management of team diversity. For example, how the teams manage expectations and experiences about the advantages and disadvantages of team diversity. This will help the teams manage their diversity better.
7 References


