Generation and Selection of Innovative Ideas in Cross-Functional Teams

The role of communication and information diversity

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Idégenerering och idéurval av innovativa idéer i multidisciplinära team
Betydelsen av kommunikation och olikartad information

Harun Poljo
**Sammanfattning**

Att använda multidisciplinära team är i praktiken ett av de vanligaste sättet att implementera innovationer i företag. Tillgången till olikartad information i sådana team har hyfts fram som en av de viktigaste fördelarna. Forskningsstudier visar emellertid motstridiga resultat när det gäller förhållandet mellan teamets tillgång till olikartad information och innovation. En orsak kan bero på att forskningen om multidisciplinära team huvudsakligen har fokuserat på förhållandet mellan multidisciplinära team och innovation som det slutgiltiga resultatet, och har varit mindre uppmärksam på att förstå hur detta kan skilja sig under innovationsprocessen. I den här studien undersöks rollen som multidisciplinära team har i det första steget i en innovationsprocess, dvs att idégenereringen och idéurvalen är särskilt studerat för att förstå vilka utmaningar är och hur dessa utmaningar framgångsrikt kan hanteras.

Nio projektledare intervjuades med erfarenhet av att hantera multidisciplinära team som utför idégenerering och idéurval i olika högteknologiska företag. Resultatet av studien belyser rollen av personliga konflikter under idégenerering och idéurvalet. De personliga konflikterna härrör från att varje teammedlem kan ha mål för produkter som strider mot andra teammedlemmars mål. Tillgången till olikartad information medför också utmaningar, eftersom det många gånger är förknippat med användandet av ett varierat vokabulär, vilket hindrar teammedlemmarna att förstå den information som delas under idégenerering. Teammedlemmarna saknar också kunskap och tid för att bedöma om information från en annan teammedlem är trovärdig. Vissa utmaningar uppstår också som en följd av hur idéurvalprocessen i idégenereringsfasen är utformad. Dessutom kan studien identifiera några användbara projekthanteringsstrategier för hantering av idégenerering och idéurval i multidisciplinära team.

Denna studie indikerar att nya rön i det framväxande forskningsområdet inom transaktiva minnesystem (TMS) kan vara ett nytt och stötande verktyg för att förbättra förståelsen av rollen som kommunikation och olikartad information har i multidisciplinära team under idégenerations- och urvalsprocessen. Det kan potentiellt stödja forskning om att autonom multidisciplinära team är lämpade för radikal innovation, eftersom teamen har en större möjlighet att interagera och utveckla en stark TMS. Slutligen ger avhandlingen förslag till framtida forskning inom TMS och idégenerering och idéurval i multidisciplinära team.
Abstract

Making use of cross-functional teams is in practice one of the most common ways to implement innovations in firms. The access to diverse information in such team has been pointed out as one of the key benefits. Research studies show however conflicting results when it comes to the relation between the team’s access to diverse information and innovation. One reason may be due to that research on cross-functional teams has mainly focused on the relation between cross-function teams and innovation as an outcome, and have paid less attention to understand how this may differ along the innovation process. In this study, the role of cross-functional teams in the first step of an innovation process i.e. the idea generation and selection is investigated particularly to understand related challenges and how it successfully can be managed.

Nine project leaders with experience from managing cross-functional teams in idea generation and selection in different high-technology companies were interviewed. The result from the study shed light on the role of personal conflicts during idea generation and selection. The personal conflicts originate from that each team member could have goals for products that contradict goals of the other team members. The access to diverse information also imposes challenges, since it many times is associated with the use of a diverse vocabulary, hindering team members to understand the information that is shared during idea generation. The team members also lack the knowledge and time to judge if information from another team member is credible. Some challenges also arise as a consequence from how the idea selection process in the idea generation phase is designed. In addition, the study is able to identify some useful project management strategies for handling idea generation and selection in cross-functional teams.

The study indicates that findings in the emerging research field of transactive memory systems (TMS) theory could potentially be a novel and supportive tool by improving understanding on the role of communication and information diversity in cross-functional teams in the idea generation and selection process. It could potentially support research on that autonomous cross-functional teams are suitable for radical innovation, since the team has a higher opportunity to interact and develop a strong TMS. Finally, the thesis, makes suggestions for future research on TMS and idea generation and selection in cross-functional teams.
Firstly, I would like to thank my supervisor Susanne Nilsson at Integrated Product Development, KTH Royal Institute of Technology, for her guidance and support during this research. Without your engagement and helpful encouragement to explore the research on cross-functional teams, I would not have had this amazing learning journey.

Secondly, I would like to thank my parents Samir Poljo and Mevla Poljo for their support throughout these weeks. And a special thanks to my younger brother Haris Poljo for always being an inspiration to do more.

Thirdly, I would like to thank all the interviewees that through their time and valuable information made this thesis possible.

Finally, I would like to thank all friends that showed support throughout the writing of this master thesis, you know who you are! A special thanks to Sunny Ahmed, to my friend Kristina Bozhko for showing support in the beginning when things were the hardest and to Faraz Fahimifar for the late days studying at KTH.

If someone reading this thesis has some question regarding idea generation and selection in cross-functional teams and regarding how a transactive memory systems could become supportive to its management, please do not hesitate to contact me.

Thank you again and best regards,
Harun Poljo

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1. INTRODUCTION

This chapter describes the background, the purpose and the limitations of this study

1.1 Background
Today industries are changing faster, the competitive pressure is constantly present and the companies need to build their capability to innovate (Tidd, 2001). Firms are looking at different organizational solutions and work methods to increase their capability to be innovative (Koen, et al., 2001; Björk, et al., 2010). The product complexity has increased requiring the knowledge from different fields to be combined to create innovations. As a consequence, the use of cross-functional teams i.e. teams consisting of designers, engineers, manufactures, marketers, purchasers, has emerged as the preferred way of organizing and working for many companies (Denison, et al., 1996; Hauptman & Hirji, 1996). Leading a cross-functional team is however connected to a range of difficulties mainly as a consequence from the difficulties in communication and due to the presence of diverse information. Some research studies show for instance that different languages (Song, et al., 1996), that task conflicts are mixed up with personal conflicts (Gebert, et al., 2006), and that lack of trust (Edmondson & Nembhard, 2009) has a negative impact on performance and innovation performance. The access to diverse information in such team has in other studies been pointed out as one of the key enablers for innovation due to its support for increased creativity (Srikanth, et al., 2016; Keller, 2001; Ancona & F.Caldwell, 1992; Brown & Eisenhardt, 1995; Verworn, 2006). As a result, research shows conflicting results when it comes to the relation between teams access to diverse information and innovation. One reason may be due to that there is a lack of research on the role of cross-functional teams on the innovation outcome since the majority of research is focused on the organizational or managerial level and less on team level (Crossan & Apaydin, 2010). Another reason may be due to the lack of research on how cross-functional teams perform in different phases of an innovation process. According to Schilling’s definition of innovation i.e. “the practical implementation of an idea into new device of process” (2012), the first step in the innovation process is the generation of ideas. In the second step ideas are evaluated to become innovation by being promoted and implemented (Howell & Boies, 2004; Amabile, et al., 1996; Scott & Bruce, 1994; Mumford & Gustafson, 1988). The management of ideas is hence an important step in the innovation process and constitutes a focus for change and development in many organizations that have an ambition to build their innovation capability (Koen, et al., 2001; Björk, et al., 2010). In addition, the idea generation and selection phase is also considered to have a stronger need to access diverse information (as it requires the team to be creative and to make decisions) compared to later stages in an innovation process why studying this phase may be particularly suitable when having a purpose to understand the challenges related to cross-functional teams. Understanding the role of cross-functional teams on the idea generation and selection and how such teams should be led in order to create innovative ideas is here suggested to be an area that require extra attention when studying innovation in contemporary organizations.

1.2 Purpose
For this thesis, the aim is to investigate what challenges project leaders experience when they lead cross-functional teams to generate and select innovative ideas and how they manage to overcome these challenges. The goal is to identify specific challenges that project leaders experience and different strategies to handle these in practice in order to come up with new insights on how to make the best use of cross-functional teams in an innovation process.
1.3 Delimitations
- This master thesis is conducted at KTH Royal Institute of Technology during the autumn semester of 2017.
- The thesis will run for 20 weeks by a single student.
- 9 external project leaders will be interviewed from various high-technology product development firms in the Stockholm area in Sweden.
- The interviewees are anonymous so no names are mentioned in the thesis.
- The analysis will only consider how project leader leads cross-functional teams during the generation and selection of innovative ideas.
2. FRAME OF REFERENCE

This chapter presents the frame of reference, divided into the topics of 1) innovation and idea generation in teams; 2) cross-functional teams and their challenges and performance management; and finally, 3) literature related to knowledge sharing in cross-functional teams and transactive memory system. The research questions are also introduced in this chapter and emerge from the frame of reference.

2.1 What is innovation and idea generation

Different definitions of innovation can be found in literature and for this thesis the definition for innovation will be “The practical implementation of an idea into new device of process” by Schilling (2012). According to the definition, the first step in the innovation process is the ideas. Ideas are the fuel of the innovation process and if no ideas enter the innovation process, then there is no innovation process. The innovation process has further been described as a process that is comprised by two stages (Howell & Boies, 2004; Mumford, et al., 2002). The first stage is that ideas are generated and the second stage is that ideas are evaluated to become innovation by being promoted and implemented (Howell & Boies, 2004; Amabile, et al., 1996; Scott & Bruce, 1994; Mumford & Gustafson, 1988). A benefit of dividing the innovation process in two-steps, is to highlight that all ideas should not become innovation by being promoted and implemented. Research suggests that the success of a company is not dependent on it having the best or largest amount of ideas, but to know how to best implement and use the ideas (Zerfass, 2005; Magnusson, et al., 2014). It is hence crucial for an organisation to understand which ideas to kill and which ideas to continue with (Magnusson, et al., 2014).

2.2 How is idea generation and selection performed in teams?

An important source for ideas in high-technology firms come from teams (Petersson, et al., 2017). Teams in firms can generate, evaluate and select ideas, and in the literature review by Mumford, et al. (2002), the steps for when groups generate ideas in practice are: problem definition, information gathering and formulating concepts to understand problem situation, combination and reorganization of information in a new way, use combinations based on analogical reasoning, and generate new ideas. Before the implementation of the generated ideas, the ideas have to be evaluated and selected (Mumford, et al., 2002). If teams throughout the firm would promote and implement all ideas so they could become an innovation, then the firm could end up in a situation where all its limited resources will be exploited and bottle necks in the innovation process could be created.

Further, Mumford, et al., (2002) showed that successful project leaders encourage group members to consider a variety of information and to share information. Discussions are also allowed to be extended for multiple ideas to be generated, since creative ideas emerge slowly, and the project leader uses disagreements to frame integrative solutions. The team has expectations from the project leader to combine and reorganize information in new ways to generate ideas that could solve the defined problem. The project leader has an integrative role in the team to encourage the team to share information and encourage that a variety of information is considered, but also to ensure that disagreements lead to integrative solutions. The project leader could also build climate and culture in the team to provide a context for idea generation, and to ensure that there are task conflicts to encourage the generation of creative ideas. The project leader could also be able to identify when task conflicts develop into personal conflicts, and to exercise influence over the group to minimize personal conflicts.
2.3 What are cross-functional teams, what are the challenges and what increases their performance?

The generation and selection of innovative ideas requires information to be shared and combined by a team. Research has shown that cross-functional teams are better at creativity and decision-making than teams that are homogeneous (Srikanth, et al., 2016). A cross-functional team consists of members from different functional areas, such as various research disciplines (like chemistry, electronics, and metallurgy), engineering, manufacturing, or marketing. These teams have high levels of functional diversity (Keller, 2001). The reasons to why such teams are more creative is that diverse teams have an increased variety in the backgrounds, resources, information and skills (Srikanth, et al., 2016), which also could act as a resource for the team when it comes to innovation. Cross-functional teams has further been associated with increase in innovation performance (Keller, 2001; Ancona & F.Caldwell, 1992) Hence, cross-functional teams can be expected to be suitable for product innovation and not the least for generating and selecting innovative ideas. On the surface, the cross-functional team seems as a good fit for the generation and selection of innovative ideas. If the cross-functional team is further researched from an idea generation and selection perspective, the idea generation and selection processes and hence the innovation process may be improved. There is however research showing challenges affecting the performance of cross-functional teams. Group diversity has been associated with negative effects on teams, such as increased conflict, lack of; cohesion and communication, and reduced motivation to engage with the team, and these factors tend to weaken the positive effects of having diverse teams (Srikanth, et al., 2016).

Performance challenges

In a recent review by Srikanth, et al., (2016) two factors affect performance in diverse teams; the deep-level and the surface-level diversity. Deep-level diversity stems from the fact that group members have different functional backgrounds, educational backgrounds, beliefs and attitudes, task-relevant information or group member personalities. Those different characteristics produce differences in perspectives, values, or information. Since these differences are not shown explicitly or are immediately visible in a group they are referred to as existing on a deep level. These deep-level diversities are however not inherently hierarchical or symbolise status, and therefore do not generally produce negative interpersonal processes. On the contrary, deep-level diversity is associated with informational benefits for teams. For this thesis, the deep-level diversity is suggested to be particularly relevant for the generation and selection of innovative ideas in cross-functional teams, since it provides access to diverse information.

Surface-level diversity is defined as diversity that includes nationality, organizational tenure, group tenure, ethnicity and gender. Since these differences are generally visible to a group, they have been labelled as surface-level diversity to differentiate them from deep-level diversity. Surface-level diversity characteristics may be connected to what status a group member has in the group. For instance, younger team members could have lower status than older team members, or a man is treated with higher status than a woman etc. This could create a basis for conflicts. The visible differences of surface-level diversity provide a basis on which members in a group can identify with others in the group that are similar and which can make them distinguish themselves from others, leading to negative consequences of social categorization.

According to Srikanth, et al., (2016) the dominant metaphor used in research to understand diverse teams, is to use the metaphor of a double-edged sword, since diversity can affect team performance both positively and negatively. To be able to manage a diverse team efficiently, a balance should be achieved between the informational benefits and the effect of social categorisation that leads to negative effects on cohesion (Srikanth, et al., 2016). The review highlights especially that surface level diversity could have a negative effect.

4
Research studies have also been performed on cross-functional teams when the R&D department and marketing department have to integrate. Numerous challenges and problems related to such integration have been demonstrated that severely hinder the development of products (Souder, 1981). Different underlying factors to these challenges were identified including the lack of trust or respect from members of the other unit; different ideologies, languages, goal orientations; lack of formalized communication structure; lack of physical closeness; and lack of managerial support (Song, et al., 1996). These overall challenges may also have an impact on the team’s ability to generate and select ideas.

**Innovation performance challenges**

Research by Ancona & F.Caldwell (1992) on cross-functional teams and innovation has shown that high levels of functional diversity in cross-functional teams are negatively related to cohesiveness and that it impedes social integration. Two diversity characteristics were found to be important for product development teams; the homogeneity of tenure and the diversity of the functional specialties in the team. The greater the functional diversity in a team, the more team members in the team communicated outside the boundaries of the team instead of communicating inside the team. High levels of functional diversity in a team is also associated with lower levels of performance, and particularly the management ratings of innovation. But if there is more external communication in the cross-functional team and high functional diversity, the higher was the managerial rating of innovation. High tenure homogeneity had impact on internal group dynamics, rather on external communication. It was associated with improved task work, such as setting priorities and clarifying group goals. This clarity was associated with high rating of overall performance. The conclusion in their research was that the overall the effect of diversity on performance is negative, but that more external communication increased the managerial rating of innovation. The positive effects come from increased creativity, but is impeded by implementation because there is less capability for team work, than there is for homogeneous teams (Ancona & F.Caldwell, 1992).

Research by Keller (2001) on cross-functional teams and innovation has shown conflicting results. On one hand, cross-functional teams are associated with negative budget performance, increased costs, increased felt stress, lower group cohesiveness, increased turnover, lower job satisfaction, higher emotional conflict and increased misunderstanding among functional departments. On the other hand, it was also shown to lead to better product quality, shorter development times, increased two-way communication among project members from different functions, that it drives task conflicts and increases external communication. Task conflicts emerge when team members can’t move forward with a task due different perspectives on how to solve it, and this tension could result in creative ideas that lead to innovations. The article concludes that the results from the research, point out the complexity of cross-functional teams and that there is a need to separate the effects of intervening variables (Keller, 2001).

Research by Lovelace, et al. (2001) also confirmed that cross-functional teams have different perspectives on how a task should be solved, and found that the outcome of task conflicts in the team depended on how free the team members felt to express their task-related doubts, and how collaboratively or contentiously these doubts were expressed (Lovelace, et al., 2001). It was discussed that “a cross-functional team's ability to be innovative and time- and cost-efficient depends on the way task disagreement is managed, by team members as well as by team leaders”.

Research by Gebert, et al. (2006) on cross-functional teams and innovation has shown that challenges in the cross-functional team are in the form of relationship conflicts and value conflicts which are mixed up with task conflicts. Relationship conflicts and value conflicts are personal conflicts. These types of conflicts differentiate themselves from task conflicts in that
they take focus away from the task which the team has been assigned. These conflicts promote social categorization which leads to subgroup formation and may prevent team members from expressing their individual information, since the team member isn’t appreciated as a unique individual and perceive it as a lack of recognition. One potential scenario could be that there is subgroup formation in a cross-functional team between young/old, men/women, different nationalities, and these subgroup formations could be irrelevant to implement an innovation. The consequence is that personal conflicts with the other team members could negatively affects the person’s willingness to share task related information. The article concludes with that one should not expect a positive but instead a rather nonsignificant association between cross-functionality and team innovations (Gebert, et al., 2006).

Research by Edmondson & Nembhard (2009) identifies several attributes that hinder the innovation performance in cross-functional team. The first is the project complexity in developing innovative products, where challenges are created by that the current understanding of the situation is constantly shifting and creates a high communication and coordination burden on a cross-functional team. The team is suggested to build project-management skills to deal with the project complexity. Second is the team diversity, where challenges are created by that team members are taken out of their functions which weakens the team members ties to the function and weakens the functional expertise of the team member. Different mental models from each team member also hinders team communication. The team could deal with the team diversity by gaining education about other functions and developing broader business or organizational perspectives. Third, temporary membership in cross-functional teams weakens the knowledge of who knows what in the team and it limits the time for building trust and psychological safety. The team could benefit from being offered repeated opportunities to learn “to team” and to build swift trust with new members. Fourth, fluid team boundaries make communication and coordination difficult and dispersed locations of team members give rise to misunderstandings. This could be turned to a positive by developing far-reaching network of collaborators due to the fluid team boundaries. Fifth and final, the embeddedness in the firm creates obstacles and roadblocks and the cross-functional team must invest time in finding champions and resources. The team could benefit from building boundary-spanning skills to successfully reach individuals outside the team, and to develop resilience when overcoming obstacles in the firm (Edmondson & Nembhard, 2009). Research by De Clercq, et al. (2011) found that the relationship between cross-functional teams and innovation is stronger for higher levels of shared responsibility and decision autonomy, social interaction, trust, and goal compatibility (De Clercq, et al., 2011). The results from De Clercq, et al. (2011) could be conflicting with the results by Edmondson & Nembhard (2009), since decision autonomy could be negatively affected by the embeddedness in the firm, the social interaction could be negatively affected by the dispersed locations, and the trust could be directly negatively affected by the temporary membership.

To summarize, research shows several challenges for innovation performance in cross-functional teams, but the research does not explicitly investigate the challenges during the generation and selection of ideas, which is the first step that allows for the innovation process. The access to diverse information in cross-functional teams during idea generation seems as an obvious benefit, which motivates further investigation of cross-functional teams related to generation of innovative ideas for product development. One reason to why the existing research results show conflicting results may be due to that extant research hasn’t divided the innovation process into the two steps of innovation, and studied the idea generation and selection process explicitly. This leads to the first research question in this thesis:

**Research question 1:** What challenges do project leaders experience when they lead cross-functional team members to generate innovative ideas for product development?
2.4 Idea generation and selection in cross-functional teams
In a recent mapping of the literature for how to generate ideas for innovation on an organisational level by Teza, et al. (2016), a taxonomic classification was performed and each classification was discussed. The access to diverse knowledge was highlighted as an important factor when generating and selecting innovation ideas and that employees are a source for ideas (Teza, et al., 2016). Further in a recent literature review on the generation of ideas by Dorow, et al. (2015) it was also emphasised that a source for innovative ideas come from ideas that are generated cross-functionally. One of several things that the literature mapping and the literature review have in common is that they do not discuss the challenges that have been presented in this thesis that cross-functional teams are associated with (Teza, et al., 2016; Dorow, et al., 2015).
Recent research by Ghobadi & D'Ambra (2012) on knowledge sharing in cross-functional teams didn’t explicitly study idea generation and selection, but researched how the challenges in cross-functional teams affected the knowledge sharing. The findings were that cooperative task orientation, cooperative communication and cooperative interpersonal relationships drive effective knowledge sharing, but the researchers concluded with “The phenomenon of knowledge sharing in cross-functional project teams is not easily understood, and this is due to the complexity of interactions between different specialists and stakeholders. Despite the recognition of the importance of effective knowledge sharing in cross-functional teams, there is a lack of theoretical and empirical attention in the management of this process.” (Ghobadi & D'Ambra, 2012). This highlights the lack of understanding for the idea generation and selection process in cross-functional teams on a team-level, and that there could be a need to find a model which explains the process.

2.5 A radically new idea management approach for cross-functional teams?
A candidate for a radically new approach to manage cross-functional team during idea generation and selection may be found in an emerging research field related to what is referred to as transactive memory system (TMS) theory. The term transactive memory system was first coined by Wegner (1986), and describes the process through which a group of people collectively encode, store and retrieve knowledge (Wegner, 1986; Lewis & Herndon, 2011; Ren & Argote, 2011). Simplified the TMS can be explained as a collective knowledge of who knows what in the team. In a later article, Wegner (1995) explains that the TMS consists of the knowledge that is stored in each individual’s memory, but also of an overarching memory that contains the information of different teammate’s domains of expertise (Wegner, 1995). Each team member in a cross-functional could hence through a TMS become aware of each other’s expertise and become able to retrieve it from the relevant team member when sharing and recombining information to generate new ideas, as well as when evaluating and selecting innovative ideas. That a TMS can be developed in a cross-functional team has gained support in a study by Hammadi, et al. (2013) were it is explained that the TMS theory clarifies how a cross-functional team gain, store, combine and utilize their knowledge when solving complex problems. It was shown that it was positively related to decision making, evaluating and selecting innovative ideas (Hammadi, et al., 2013). In a recent study by Tang, et al. (2015), it was found that tasks in cross-functional teams that involve exploration, informal communication and face-to-face communication are positively related with the development of a TMS. The generation of ideas in cross-functional teams is in this thesis argued to involve all the tasks (i.e. exploration, informal and face-to-face communication), why the development of a TMS may be a suitable approach to successfully manage an innovation process.

To summarize, research shows no clear model for how to lead cross-functional teams to successfully generate and select innovative ideas for product development. This leads to the second research question in this thesis:
**Research question 2:** How can project leaders lead cross-functional teams to successfully generate innovative ideas for product development?
In this chapter, the working process is described which is used in this research study to reach the purpose of this thesis

3.1 Research Design
A case study approach was chosen as a basis for the thesis, as according to Voss, it’s one of the most powerful research designs to use when developing new theory (Voss, et al., 2002). The first step was to perform an initial literature study narrowing down the scope and defining the research questions. The research questions were formulated through identifying and exploring the “what” and “how” based on the literature study, as suggested by Yin (Yin, 2009). A theoretical framework was then developed to better understand what areas are relevant based on research that has been done on the subjects previously. The aim of the theoretical framework was to use it to discover patterns in the theory that could contribute to the understanding of the phenomena that was researched (Alvesson & Sköldberg, 2008).

Based on the literature study, an interview guide was created. Semi-structured qualitative interviews were conducted individually with nine project leaders. The project leaders were from various industries and sizes and they were selected on the basis that they all have experiences with leading cross-functional teams.

The collected data was transcribed and coded, and all transcribed data that didn’t affect the cross-functional team during the generation of innovative ideas for product development was removed. The remaining data was coded into different categories to allow a chain of evidence to emerge, which is important according to Voss (Voss, et al., 2002). Based on the codes and chain of evidence, the data was analysed in interaction with the theoretical framework to answer the two research questions in multiple iterations.

Each element of the research design is described in more detail below.

3.2 Literature Study
A literature study was conducted with the aim to find factors that affects cross-functional teams, how the innovation process in cross-functional teams is affected by being a cross-functional team and how idea generation in cross-functional teams is affected by being a cross-functional team. The results from the literature study is used to support the analysis and discussion section in the thesis. Relevant research articles were identified through searching the database KTHB Primo for scientific articles published in journals and books. When searching the databases, the following keywords among others were used Cross-functional teams, idea generation, innovation, leadership, transactive memory system.

3.3 Data collection
Nine semi-structured qualitative interviews were conducted with project leaders for cross-functional teams in different high-technology companies, see Table 1 for more detailed information. The aim of the interviews was to find answers for the research questions and then see how the data relates to the theoretical framework. See the interview guide used during the semi-structured interviewees in appendix A.

The interviews were held at the project leaders work location, and were approximately 60 min long. All the interviews were held in Swedish, so the citations were translated into English by the author. The interviewees were guaranteed anonymity, so all citations are anonymized.
### Table 1. Detailed information for the interviewees

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Industry</th>
<th>Senior/Junior</th>
<th>Size of teams</th>
<th>What functions</th>
<th>Size of company</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Automotive</td>
<td>Senior</td>
<td>5-10</td>
<td>R&amp;D, purchasing, production</td>
<td>40000-50000</td>
</tr>
<tr>
<td>2</td>
<td>Automotive</td>
<td>Senior</td>
<td>5-10</td>
<td>R&amp;D, purchasing, production, suppliers, universities</td>
<td>40000-50000</td>
</tr>
<tr>
<td>3</td>
<td>Electronics, Consulting</td>
<td>Senior</td>
<td>5-10</td>
<td>Software, electronics, manufacturing, production, packaging, IT-engineer</td>
<td>1-10</td>
</tr>
<tr>
<td>4</td>
<td>Environmental research</td>
<td>Senior</td>
<td>5-10</td>
<td>Mathematical modelling, automatic control engineering, environmental engineering, wastewater engineering, LCA expert, researchers, product developers</td>
<td>200-300</td>
</tr>
<tr>
<td>5</td>
<td>Robotics, Consulting</td>
<td>Senior</td>
<td>5-10</td>
<td>Mechanical engineers, electronic engineers, software developers, systems architects</td>
<td>20-30</td>
</tr>
<tr>
<td>6</td>
<td>Software, Consulting</td>
<td>Senior</td>
<td>5-10</td>
<td>Agile software team</td>
<td>1000-1500</td>
</tr>
<tr>
<td>7</td>
<td>Energy</td>
<td>Senior</td>
<td>10-20</td>
<td>Agile team</td>
<td>30000-40000</td>
</tr>
<tr>
<td>8</td>
<td>Automotive</td>
<td>Senior</td>
<td>5-10</td>
<td>R&amp;D, purchasing, production</td>
<td>40000-50000</td>
</tr>
<tr>
<td>9</td>
<td>Medicine</td>
<td>Senior</td>
<td>5-10</td>
<td>Physicians, researchers, engineers, after market</td>
<td>15000-20000</td>
</tr>
</tbody>
</table>

#### 3.4 Data Analysis

The first step of the data analysis was to transcribe and code the interviews to sort and organize the data. For the transcribing process, it is important to ensure that the transcriptions are complete and include everything from the interviews, both the questions and answers from the interviewer and the questions and answer from the interviewee (Thornberg & Charmaz, 2013). The relevant parts for the researched subject were marked up in the transcribed interviews. The relevant parts were challenges and methods utilized by the project leader that affected the cross-functional team during the generation of innovative ideas for product development. The project leaders also discussed challenges and methods for the implementation of ideas, but those part were sorted out, since it lays outside the scope of this study. All other transcribed material that didn’t affect the cross-functional team during the generation of innovative ideas for product development was sorted out.

The remaining transcribed material was then divided into material that concerns the first research question and material that concerns the second research question. The transcribed material was then coded, and sorted into main themes in regard to the theoretical framework and outside the theoretical framework if a certain theme was mentioned several times. Some examples of themes are; idea generation, idea selection, conflicting goals, customer requirements, firm benefits, cross-functional interdependencies, knowledge, personal conflicts etc. The coded material was clustered into descriptive categories. Some examples of the descriptive categories are; goals, shared vocabulary, shared knowledge, team culture, team engagement, assumptions etc. The coding was supported by using Trello, Google Docs, Post-it notes and white boards.
3.5 Evaluation of Methodology

Since the sample size of the data collected was small, no generalizations can be drawn. The data can be used to highlight areas of interest and give indications for starting points for future studies. Quantitative data could have been collected as an alternative method to gain a broader perspective, for example by conducting a survey. This method was considered to not be appropriate since the aim of the research question is to understand the project leader in cross-functional teams during idea generation and quantitative data was considered unable to provide the level of details required to answer the research questions selected.

The research method of semi-structured interviewees, could lead to that some interviewees, based on their answers, would receive probing questions outside the interviewee guide to further understand the answers from the interviewees. Some of the probing techniques used for semi-structured interviews is the basic probe: when a question is repeated to get the interview back on track, the explanatory probe: which is used to get a clearer understanding of an incomplete statement of the interviewee, the focused probe: is used to get particular understanding of a topic during the interview, the silent probe: is used by that the interviewer is silent when the interviewee is taking a time to respond or is hesitant to respond, the drawing out probe: is used when the interviewee is not responding and the interviewer restates the last questions, the giving ideas or suggestions probe: the interviewer gives suggestions or ideas to think about for example “What are your thoughts about…?” the mirroring or reflecting probe: the interviewer repeats what the interviewee just said with his/hers own words and this help the interviewee to think about their answer (Easterby-Smith, et al., 2002). This could lead to that some of the conclusions are less generic, since the variety of probing in different interviewees, would affect the available data concerning each question from the interview guide. There is also a risk that the interviewer could have steered the interview consciously or unconsciously towards desired answers. The interviewees also are from several different industries with varying sizes, which could lead to broader understanding of the researched subject, in contrast if the interviewees were conducted with interviewees at a single firm.
4. RESULTS

In this chapter, the most important findings from the semi-structured interviewees are presented divided into the categories generated after the clustering of the coded data.

4.1 The role of goals

Several interviewees expressed that different functions have conflicting goals for a product, and that each team member many times has different perspectives for what is the most important aspect of a product. This creates task conflicts in the team. The interviewees expressed that some of these contradicting goals may have their origins from the need to take in consideration new governmental regulations. This may lead to solutions that are not optimal for the firm or for the customer. An interviewee from the automotive industry explained how they solved it cross-functionally when EU had set new goals to decrease emissions for motor vehicles. On an organizational level the goals risked leading to decreased profitably of the firm. However, the a cross-functional team reframed the goal into that the R&D department would decrease the fuel composition of the vehicle and that the marketing department would advertise to the customer that the total cost of ownership is lower than for the competition. The goal of decreasing emissions could have had resulted into the R&D department developing products that would increase the cost of the product, and which would make it harder for the marketer to advertise a price competitive product. But instead the R&D department and the marketing department reframed the goal into goals that would benefit the firm and at the same time comply with the new emission regulations. This way of setting goals together in a team was expressed as a successful method by multiple interviewees to ensure that all team members had buy-in for the goals, and that all team members could see how the goal could benefit them.

“And they put most things in from the top, for example installing the engine and things like that, while we want to reach everything from the bottom, so there are different perspectives all the time”

Interviewee 8

“It is very important that you as a team is involved early in the process, so that you also feel ownership and responsibility. But also, to gain insight in what is it that you actually are trying to solve and that often leads to better quality.”

Interviewee 6

Furthermore, interviewees expressed that different methods were utilized to find buy-in for goals and to communicate how the goals would benefit the team. One approach was to do it top-down, where the management sets a vision for what direction the firm is heading for into the future. The characteristics of the vision was that it is broadly defined to incorporate all functions of the firm, and each function could see how the generated ideas could enable the vision. This could then lead to buy-in and that each team member can see how the set goals could benefit them. The interviewees also expressed that the vision could increase the probability that ideas get managerial support when being promoted and implemented, since the management has expressed support for the vision. Two challenges were however expressed among the interviewees regarding the use of visions. The first challenge was to ensure that the vision is not too narrowly defined so that it limits the idea generation process into generating a narrow span of ideas. The second challenge is that the vision cannot be too broadly defined so that it loses its substance and does not mean anything to anyone in the cross-functional team. One interviewee expressed that the challenge of too broad visions can be solved by that the project leader fuels the vision with a particular meaning and purpose for the cross-functional team.
“One goal we had was that it should be in line with our strategy, that we believe in these four things, can you come up with things that we don’t do today that could contribute to that we reach our set total goal for the whole energy company”

Interviewee 7

The other methods utilized by some interviewees, was to first define how the different functions are interdependent to each other, before setting goals for the idea generation. The main goal for the cross-functional team would be deconstructed into sub-goals with the interdependencies in mind, so that ideas could be generated that each team member could have buy-in for, see how their contribution could benefit reaching the goal, and understand how reaching the goal would benefit them.

“Actually it is becoming better, because now you build a system, where you see your contribution in the system, ... earlier we looked at the mechanics, we will set these goals, and then you try to paint a picture from the leadership perspective into something that will motivate and inspire the team that had this specific technological discipline, the thing is that most often this didn’t go hand in hand with the other functions individual set goals, even though that it was maneuvered out of a common vision... So multidisciplinary and that you think more like a system rather as components when you think from a discipline perspective, will give you greater opportunities to see possibilities, to see what this will contribute to, what kind of benefits will this contribute into what this system actually will do”

Interviewee 5

4.2 Lack of shared vocabulary and knowledge

A couple interviewees commented on the fact that you often have to pull out information from team members, since you do not have the capability to judge if the information is correct or if the team member has shared all relevant information to reach the goal set for the idea generation. The benefit is that at least the team members are pushed as far as possible to share as much information as possible. But one interviewee highlighted the challenge is that you have to ensure that the other team member does not think you are seeking a personal conflict, when being pushed to share information. The team members could spend time to double-check if the shared information is correct, but an interviewee expressed that all team members are too busy to have time to do it and instead choose to simply trust the team members. But if several interactions with a team member has proven that a team member is sloppy, then the project leader would learn to verify the information that the team member has shared.

There is also the challenge that if a team member expresses their information for an idea first, that there is risk of groupthink and team members follow the information expressed by one team members instead of sharing their own information. A method to motivate all team members to share as much information as possible was explained by a couple of interviewees. The method consists of first defining what the goal for the idea generation is and then to give time to all team members to simultaneously develop relevant information before sharing it to the whole team.

On the contrary an interviewee expressed how function specific information is shared through ideas, but the lack of shared vocabulary could hinder the team members to understand the idea. So, for example when ideas are evaluated the idea could be expressed using words that team members do not understand and the idea could therefore not be evaluated. But if there is overlapping vocabulary present in the team, an interviewee highlighted that is enables the team to build upon each other ideas and to discuss them with another.
“It is very simple to write something pretty fuzzy because the persons that wrote it thinks it is super clear, but when you weren’t part of it and know what was discussed and how they thought... I don’t think everyone should be involved writing, but I think it is good to at least have seen it and you can ask questions and come with suggestions”

Interviewee 4

4.3 Team culture and engagement
As the team members in a cross-functional team originate from different parts of the organization, the interviewees expressed the need for the team to meet before the project starts and to socialize outside work to create trust, empathy, respect and cohesion in the team. The interviewees highlighted that cross-functional team work requires high-levels of empathy. This could according to the interviewees lead to that the team members care more about the results of the team and are more willing to share information. But there is a challenge in that there is a lack of physical closeness which creates friction to meet often.

“To become truly cross-functional requires a very empathic group work, where you understand and listen a lot to your teammate”

Interviewee 1

A challenge in cross-functional teams is that there is a risk that personal conflict can arise from task conflicts between the different team members, since each team member could bring a unique perspective to how the goal of the idea generation can be fulfilled. The cross-functional team could then benefit from establishing values and a culture for how task conflicts will be handled to ensure that information is shared and recombined into new ideas, instead of managing the personal conflicts within the team.

“It is about doing it in such a way that isn’t personal and isn’t an attack on one person, that is the most important and then you have to talk through what values do we have in the team and how will we be towards each other. And I have seen people yell at each other and that is a very extreme case, but of course things like this happen.”

Interviewee 6

One interviewee expressed how the level of engagement from one team member, could affect if that team member would be incorporated throughout another project from idea to implementation, or if another employee from that functions will be picked instead.

“Some are so incredibly engaged, then they are like that in everything. And some aren’t engaged at all. The thing is that you then often want to continue to work with they who are engaged and you give fewer tasks to them that aren’t engaged ... Sometimes they don’t have anything to do, but it can quite often be their own fault”

Interviewee 4

4.4 Separating information from assumptions
During idea generation both information and assumptions are shared. Many team members have a hard time to separate between what is information and what are assumptions from a team member, that originate from other functions. If an assumption incorporated into an idea is proven during implementation to be a false positive, then an interviewee highlighted that it may have negative consequences on the budget. But in the beginning during idea generation the interviewees mean that the team members could have a high sense of optimism, which could be interpreted as a heightened state of risk taking and the team could select ideas based on assumptions that lead to false positives. An interviewee expressed that the learned reality that the
probability is low that an idea will be implemented into an innovation, could also decrease the optimism in the team, hence make the team more risk averse.

Furthermore, there is a tension when generating ideas in that the selected ideas are expected to be able to balance between benefiting the customer and the firm and it is a challenge to strike this balance. In an attempt in striking this balance, assumption are many times introduced about the customer needs and about what would benefit the firm, when information is shared. The interviewees mean that having a product owner present during the generation of ideas, assumptions regarding the customer could be exchanged for information regarding the customer. The product owner then ensures that the customers voice is present throughout the process instead of relying on the assumptions. But the most important is to validate that there is a customer case, since if the customer doesn’t want to pay for the developed product, then there is no business case no matter how many assumptions there are about the firm.

“You will benefit if you do short cycles, then you will very quickly learn from each other and very quickly get input from each other ... and stimulate each other and that I think is very important. Iterate more!”
Interviewee 3

“We have also done mistakes in that sense, we have developed features where strong marketing units are completely confident about that they will be able to sell significantly more or many options and then we have acted on it and developed it and it turned out not to be correct”
Interviewee 9

“I believe more in the general, so in general this is what the customer wants and we should develop this. To have the customer in focus I think. So, for me it is more valuable that you successfully managed to somehow validate or tested your idea with the customer in some way and that there is a pull. Then you know that. Otherwise you could be like this that that it will theoretically sell this many of this, then we will make this much money, but does the customer want it?”
Interviewee 7

4.5 Role of cross-functionality when evaluating and selecting innovative ideas
There are several challenges in the methods of evaluating ideas. Firstly, the selection process cannot be too time consuming, since a market opportunity could be missed. Secondly, not too many ideas can be selected, because otherwise there will not be resources to implement the ideas quick enough to not miss the market opportunity. Thirdly, not too few ideas can be selected, because otherwise if one idea is proven to be a false positive then the market opportunity could still be met if there are more ideas that could be implemented.

Generated ideas are at the end evaluated and selected, were the main approach identified in the study was to trust the most experienced individual to evaluate which ideas are innovative, and should be promoted and implemented. The experience of the team member could have been gained by that the team member has worked at several different functions within the firm throughout their career. According to the interviewees such experience enables the team member to select ideas by having cross-functionality in mind by understanding how the different functions are interdependent. The experienced team member could also use their contact network that they have gathered throughout their career to get further input when evaluating the ideas. But this experience could be difficult to express in words to the other team members, so the ideas are many times perceived by the other team members to be selected by intuition or by expressing
confidence. The experienced team member could also limit the team to consider radical ideas, because they lack experience in how such ideas can be implemented into innovations.

“Usually it becomes clear pretty soon which ideas that is best. And then we come to the cross-functional again, you have to do this cross-functionally together, otherwise you are screwed already from the beginning.”

Interviewee 1

On the other hand, interviewees stated that in order to ensure that many perspectives are taken in consideration, the ideas would benefit from being evaluated and selected by several team members. This approach could be assisted by a team member that has specific knowledge in understanding how the different functions are interdependent, and this team member could guide the evaluation and ask questions aimed to the different team member. This could ensure that the input from each team member is considered and weighted against another. Further the product owner could also provide input during the evaluation to ensure that ideas that the customer values are selected.

“The system specialist and the architect have a better possibility to make a judgement and it is usually these two that somewhere in some form play tennis with another and then there are several people that are knowledgeable within their own field that tell what is possible and what is not possible within their field.”

Interviewee 5

The interviewees stated that the process of evaluation ideas could be simplified if it can be proven that implementing an idea will decrease the cost for the firm to provide the customer with value. The other team members can clearly see how the implementation of an idea will lead to a financial outcome greater than other ideas. One interviewee highlighted that it is important that a standardized method of calculating ROI is utilized across the functions to ensure transparency in the calculations, since otherwise the number will not be meaningful. The lack of transparency was expressed by an interviewee makes it easy to manipulate numbers in the calculation through different assumptions until the idea can show a positive ROI if implemented.

“There is no point in starting a project, if the product can’t become cheaper. The product has to become cheaper, everything is about developing cost effective product, that the customer still wants, so that the customer value is still there. It is always about giving and taking.”

Interviewee 2

The team members in a cross-functional team could have task conflicts and generate different ideas. During the evaluation some the ideas are not selected, and the interviewees stated that the aftermath of the non-selected ideas has to be handled. The aftermath could be handled so that it is clarified that only because an idea is selected to be implemented, that all other ideas aren’t automatically bad ideas. The current circumstances could affect which ideas will be chosen or not chosen. Additionally, ideas are relevant for different time horizons, since the goal could for example be that an idea should be implemented within one year but ideas are generated that could be implemented within 5 years. It could be clarified to the team members that an idea is innovative but not relevant for this specific time horizon. On the other hand, interviewees said that it is difficult to estimate how long it will take to implement an idea into an innovation, but also that the firm is constantly changing due to external forces which could lead to ideas that aren’t relevant for a certain time horizon could earlier than expected become relevant.
“It is only about degrees and what is the best right then and often you end up in a compromise ... a good team then knows each other and you accept each other’s opinions and say OK I guess we test your way this time and we test my way the next time”

Interviewee 6
This chapter aims to analyse the results and discuss the results based on the available frame of reference

5.1 Analysis and Discussion

Several challenges and possible means to overcome the challenges have been identified, and the following section will analyse and discuss the findings most relevant to idea generation and selection. Support for cross-functional teams to develop a TMS for idea generation and selection will also be presented.

5.1.1 The role of personal conflicts in idea generation and selection

Contradicting goals in cross-functional teams are found to lead to personal conflicts already in the idea generation stage of the innovation process. This adds to the research of Song, et al. (1996) where it was shown that cross-functional teams have performance challenges due to different goal orientations. The contradicting goals could lead to task conflicts, which was shown by Gebert, et al. (2006) to be mixed up with personal conflicts. The personal conflicts could take away attention from the idea generation and selection, and make the process less efficient.

The cross-functional team could according to the results benefit to set goals together before the idea generation starts, so that each team member can see how the goal could benefit them and ensure that all team members have buy-in for the goals, so that contradicting goals don’t lead to personal conflicts. This gains support from the research by Lovelace, et al. (2001), since the outcome of task conflicts was shown to be depended on how free team members felt to express their task-related doubts. Setting the goals together before idea generation starts could be the method that encourages that task-related doubts are expressed, before the team starts the idea generation.

The selection of ideas could also lead to personal conflicts, since there are task conflicts in the team and not every idea will be selected. It could be beneficial to communicate to the team that several ideas could be innovative, but some ideas are not relevant for the set time horizon or for the current circumstances in the firm. Otherwise there could be a risk that a personal conflict emerges, if a team member does not understand why their idea was not selected over other team members ideas. The selection process could potentially be affected by the embeddedness in firm of the cross-functional team, since the research by Edmondson & Nembhard (2009) has shown that cross-functional teams in some organization structures use individually based rewards. Selecting certain ideas when implemented could therefore lead to that certain team members could receive individual awards, while other team members would not. This could create a challenge in team work since some organizational structures values individual achievement, but a cross-functional project seeks a collective accomplishment. It is unclear how much an individual based reward structure in an organisation could affect idea generation and selection, and how that could impact the ability for the cross-functional team to set goals that do not lead to personal conflicts.

Further the project leader could also benefit to first define how the different functions are interdependent before setting goals for idea generation. Sub-goals could be deconstructed and each team member can see how their contributions during idea generation benefit the whole team. This is an addition to the conclusions of Edmondson & Nembhard (2009), that cross-functional teams could benefit from gaining education about other functions and developing a
broaden organizational perspective. This builds on the research of Gebert, et al. (2006) where it was shown that cross-functional teams could mix up personal conflicts with task conflicts. If the team members understand how they are interdependent then discussions during task conflicts could be more productive since each team member understands why there is a task conflict. But Edmondson & Nembhard (2009) has shown that cross-functional teams in some organizations use department-based resource allocation. Selecting certain ideas could lead to that certain departments resources will be more utilized than other departments resources. It is uncertain how each department will get compensated in proportions that mirror the deployed resources for the cross-functional project. The way resources are allocated in a firm could in the end create a scenario where it hinders the cross-functional team to set goals that benefit the whole team, since the required resources from a department during implementation could perhaps not match the resulting pay-back to the department. If there is a scenario where there is no department-based resource allocation, then ideas could be generated and selected that could benefit the firm as a whole but theoretically could benefit the different departments unevenly. Instead department resource-allocation could lead to that instead of focusing on how the firm stays competitive by implementing innovations, there is instead focus on how the departments stay competitive within the firm. This could lead to task conflicts in the cross-functional team that could be mixed up with personal conflicts.

Utilizing a vision to lead the cross-functional team to set goals during idea generation is an addition to the literature that is suggested to be further explored. The vision shifts focus from contradicting goals to instead focusing on what the goal is for the whole firm. The challenge here is to state a vision for the firm that is sufficiently broadly defined to incorporate all the functions and isn’t so vague that none of the team members can relate to it. But is not so narrowly defined that only a few functions can relate to it. A properly defined vision could lead to that ideas are generated that if implemented ensure that the firm stays competitive in the future. All team member could through the vision see beyond the task conflicts and the vision could steer the team away from personal conflicts. The management level could also exercise subtle control over a team by communicating a clear vision for a product development team, while giving the team members freedom to work autonomously within the vision (Brown & Eisenhardt, 1995). Utilizing visions by a team leader in teams is one part of a leadership style referred to as transformational leadership, which has been described as leadership through: idealised influence, inspirational motivation, intellectual stimulation and individualised consideration (Mitchell & Boyle, 2009). In the research of Mitchell & Boyle, (2009) a theoretical model is presented for how transformational leadership could have a positive effect on the team innovations in cross-functional teams. Another theoretical model for what effects transformational leadership could have on task conflicts and relationship conflicts was presented by (Hüttermann & Boerner, 2011). It was discussed that there is theoretical support for that relationship conflicts could be decreased in cross-functional team. On the other hand, it is ambivalent what the effects would be on task conflicts. Recent research has shown that transformational leadership has a positive indirect effect on individual creativity and team knowledge sharing in product development teams (Dong, et al., 2017). There is empirical support that transformational leadership has a positive effect on effectiveness and efficiency for decision making in teams during idea selection at a management level (Hammedi, et al., 2011). In this study the focus was on idea generation, and it shows some support that transformational leadership through visions, could be a method to set goals. But it is unclear how to define a vision so it could have a positive effect on idea generation in cross-functional teams, so that task conflicts do not develop into personal conflicts.

The personal conflicts could also be managed by building a culture in the cross-functional team by socializing outside work to create trust, empathy, respect and cohesion in the team. The culture could lead the team members to care more about the results of the team and are more willing to share information. This support recent research by Markham & Lee (2014) which
showed that cross-functional teams with positive cohesion had a positive association with innovation, and research by Shaner, et al. (2016) showed it leads to more knowledge sharing in cross-functional teams. Still a challenge with this method is that there is a lack of physical closeness between team members, so it could be difficult for the project leader to build culture in a cross-functional team without the right conditions. The research by Mumford, et al. 2002 identified that a culture for idea generation and implementation includes dimensions of risk taking, freedom, work challenge, openness, trust, support, intellectual orientation, intrinsic involvement and activity/experimentation. This raises question for how the lack of physical closeness and the temporary membership in cross-functional teams (Edmondson & Nembhard, 2009) affect the probability that a culture could emerge. The lack physical closeness creates barriers for the team to meet to build culture and the temporary membership limits the available time to build a culture.

Further establishing values in the cross-functional team that address how task conflicts in the team could be handled so that they don’t lead to personal conflicts is an approach that is not discussed in existing literature. Establishing values could be a tool that is utilized throughout the idea generation every time the project leader senses that a task conflict is shifting into becoming a personal conflict. The whole team could then be held accountable towards the values, and the team could shift focus from personal conflicts to sharing information and recombining it into ideas.

5.1.2 The challenge of access to diverse information

The literature study showed that there is a lack of a shared vocabulary in cross-functional teams (Song, et al., 1996). One interesting insight generated in this study is the finding that the team members in cross-functional teams many times are lacking a shared vocabulary to understand the description of an idea which creates a paradox during idea generation. Diverse information is shared, but there is a risk that team members don’t understand the vocabulary used, and actually in the end no information is shared. This could hinder the team members to recombine information to generate ideas. The project leader could put more focus on uncovering if there is a lack of a shared vocabulary in the team and ensure that a shared vocabulary is established. This expands on the research by Mumford, et al. 2002, where it was shown that successful project leaders allow extended discussions since creative ideas emerge rather slowly, but it was not discussed how a shared vocabulary in a team affects the discussions. Allowing for extended discussions could be a method to allow for the shared vocabulary to emerge. This raises the questions if innovative ideas could emerge faster if the cross-functional team has a method to actively work with its shared vocabulary.

The diverse information and knowledge in the team also creates a setting where each team member could lack the capability and time to assess if information that has been shared is correct. The team members have to trust each other, and judge if the information is to be trusted and could be used to recombine with other information to create new ideas. But a challenge in cross-functional teams is many times the lack of trust (Song, et al., 1996; Edmondson & Nembhard, 2009). Team members could hence be aversive to take information into account when generating ideas. The result in this study suggests that research could benefit from studying how team members judge the credibility of other team members in a cross-functional team. One potential explanation is that the surface-level diversity within the team is used to judge credibility. But research shows that surface-level diversity is separated from functional deep-level diversity (Srikanth, et al., 2016), so it could have a negative effect if this method is utilized. Making assumptions about the deep-level diversity in the team through the surface-level diversity in the team could give a false understanding. Research by Gebert, et al. (2006) showed that personal conflicts in cross-functional teams could emerge from that a team member isn’t appreciated as a unique individual and perceive it as a lack of recognition. It could be argued that
being appreciated as a unique individual in a cross-functional team means that the other team members recognize and utilize the diverse information available to the team. But instead team members could deliberately or undeliberately utilize surface-level diversity to assess if information that is shared is correct, which could lead to that some team members perceive it as a lack of recognition. This is also suggested to be a topic for further research.

An interesting insight generated in this study is the finding that cross-functional team attempt to strike a balance when generating ideas so that the implemented ideas could provide value to the customer and to the firm. Research has shown that having goal constraints from the customer and firm perspective increases; the novelty and usefulness of product ideas and helps harness the functional diversity in teams when generating innovative ideas (Hirunyawipada & Paswan, 2012). This study shows however that in order to strike this balance, assumptions are sometimes introduced while information is shared, leading to a false understanding of the customer needs and the firm benefits. Since team members could lack the information to understand that an assumption has been shared by another team member, this could be passed on as correct information, for example when calculating the potential ROI for ideas. This could lead to that the ideas are proven to be false positives when implemented. The project leader could benefit from utilizing an iterative process where information is constantly verified so that assumptions could be proven to be false or true. It could be a successful strategy to find the weakest link in all the information shared and prove or disprove it early. If the weakest link is proved to be correct, then more information could be built on the idea and the next weakest link could be identified. Favourably the assumptions regarding the customer could be verified first, then the team knows that there is a customer case. That there is customer case is important, since if there is not a customer case then there is not a business case. The addition of a product owner during the generation of innovative ideas could be beneficial to ensure that correct information regarding the customer is shared and that assumptions regarding the customer could be proven to be false or true.

5.1.3 Fast or slow evaluation and selection of innovative ideas
The study showed that cross-functional teams either had the approach of that the most experienced evaluates and selects the ideas, with cross-functionality in mind. Or that the whole team evaluates and selects ideas cross-functionally. In the latter, one team member has the specific knowledge in understanding how the different functions are interdependent and could direct questions to each team member to ensure that all perspectives are considered and weighted against another. It is unclear when each of these methods are most successful. Research has shown that both involving the whole cross-functional team can be successful (Hammendi, et al., 2013) as when the most experienced evaluate and select ideas (Magnusson, et al., 2014). It could be argued that involving the whole team could require more coordination, but more information could be available to make a correct decision. While if the most experienced team member does it, it could be quicker but less information could be available to make a correct decision.

5.1.4 TMS – the missing link between cross-functional teams and innovation performance?
Wegner (1995) explains that the TMS consist of the knowledge that is stored in each individual’s memory, but also of an overarching memory that contains the information of different teammate’s domains of expertise (Wegner, 1995). Each team member in a cross-functional could hence through a TMS become aware of each other’s expertise and be able to retrieve it from the relevant team member when sharing and recombining information to generate new ideas, and when evaluating and selecting innovative ideas.
The TMS theory could explain the conflicting results of innovation performance in cross-functional teams, since some teams could have had a strong TMS while other teams could have had a weak TMS. One potential explanation could be that research by Edmondson & Nembhard (2009) identifies temporary membership, fluid team boundaries and the embeddedness in the firm as some of several attributes that hinder the innovation performance in cross-functional team. A team is required to interact over time to develop a TMS (Ren & Argote, 2011), and the challenges for cross-functional teams could affect the possibility for the team to interact. This could lead to a negative impact on the emergent of a TMS in cross-functional teams. On the other hand, there is a positive relation between autonomous cross-functional teams and radical innovation since there is less interference from the organisation in autonomous teams (Patanakul, et al., 2012). This positive relation could be explained by that autonomous teams have a higher opportunity to interact, which has a positive relation on the emergent of a TMS in the team. This is suggested to be a topic for further research.

In a recent study by Tang, et al. (2015), it was found that tasks in cross-functional teams that involve exploration, informal communication and face-to-face communication are positively related with the development of a TMS. The generation of ideas in cross-functional teams is an explorative task, since the team is handling new information shared from different team members (Mumford, et al., 2002). The generation of ideas involves informal communication since the discussions could develop in unexpected directions which there aren’t routines for (Mumford, et al., 2002). Face-to-face communication is performed during idea generation since there is direct access to information and feedback from the other team members (Mumford, et al., 2002). These tasks are argued to be correlated to the generation of ideas, and a strong TMS in a cross-functional teams could increase the idea generation performance. The development of a TMS may be a suitable approach to successfully manage an innovation process in a cross-functional team and particularly the first step of idea generation and selection. This is suggested to be a topic for further research.

Research has shown that syntactic, semantic and pragmatic boundaries in cross-functional teams hinder knowledge integration (Carlile, 2004; Liao, et al., 2012) and that syntactic and pragmatic boundaries negatively affect the development of a TMS in a cross-functional team (Kotlarsky, et al., 2015). These boundaries could create obstacles when generating innovative ideas for product development in cross-functional teams. The different functions may use words that other team members don’t understand (syntactic boundaries), team member may use words that have different meaning for different functions (semantic boundaries), or team member simply don’t see how the information shared by other team members would benefit them to reach their goals (pragmatic boundaries). The result from this study shows support for that syntactic knowledge boundaries could be present during idea generation in cross-functional teams, since there is a lack of a shared vocabulary. The study also shows support for that there could be pragmatic knowledge boundaries in cross-functional teams during idea generation, since the team members have contradicting goals for the idea generation and selection. Edmondson & Nembhard (2009) showed that cross-functional teams could benefit from gaining education about other functions and developing a broader organizational perspective. This could enable the cross-functional team to cross the pragmatic knowledge boundaries by being able to consider the whole organisation during idea generation and selection. Understanding the interdependencies could enable the team to communicate and build a TMS.

In the research by Lewis (2003) it is shown that measuring specialization, credibility and coordination in teams are valid methods to predict the presence of a TMS. Hammeci, et al. (2013) showed that the TMS emerges if the cross-functional team members manage to synchronize the processes of specialization, building credibility and coordination to achieve the goals of the team. The process of specialization is achieved when the team gains information
about what knowledge all other team member hold and the team members use this information to acquire a diversity of complementary knowledge from the other team members. Each team member can then start to further enhance their knowledge in areas that the team is lacking so that the total amount of knowledge in the team can further increase, instead of acquiring congruent knowledge (Lewis, 2003).

The temporary membership in cross-functional teams weakens the knowledge of who know what in the team since team members could be added and removed throughout a project (Edmondson & Nembhard, 2009), and membership change is one of several moderators of TMS and its outcomes (Ren & Argote, 2011). Since a project leader could allow for extend discussions since creative ideas emerge rather slowly (Mumford, et al., 2002), there could be a need to measure for how long these discussions could be extended before team members are added or removed. Measuring the levels of specialization, credibility and coordination in a cross-functional teams longitudinally during extended discussions, could give indications to the management level if team members could be added or removed from the project. One example could be that if a team has high levels of: specialization, credibility and coordination: and high performance, the management could utilize this information to ensure that team members aren’t removed from the project. One other example could be that management decides to add a team member to a cross-functional team that has high performance in idea generation and selection. The performance of the team could decrease and there could be a correlation with decreased specialization, credibility and coordination in the team. Management could utilize this information to decide if the team member should be removed or that other action could be taken to increase the levels again. For example, since team members have temporary membership there could be the constant need to build up the level of specialization in the team, since new team member could have other specializations. Adding a new team member could decrease the level of specialization in the team. The finding in this study could support the need for the whole team to set goals together and communicate interdependencies together before idea generation and selection, each time a new team member is added, to ensure a high level of specialization in the cross-functional team. If future research could find a statistically significant correlation between a strong TMS in cross-functional teams and high idea generation and selection performance, then it could support this finding in this study. This is suggested to be a topic for further research.

Credibility reflects by which extent each team member believes that the other team members relevant knowledge for the task is correct and accurate. If a team member’s knowledge relevant for the task has been used several times without negative consequences, then the other team member will see the other team member’s knowledge as more credible (Lewis, 2003). The level of credibility in teams has correlations to the results in this study in that each team member could lack the capability and time to assess if information that has been shared during idea generation is correct. Cross-functional teams have lack of trust (Song, et al., 1996; Edmondson & Nembhard, 2009), and this raises question for how the lack of trust affect how team members judge the credibility of other team members. There could be a double-edged sword for when team members judge the credibility during idea generation. This study showed that assumptions are sometimes introduced while information is shared, since team members could lack the information to understand that an assumption is shared. One reason that an assumption is passed on as information could be that the team member is judged to have a high level of credibility. It could be beneficial to lower the level of credibility for that team member, so that assumptions are stopped from being passed on as information. Otherwise it could lead to that ideas are proven to be false positives when implemented.

As discussed earlier it could be beneficial to utilize an iterative process where information is constantly verified so that assumptions could be proven to be false or true. This has resemblance to the process for which credibility is built, since if information is used without negative
consequences then credibility is increased, otherwise it is decreased. An iterative process could then decrease the credibility of that team member and the team could be capable to understand that assumptions are passed on and not information. This could increase the performance of the idea generation since ideas are not built on an assumption, but the team knows that there is need to prove or disprove the assumptions before the idea is implemented.

The other side of the double edge sword could be that a team member is sharing information, but team members incorrectly judge it as assumptions. This could lead to that information is not recombined into an idea. This could gain support from the research by Gebert, et al. (2006) where it was shown that team members in cross-functional teams could perceive lack of recognition and not being appreciated as a unique individual. It could be argued that this could have parallels to that the team members judge that the team member is not credible. For example, the surface-level diversity could be used to judge credibility. But research has shown that surface-level diversity is separated from deep-level diversity, which could mean that utilizing surface-level diversity is an unsuccessful method to judge the credibility of a team member when information is shared. Again, an iterative process gives team members several opportunities show that their information brings positive consequences to the idea generation. The team member could increase their credibility to a level that reflects how often the team member passes on information instead of assumptions. The result could be that the credibility level in the TMS of a cross-functional team accurately reflects how aware team members are of what are assumptions and what are information, without the need to possess the functional knowledge of the other team member. This could enable the team to quicker find the weakest link of an idea, and test prove or disprove the assumption, before the idea is further implemented.

Finally, coordination is the degree of how necessary explicit planning and coordinating is during teamwork (Austin, 2003), where in a team with a strong transactive memory system, each team member is aware of the other team members strength and weakness, and each team member anticipates the behaviours and responses to make changes to their own behaviour (Wegner, 1995). It could be argued that the ability for team members to anticipate behaviours and responses to make changes to their own behaviour has similarities to how cross-functional teams handle task conflicts. The research of Lovelace, et al. (2001) discussed that the way task conflicts are managed in cross-functional teams could determine if the team is innovative. This study showed that personal conflicts could be present during idea generation and that establishing values could have a positive effect on managing the personal conflicts. Cross-functional teams that do not build culture and establish values for how personal conflicts are managed, could have lower levels of coordination. Values could have a positive effect on the level of coordination in cross-functional teams, since the team stays focused on the task conflicts.

This study also showed that there could be a risk of groupthink if one team member starts sharing information first, instead of giving all team members time to first simultaneously develop relevant information before sharing. Utilizing the method of first developing information simultaneously and then share it could have a positive effect on coordination, since it could enable information to be coordinated. On the other hand, if a person dominates the idea generation there could be a negative effect on coordination, since the other team member do not get the possibility to share their information. This is supported by research which showed that groups with a hybrid structure, where group members first generate ideas individually and then continue generating ideas in a group generate more ideas, better ideas and are better at evaluating the quality of the ideas (Girotra, et al., 2010). This study could be expanded to cross-functional teams, were the level of coordination in the cross-functional team is measured, to see how a hybrid structure would affect the coordination. This is suggested to be a topic for further research.
6. CONCLUSIONS

This chapter aims to present conclusions that answer the two research questions based on the frame of reference, qualitative interviews, analysed data and discussed data.

6.1 What challenges do project leaders experience when they lead cross-functional team members to generate innovative ideas for product development?

Project leaders experience challenges in that: task conflicts could be mixed up with personal conflicts during idea generation and selection, diverse information could be associated with a diverse vocabulary which could lead to that some team members do not understand the information shared, there could be lack of time and information to identify assumptions that are passed on as information, it is unclear when to involve the whole team or to let the most experienced team member evaluate and select ideas.

6.2 How can project leaders lead cross-functional teams to successfully generate innovative ideas for product development?

To successfully lead the cross-functional team the project leader could: involve the whole team to set goals and communicate interdependencies, build culture and establish values for how to handle personal conflicts, actively build a shared vocabulary, evaluate information iteratively to build credibility and find false positives for information about the customer and the firm, and utilize the diverse knowledge of the team or the experienced team member to evaluate and select innovative ideas cross-functionally.

From the perspective of the TMS theory, to successfully lead the cross-functional team the project leader could: involve the whole team to set goals and communicate interdependencies to build specialization and cross pragmatic knowledge boundaries, build culture and establish values for how to handle personal conflicts, actively build a shared vocabulary to cross syntactic knowledge boundaries, evaluate information iteratively and find false positives for information about the customer and the firm to build credibility, utilize the diverse knowledge of the team to evaluate and select innovative ideas cross-functionally by building a strong TMS. Managing the team as an autonomous cross-functional team could increase the possibility to build a strong TMS in the team.
7. RECOMMENDATIONS AND FUTURE WORK

7.1 Recommendations
The team could benefit to together first clearly define the goals for the ideas that are generated, and that each team member can see how reaching the goals could benefit them. The team can then bring task conflicts into discussion early and understand why there could be task conflicts in the team. This could increase the probability that team member does not mix up task conflicts with personal conflicts. There could be benefits in first discussing how the team culture will be and to write down the values that the team will live by during idea generation. This could help the team avoid personal conflicts and focus on the task conflicts. Forbidding abbreviations could be a successful first step to establish a shared vocabulary, since abbreviations could sometimes not be commonly known. The project leader could also feign ignorance and ask to get a word explained outload, if the project leader has had experience that certain functions use certain words that other functions do not understand. The team could also establish a culture where team members are encouraged to explicitly express if they do not understand the vocabulary and instead of passively accepting that they do not understand the vocabulary. Understanding early what the assumptions are and testing them on the customer, could ensure that more information is not built upon an idea that could go to waste, if the weakest link of the idea breaks.

The knowledge of who knows what i.e. a TMS could emerge if management continuously is assessing and increasing the level of specialization, credibility and coordination in a cross-functional team. The management of TMS in cross-functional teams could be further assisted by the previously suggested recommendations. This could be a successful method of managing idea generation and selection in a cross-functional team. The management level in firms could further benefit to reflect on how the management of cross-functional teams affects the TMS in the team, and how changes could be made to promote that TMS:s emerge. For example, autonomous cross-functional teams have a positive relation with radical innovation, and could have a stronger TMS since there is less interference from the organization.

7.2 Future work
Since the literature list several challenges with cross-functional team and that this thesis also highlighted challenges during the generation and selection of innovative ideas and highlighted few solutions, calls for a radically different approach of studying cross-functional teams. The field of TMS could provide this radically different perspective on how cross-functional teams could successfully manage the first step of innovation i.e. the generation and selection of ideas. The analysis and discussion in this thesis has highlighted that there could be support to further expand the research on idea generation and selection in cross-functional teams through the theory of TMS. For example, the field of TMS has developed questions that can be asked to a group of people to measure the specialization, coordination and credibility in the group (Lewis, 2003). These questions could be used in research to understand how different control variables and different methods of generating and selecting ideas affect the level of specialization, coordination, credibility in a cross-functional team. There could potentially be many fruitful findings to further understand idea generation and selection in cross-functional teams through the emerging theory of TMS.


APPENDIX A: INTERVIEW GUIDE

Interview guide for the semi-structured interviews with the project leaders for the cross-functional teams in the high-technology product development firms. The interviewees where conducted in Stockholm, Sweden with Swedish speaking interviewees, so the interview guide is therefor in Swedish.

Intervjuguide

Generella frågor
1. Skulle du kunna berätta lite om dig själv och din bakgrund?
2. Hur skulle du definiera ett multidisciplinärt team för produktutveckling?
3. Leder du eller har du lett några multidisciplinära team för att utveckla produkter?
4. Hur många team, hur länge och vad var storleken på teamen?
5. Kan du ge några erfarenheter. Vad för produkter? Vad för innovationer?
6. Vilka andra typer av team för produktutveckling har ni på företaget?

Målsättning
1. Hur sätts målen för dig som projektledare angående generering av innovativa idéer för produktutveckling?
2. Mot vem är du som projektledare ansvarig för att visa resultat för produktutveckling?
3. Vem/ vilka är den multidisciplinära teammedlemmen ansvarig att visa resultat till? Har de flera projektledare de är ansvariga mot?
4. Vad är processen du använder för att sätta upp vilka mål som dem genererade innovativa idéerna för produktutveckling ska möta?
   a. Hur påverkas den precis nämnda processen, som du använder för att sätta mål som de genererade innovativa idéer för produktutveckling ska möta, av att de innovativa idéerna ska genereras av ett multidisciplinärt team?
   b. Kan du berätta positiva erfarenheter med den nämnda processen, för att sätta mål som de genererade innovativa idéerna för produktutveckling ska möta, när målen appliceras på ett multidisciplinärt team?
   c. Kan du berätta negativa erfarenheter med den nämnda processen, för att sätta mål som de genererade innovativa idéerna för produktutveckling ska möta, när målen appliceras på ett multidisciplinärt team?
   d. Hur har du utvecklat den nämnda processen över tid?
5. Hur involveras det multidisciplinära teamet i processen för att sätta upp vilka mål som dem genererade innovativa idéerna för produktutveckling ska möta?
   a. Vilka positiva erfarenheter har du haft av att involvera det multidisciplinära teamet i processen för att sätta upp vilka mål som dem genererade innovativa idéerna för produktutveckling ska möta?
   b. Vilka negativa erfarenheter har du haft av att involvera det multidisciplinära teamet i processen för att sätta upp vilka mål som dem genererade innovativa idéerna för produktutveckling ska möta?

Kunskap
1. Vad för process använder du för att det multidisciplinära teamet ska generera innovativa idéer för produktutveckling?
a. Hur påverkas den precis nämnda processen, som du använder för att generera innovativa idéer för produktutveckling, av att processen appliceras på ett multidisciplinärt team?

b. Kan du berätta om positiva erfarenheter med den nämnda processen, för att generera innovativa idéer för produktutveckling, när processen appliceras på ett multidisciplinärt team?

c. Kan du berätta om negativa erfarenheter med den nämnda processen, för att generera innovativa idéer för produktutveckling, när processen appliceras på ett multidisciplinärt team?

d. Hur har du utvecklat den nämnda processen över tid?

2. Vad för process använder du för att kunskap från de olika teammedlemmarna i det multidisciplinärt team ska inkorporeras och bidra positivt för att generera innovativa idéer för produktutveckling?

a. Hur påverkas den precis nämnda processen, som du använder för att inkorporera kunskap för att generera innovativa idéer för produktutveckling, av att processen appliceras på ett multidisciplinärt team?

b. Kan du berätta om positiva erfarenheter med den nämnda processen, för att inkorporera kunskap för att generera innovativa idéer för produktutveckling, när processen appliceras på ett multidisciplinärt team?

c. Kan du berätta om negativa erfarenheter med den nämnda processen, för att inkorporera kunskap för att generera innovativa idéer för produktutveckling, när processen appliceras på ett multidisciplinärt team?

d. Hur har du utvecklat den nämnda processen över tid?

**Hur kunskap används för att bedöma om målen har mötts**

1. Kan du förklara processen som används för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper?

a. Hur påverkas den precis nämnda processen, för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper, av de innovativa idéerna genererades av ett multidisciplinärt team?

b. Kan du berätta om positiva erfarenheter med den nämnda processen, för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper, när de innovativa idéerna genererades av ett multidisciplinärt team?

c. Kan du berätta om negativa erfarenheter med den nämnda processen, för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper, när de innovativa idéerna genererades av ett multidisciplinärt team?

d. Hur har du utvecklat den nämnda processen över tid?

2. Hur involveras det multidisciplinära teamet i processen för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper?

a. Vilka positiva erfarenheter har du haft av att involvera det multidisciplinära teamet i processen för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper?

b. Vilka positiva erfarenheter har du haft av att involvera det multidisciplinära teamet i processen för att välja ut vilka innovativa idéer som ska vidareutvecklas till koncept och prototyper?

c. Hur har du utvecklat den nämnda processen över tid?