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The influence of shared cognition on start-up team performance

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Abstract

Start-up team performance has been an active area of research for many years now, where researchers have tried to pinpoint what factors could contribute to the enhancement of the performance of start-up teams. One of these potential factors identified is shared cognition, a concept that represents the degree of a shared agreement and understanding that is present within the team. However, it was found that many studies focus solely on the individual cognition of team members and its influence on team performance, and not on the shared cognition of the team as a whole. This thesis aimed to help fill the knowledge gap caused by the lack of research on shared cognition, since it is on the team level where the decisions are taken that drive new ventures forward, and provides new insights on the relationship between shared cognition and start-up team performance. A data set was acquired from a large technology-driven competition in which 100 teams competed in an environment of time pressure and competitiveness, simulating the field in which start-ups operate. Subsequently, a new framework was developed for the operationalization of shared cognition, which provides a start to an objective assessment method that can help quantify this cognitive concept, and can help future researchers in the assessment of shared cognition. Furthermore, a positive relationship was hypothesized and found in a regression analysis between shared cognition and start-up team performance, a relationship which was found to be fully mediated by coordinated work. These findings revealed the importance of shared cognition within start-up teams, and provides start-up teams with a new area in which they can influence the performance and thus direction of their venture. Lastly, a negative moderating effect from focused team deliberation on the relationship between shared cognition and coordinated work was proposed as well, but did not find support in a regression analysis. This rejection of the last hypothesis revealed that the concept of shared cognition is more complex than initially perceived, and this thesis therefore concludes with interesting suggestions for future research in revealing what factors might lie at the roots of shared cognition.

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1 Introduction

New venture and start-up performance has been an active area of research for many years (Covin and Slevin, 1990; Feeser and Willard, 1990; Johnson and Bishop, 2002). Scholars have tried to pinpoint what factors influence new venture and start-up performance, and how this knowledge can be used by new start-ups in order to maximize their chance of success. One of the reasons there is such interest in this particular field originates from the fact that ostensibly similar ventures have a significant distinction in performance (Hay et al., 1993; Moore, 1995). It is apparent that the unique environment of high time pressure and risk in which new ventures operate creates, interestingly so, a field of fine margins whereas the difference between failure or success depends on the correct answers to the raised questions.

One of the questions raised can be defined as the emergence of new opportunities, where the venture must decide on seizing these opportunities or staying the course. The creation of a new venture has always been preceded by the recognition of an opportunity, yet it is the emergence of new opportunities where different new ventures distinguish themselves from one another. Answering such questions is different for new ventures in comparison to more established firms. A main distinction between a more established firm and a new venture is the major factor of risk (Busenitz and Barney, 1997). The new venture does not have the protective buffer that large spending power offers, making it of utmost importance that no unfavourable decisions are taken. Such decisions might even result in the downfall of the venture in these early stages (Hay et al., 1993). The decisions in which it is determined when to pursue opportunities and where to allocate resources are in other words the strategic decisions that a new venture has to take (Bowman and Ambrosini, 1997; Busenitz and Barney, 1997).

The strategic decisions of a new venture determine the path which it will follow. Consequently, it will determine if the venture still exists in the long term (Hay et al., 1993). The differences between the ostensibly similar ventures that have such contrast in their performance have their roots in the strategic decisions taken by the top management team. Strategic decision making for new ventures in particular has therefore been of interest of research, due to the large impact it has on the performance in the long run (Hay et al., 1993; Moore, 1995). It is interesting to see what factors contribute to distinctive strategic decisions from competing new ventures' top management teams.

One of the reasons different strategies are formulated and followed by an individual person can be explained by the cognition of that individual. It is cognition that determines a person's perception of a strategy, and therefore one can conclude that different people might choose different strategies in identical settings due to that individual cognition (Blaylock and Rees, 1984). This has therefore not been an uncommon subject in the field of entrepreneurship research (Busenitz and Barney, 1997; Houghton et al., 1994; Shepherd and Zacharakis, 1997). However, it should be noted that the top management teams of the new ventures do not consist of identical individuals, and therefore one might correctly conclude that the results from those studies might not be directly applicable for the strategic decision making processes in which the entire team is involved. What happens when managers firmly disagree, or agree but not fully understand each other's perception? These studies focused on the individual cognition do not shed light on the team analysis, and it is on this level on which the actual decisions and actions are taken (West, 2007).

The cognition of the top management team as a whole is what determines the strategy of that team, and thus the venture. It is this collective perspective or knowledge structure that guides the direction of the venture rather than the individual's (West, 2007). This *shared cognition* does therefore seem to be of great research interest, due to its seeming influence on new venture performance. One might say that the presence of such a shared cognition will ensure that the top management team as a whole better comprehends the goals of the venture, and will thus consequently have a positive influence on the performance.

However, sufficient empirical evidence has not been produced so far by the scientific community. Different definitions within studies create a field of ambiguity which influences the comparability of the results. In addition, contradicting results have been produced as well (Ensley and Pearce, 2001; de Mol et al., 2015). This, interestingly so, hints at the existence of certain influencing factors on the relation of shared cognition and new venture performance, and asks for further research to identify and define these factors.

Furthermore, it has been shown that the shared cognition of the team can not simply be deducted through aggregation of the individual cognition (West, 2007). This entails that one can not simply collect the results from studies on individual cognition to predict the influence of shared cognition on performance. Shared cognition has been identified to be more of an emergent property (de Mol et al., 2015). In other words, the whole can be more, or less, than the sum of its parts.

The aim of this research is therefore to provide more scientific evidence on what the actual impact of shared cognition is on the performance of a start-up team. In addition to that, the aim is to determine if that impact is mediated by the level of coordinated work within the team, and if a focused team deliberation has any diminishing effect on the relationship between shared cognition and coordinated work. The main research question is therefore formulated as:

- **RQ:** *To what extent does shared cognition influence the performance of a start-up team, and how does coordinated work and a focused deliberation within the team influence that relationship?*

In solving this research question the goal is to provide more clarity, through empirical evidence, on what the actual influence is of shared cognition on start-up team performance, and if this relationship might be (partially) explained through an enhancement of coordinated work. The assessment of focused team deliberation as a possible negative moderating variable would help shed light on the complexity and importance of shared cognition, providing more insights if such a deliberation would be a sufficient replacement of the cognitive concept. Furthermore, this information will therefore be very useful for start-up teams, or for institutions that provide guidance for aspiring start-up companies. The results of this study can be used to determine if it is of interest for new ventures to focus on analysis and perhaps the improvement of the existing shared cognition within the start-up team, and how this can be utilised to maximise new venture performance. If there is a relationship identified, then the findings might give new ventures an increased feeling of control, due to the fact that the performance differences between ostensibly similar ventures depend less and less on randomness, but rather on factors that can be influenced.

The findings of this study may be used to clarify the results obtained from previous studies, and will contribute to the overall understanding of shared cognition within start-up teams. It will help answer questions raised in literature such as "how desirable is like-mindedness?" (Schneider and Angelmar, 1993). Furthermore, it will pave the way for future studies that can expand on the findings in order to better understand how new venture performance can be influenced, and how the findings from this research hold over an extended period of time.

2 Literature Review

In this chapter a literature review is conducted to determine what prior research has already contributed to the knowledge base, concerning the subjects of interest in this thesis. The articles and books that were determined to be relevant and of interest, were primarily found through the use of the scientific search engines SmartCat and Google Scholar.

It is apparent that for two main concepts discussed within this thesis, *start-up teams* and *shared cognition*, a plethora of different but similar definitions exist in the literature. Therefore, in order to prevent ambiguity and improve the comparability of this thesis with respect to the current literature it is important to clarify what definition will be used.

2.1 Performance

The performance of a new venture is seen as a measurement of its functioning and the outcomes of its operations, and is what distinguishes a start-up from walking the path of success to becoming a failure. Consequently, new venture performance has typically been defined with the use of two dimensions: survival and success (Chrisman et al., 1998; Ensley et al., 2003). The idea or opportunity that lies at the roots of the new venture might seem promising, it still should be seized or capitalized on sufficiently. Thus, new ventures should always find ways to maximize their performance, in order for them to thrive.

In this thesis, the interest lies in the influence of shared cognition on the performance of the start-up team. Therefore, it is essential to determine to what extent the performance of the start-up team and that of the new venture are related. The influence of the individuals, and thus the start-up team involved with the new venture, is hinted at in prior research in which it was found that human capital is an important determinant of new venture performance (Cooper et al., 1994; Gimeno et al., 1997; Herron and Robinson Jr., 1993). In addition to that, it has been argued by others that the entrepreneurial ventures that have the highest performance are the ventures with the best performing top management teams (Timmons, 1999).

These previously mentioned findings are supported by the upper echelon theory developed in strategic management literature (Hambrick and Mason, 1984). In this theory, it is argued that the top management team of a venture shapes the performance of the venture itself due to the fact that they have a large impact on the decisions made, and ultimately on the outcomes realised by the venture (Hambrick and Mason, 1984). Building further on the upper echelon theory, it was found for new ventures in particular that the influence of the top management team is even more significant (Covin and Slevin, 1990; Gimeno et al., 1997). It is interesting to make this distinction, since new ventures differ in the fact that new ventures do not have equivalent organizational norms and structures as compared to the more established ventures (Busenitz and Barney, 1997; Mazzarol and Rebound, 2006). Furthermore, in the early stages of the new venture that are of interest in this thesis the start-up team is of equivalent construct to the venture itself. Thus, in maximizing the performance of the start-up team one would maximize the performance of the new venture.

It should be noted that there is not a consensus present in literature on the definition of team performance, nor any agreed-upon metrics for quantifying it (Valentine et al., 2015). However, team performance has been argued to be equivalent to team effectiveness, which is seen as to what extent team goals or objectives are met (Andersson et al., 2017; Ensley et al., 2003). Thus, the team outcomes should be compared to the goals set upfront.

Several factors have been identified in the past that can influence new venture team, or start-up team, performance. Factors such as team flexibility (Andersson et al., 2017; Pryor et al., 2015), work engagement (Mäkikangas et al., 2016) and good relationships among team members (Paul et al., 2016; Schjoedt et al., 2012) have all been identified to positively influence the performance. However, a lack of conclusive research exists on shared cognition as a contributing factor, which is the possible determinant that is of interest in this thesis.

Furthermore, in the assessment of the performance of a start-up team it has been proposed that an adequate team performance assessment method should (1) be designed to focus on processes and outcomes, (2) meet a specific goal, and (3) be linked to the specific scenario or context (Andersson et al., 2017; Valentine et al., 2015). Additionally, it was found that both evaluation performed by team members themselves in the form of assessment reports, and evaluation by others such as behavioural observer scales are seen as reliable methods (Andersson et al., 2017). However, in the context of team cognition and performance, it was found that self-assessment techniques are generally seen as the favourable choice (West, 2007; Wildman et al., 2014).

2.2 Start-up teams

In the search for explanatory variables for new venture performance, it was argued in the past that the entrepreneur is an essential determinant of that performance (Carland et al., 1988; McClelland, 1961). However, in further research it has been concluded that the evidence available is inconclusive (Chrisman et al., 1998). As an explanation, it has been proposed that the focus should lie more on the new venture or start-up team, rather than an individual entrepreneur (Ensley and Pearce, 2001; Roure and Madique, 1986). It should be noted that due to the fact that the focus in this thesis lies on the initial stage of the new venture, the start-up team is equivalent to the top management team of that new venture.

In the past, scholars have tried to pinpoint why some start-up teams thrive and are more effective in launching a new venture, while other teams do not and seem to struggle (Klotz et al., 2014; Lazar et al., 2019). However, despite the fact that start-up teams have been an active area of research over the years, it was found that in the present literature there is a lack of a clear definition of what a "start-up team" or "top team in start-ups" precisely entails (Knight et al., 2019). In addition to that, different terms have been used to describe similar concepts. An overview of similar terms found in literature is presented in Table 1.

Term	Authors
Start-up team	Franke et al. (2008), Knight et al. (2019)
Entrepreneurial team	Kamm et al. (1990), Lazar et al. (2019), de Mol et al. (2015), Vissa and Chacar (2009), West (2007),
New venture team	Klotz et al. (2014)
Founding team	Beckman (2006), West (2007)
Entrepreneurial top management team	Beckman and Burton (2008), Ensley and Pearce (2001), Timmons (1999)

Table 1: An overview of similar start-up team terms found in literature.

The presence of different but similar terms and definitions used in literature impede the comparability of the results. Therefore, in an attempt to unify this fragmented area of research, Knight et al. (2019) proposed a multidimensional conceptualization through an integrated review of past research. They advocated to abandon the usage of taxonomies and typologies. Instead of discrete classification, a multidimensional approach is proposed that uses continuous dimensions. The dimensions that are proposed are *Ownership of Equity*, *Entitativity* and *Autonomy of Strategic Decision Making* (Knight et al., 2019).

Ownership of Equity entails to what extend the team members actually own the work they deliver and create. *Entitativity* refers to the unity of the team, if they are "one" or if the team is a part of a bigger whole. Lastly, *Autonomy of Strategic Decision Making* refers to what extend the team can make their own strategic decisions, or if they need to consult a higher or external body for approval.

In order to clearly define the concept used within this research, and therefore minimize the ambiguity with respect to existing literature, the definition will be positioned in the proposed multidimensional framework. In this thesis the interest lies in teams that stand at the basis of a new venture, and how shared cognition could influence their performance. This definition that is used thus has a high *Entitativity*, implying that the new venture and the start-up team are equivalent constructs (Knight et al., 2019). Furthermore, in order to adequately research the influence shared cognition has on the performance of the team, the interest lies in teams that have a high control over their decision making. Thus, the *Autonomy of Strategic Decision Making* is high in the definition as well. Lastly, the continuous dimension *Ownership of Equity* is also high in this definition, implying high internal ownership which is inherent to the initial phase of a start-up that is of interest.

2.3 Shared cognition

The strategic decisions of a new venture are what determines its path for the future (Atuahene-Gima and Li, 2004; Covin and Slevin, 1990; Desmidt et al., 2019). These strategic decisions are taken by the start-up team, and are thus influenced by multiple individuals. Therefore, rather than solely focusing on the individual cognition, it should be determined what influence the cognition of this group as a whole has. This "shared cognition" is of interest, due to the fact that it has the potential to explain why some teams, and thus ventures, thrive while ostensibly similar teams do not. However, one of the challenges present in the current literature is the lack of a clear definition for shared cognition. A collection of similar cognitive team concepts exist, such as Strategic consensus (Floyd and Wooldridge, 1992; Vissa and Chacar, 2009; Wooldridge and Floyd, 1989), Shared strategic cognition (Bromiley and Rau, 2016; Desmidt et al., 2019; Ensley and Pearce, 2001), Collective Cognition (West, 2007) and Creative Cognition (Shalley and Perry-Smith, 2008). There has only been one attempt so far to clarify this fragmented area of research (de Mol et al., 2015). It is therefore important to clearly define the concept that will be researched, in order to prevent ambiguity and improve the comparability of the findings. In Table 2, an overview is given of the similar cognitive team concepts found in literature.

Term	Definition	Authors
Strategic consensus	The extent to which individual mental models overlap on strategy.	Floyd and Wooldridge (1992), Vissa and Chacar (2009), Wooldridge and Floyd (1989)
Shared strategic cognition	The extent to which strategic mental models held in the hearts and minds of the top management team members overlap or agree.	Bromiley and Rau (2016), Desmidt et al. (2019), Ensley and Pearce (2001)
Collective cognition	The extent to which two perspectives, integration and differentiation, merge within a team.	West (2007)
Creative cognition	The extent to which there is a shared repertoire of ideas on how to solve problems.	Shalley and Perry-Smith (2008)
Entrepreneurial team cognition	An emergent state that refers to the manner in which knowledge is mentally organized, represented and distributed within the team.	de Mol et al. (2015)

Table 2: An overview of similar cognitive team concepts found in literature.

In order to provide a clear definition for shared cognition for this research, the aim is to find connections or overlap within earlier proposed definitions found in the literature. In earlier research, strategic consensus has been defined as understanding and agreeing on strategy (Floyd and Wooldridge, 1992; Wooldridge and Floyd, 1989). In other research focused on strategy, scholars have suggested to use new venture strategy as a springboard to discuss collective cognition, since it is the product of collective consideration within the top management team (West, 2007). It was found that greater strategic consensus was achieved when greater overlap or agreement between top managers is present regarding the strategy of the firm (Floyd and Wooldridge, 1992; Wooldridge and Floyd, 1989).

Building further on these previous approaches, shared strategic cognition has been defined as the extent to which strategic mental models held in the hearts and minds of the top management team members overlap or agree (Ensley and Pearce, 2001). Furthermore, in the last row of Table 2 an extensive definition is provided that is proposed in a literature review in a prior attempt to integrate the different definitions present (de Mol et al., 2015). The interesting addition that is explicitly stated is that shared cognition is seen as an emergent state. This is an important addition to the definition, due to the fact that it has been shown that the shared cognition of the team can not simply be deducted through aggregation of the individual cognition, as stated earlier (West, 2007).

It can thus be said that shared cognition is a concept that captures an emergent shared or overlapping *agreement and understanding* on strategic decisions. However, it should be noted that one might *agree* on a certain strategic decision that is formulated by the team, but might have a different interpretation and thus *understanding* of that same decision compared to the other team members. It was found that acceptance at the individual level of the team's strategic decisions altered depending on whether the team used a dialectical inquiry or consensus technique for decision-making (Priem et al., 1995). One can thus deduct that at the team level a consensus may be reached, but at the lower individual level still varying levels of commitment to and satisfaction with the team decision (West and Meyer, 1998). Furthermore, in prior definitions the word consensus has been used.

However, it should be noted that consensus is by definition solely an agreement. Therefore, it does not fully capture the *understanding* that is of interest as well in shared cognition. Thus, in this research, it is chosen to move away from the word consensus, due to the fact that is the influence of this shared understanding and agreement that will be researched within this thesis, rather than purely a consensus or agreement.

2.4 Shared cognition and start-up team performance

One of the main reasons for the interest in shared cognition is the possible relationship between shared cognition and the performance of the start-up team. Identifying such a relationship would provide those teams with additional tools in enhancing their chance of success, in an environment where uncertainty and risk are dominant factors. Additionally, there has been research ascribing causal importance to a shared strategic consensus in the explanation of organizational success for established ventures (Bromiley and Rau, 2016; Desmidt et al., 2019). However, the findings present within the current literature on a shared cognition and start-up team performance are mixed (de Mol et al., 2015).

In a study that focused purely on integration and differentiation as aspects of shared cognition, it was argued that both too much and too little integration and differentiation would have a negative effect, and that moderate levels would have a positive effect on the performance of a new venture (West, 2007). Consequently, an inversed U-shaped relationship was found. However, the research did not focus on the *understanding* but purely on the *agreement* part of shared cognition. The positive effect at moderate levels was proposed due to the fact that only then alternatives are considered prior to coming to an agreement. The consideration would ensure a better understanding as well since all team members would elaborate on their choices, thus hinting at the fact that both an agreement and understanding would have a positive effect.

Alternatively, in another study a positive relationship between shared cognition and organizational performance was proposed (Ensley and Pearce, 2001). The interactions between affective conflict, cognitive conflict, shared cognition and new venture performance were researched. However, the authors were disappointed to not find any direct relationship between shared cognition and new venture performance. Interestingly so, it was stated that the authors were "not convinced that there is no direct effect" and encouraged further research (Ensley and Pearce, 2001).

As formulated in the previous section, shared cognition is defined in this thesis as the shared understanding and agreement on the start-up team's strategic decisions. Thus, one might reasonably suspect that a larger shared understanding of those strategic decisions on the individual level would prevent a fragmented approach, whereas the individual actions of team members differ in implementation of that strategy. Additionally, it was found that ventures that pursue no distinct strategy and focus, or that are inconsistent in their strategy implementation, will not perform as well as ventures which are consistent (Porter, 1980). Thus, a positive relationship between shared cognition and start-up team performance is suspected and this subsequently results in Hypothesis 1:

- **H1:** *Shared cognition has a positive influence on start-up team performance.*

2.5 Shared cognition and coordinated work

In the current literature, scholars researched a direct relationship between shared cognition and new venture performance. The presence of mediators or moderators were hinted at but not taken into account, and that is precisely where the limitations of those studies could lie. It could be interesting to establish in what way shared cognition benefits start-up team performance.

As stated earlier, shared cognition could prevent a fragmented approach in implementation of the team strategy. The presence of a shared understanding and agreement would ensure that every team member envisions the same path towards the team goal, which consequently helps in optimally aligning the individual actions. In other words, it would enable coordinated actions which ensures that a team functions as a unit through planning and communication, and it has in fact been argued that shared cognition could be an important aid in facilitating coordinated work (Blatt, 2009; Zheng and Mai, 2013).

In addition to this, others have asserted that shared cognition could provide the basis for good coordination (Ensley et al., 2003). It is viewed that the possession of a shared agreement and understanding of the team goal would benefit the collaboration within the team, since every team member has an equivalent view on how to achieve that goal. An absence of a shared understanding and agreement could impair the way the individual actions are coordinated, due to the fact that at the lower individual level there exist different perspectives on what the same agreed goal entails. Furthermore, it has been argued as well that coordinated work is an important result of agreeing on strategic decisions (West and Meyer, 1998).

However, interestingly so, no relationship has been tested or found. It would be interesting to establish if this is indeed the case. If it is indeed the case, it would provide more knowledge on the relationship between shared cognition and start-up team performance. This consequently leads to Hypothesis 2:

- **H2:** *Shared cognition has a positive influence on coordinated work.*

2.6 Coordinated work and start-up team performance

Enhanced coordinated work as a result of shared cognition is seen as beneficial for start-up teams. Research has shown that highly coordinated and flexible teams perform well in difficult scenarios, due to the fact that the team easily adapts to the dynamic environment in which it operates (Eisenhardt, 1989; Eisenhardt and Bourgeois, 1988; Paul et al., 2016).

Coordinated work is seen as the process where a team works as a unit, in which every individual task contributes towards the same perceived team goal. The individual approaches on how to achieve that goal are not fragmented, resulting in the fact that adaptations within the team can be made more easily when obstacles arise. Thus, coordinated teams are more agile, a team attribute which is seen as a contributing factor towards the overall team performance (Andersson et al., 2017).

In other research focused on top management team performance, coordination has been proposed to have a positive relationship with performance as well (Stout et al., 1999). A coordinated team would help ensure a consistent strategy implementation, which has been proven to be beneficial for the performance (Porter, 1980). Inconsistent implementation would impair the performance even greater when the problem becomes more complex, due to the fact that it is harder to grasp the bigger picture on where the team is in terms of progression. Enhanced coordinated work results in a clear task division and prevents inefficient usage of time, through clear communication and planning. This thus leads to Hypothesis 3:

- **H3:** *Coordinated work has a positive influence on start-up team performance.*

2.7 Shared cognition and focused team deliberation

In other research focused on start-up team performance, it was argued that start-up teams are likely to perform well when the individuals within the team exchange information with one another in a clear and comprehensive way, reconciling their distinctive views and integrating their diverse perspectives (Amason et al., 2006). In addition to this, it was found that task conflict and start-up team performance have a positive relationship, since it leads to firm discussions within the team that will help reveal different perspectives as well (Ensley and Pearce, 2001).

Shared cognition is argued to have a positive influence on the start-up team performance, due to the fact that it will contribute to coordinated work and thus prevent a fragmented approach on how to achieve the team goal. It is seen that shared cognition ensures equivalent perspectives from the team members on what the same agreed goal actually entails, resulting in that coordinated approach on how to move further. However, it could be argued that taking the time for a good team deliberation facilitates clear and comprehensive information exchange which can help reveal the different perspectives present within the team.

Whereas the shared understanding and agreement within the team is seen as beneficial, a deliberation with all team members, where every individual is fully focused and not simultaneously busy with other tasks, can be used to help align that agreement and understanding within the team if it was not as present. It is argued that a team with higher shared cognition would have a more coordinated approach than a team with lower shared cognition, due to the fact that on the individual level the perspectives are aligned. However, in a focused team deliberation it can be made certain that every individual does in fact *understand* what was agreed upon. In other words, the existence of a deliberation session would diminish the advantage a team with more shared cognition has.

Furthermore, in prior research in which shared mental models within the team were found to have little to no link with performance, it was documented that extensive communication was present between the team members (Bierhals et al., 2007). This could thus be explained by the diminishing effect team deliberation might have on shared cognition facilitating coordinated work, and ultimately team performance. This therefore results in Hypothesis 4:

- **H4:** *A focused team deliberation has a diminishing effect on the relationship between shared cognition and coordinated work.*

2.8 Conceptual model

The four hypotheses that have been formulated in the previous sections and that will be tested within this thesis are visualised in Figure 1.

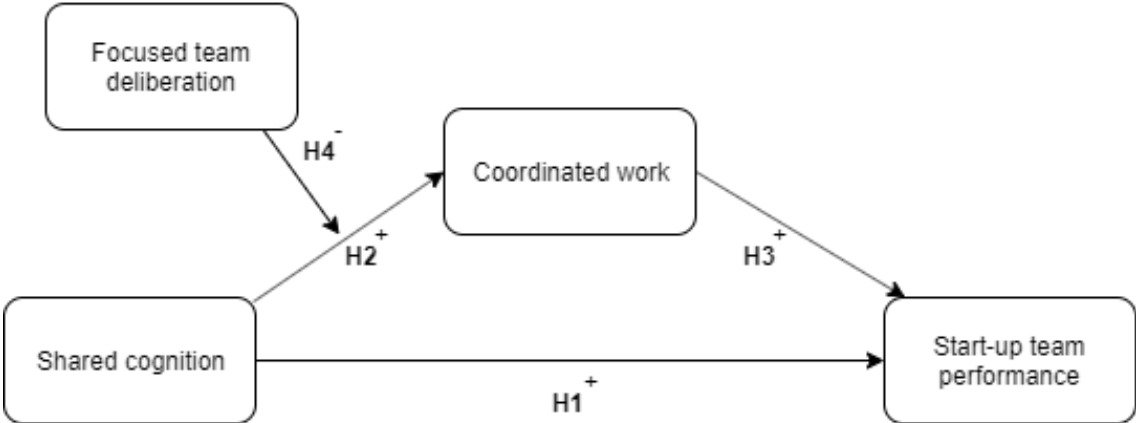


Figure 1: The conceptual model

3 Methodology

In this chapter the methodology is outlined. In order to find support for the formulated hypotheses, a data set was gathered and methodological considerations needed to be made. First, the sample will be described, followed by the applied measures and procedures.

3.1 Sample

In order to adequately analyse start-up team performance and its determinants, a data set was acquired from a large technology-focused competition. The competition was divided into eleven categories. Each category had one or two challenges that needed a solution, and each challenge had five different teams that were competing for the creation of the best solution. The competition was designed in such a way that it provided a dynamic environment accompanied with time pressure, resulting from the fact that it all occurred within the time frame of 48 hours. These aforementioned conditions of time pressure and competitiveness created a suitable data set, since it reasonably simulated the environment in which start-up companies tend to operate (Eisenhardt, 1989; Mazzarol and Reboud, 2006).

The competing teams had full control over their decisions, entirely represented their "venture" and the intellectual property of the ideas developed during the competition belonged fully to the team members. The teams thus complied with the definition of the start-up team used within this thesis that, positioned in the framework of Knight et al. (2019), has a high autonomy of strategic decision making, high entitativity and high ownership of equity.

In the competition a total of 100 teams were registered. The team members were asked to fill out two short paper surveys individually: one just prior to the start of the competition, and one just after the moment the team and its members stopped coding and presented their solution to the jury. In the first examination of the data, it was discovered that the survey data for the entire team was absent for four teams. Thus, the sample was subsequently reduced from 100 to 96 teams.

Furthermore, a team consists by definition out of a minimum of two people (Knight et al., 2019). For this reason, and to ensure that team data is measured and analyzed rather than purely data of an individual, the teams that had less than two team members that filled in the pre- and post-survey were excluded from the study. This resulted in the sample to be reduced further from 96 to 82 teams and then from 82 to 75 teams.

The 75 remaining teams had on average 6.05 team members. The pre-survey had been filled out by on average 4.47 members per team, and the post-survey had been filled out by on average 4.79 members per team.

3.2 Measurements of variables

3.2.1 Start-up team performance

As stated in the previous chapter, team performance has been argued to be equivalent to team effectiveness, which is seen as to what extent team goals or objectives are met (Andersson et al., 2017; Ensley et al., 2003). Furthermore, it was found that adequate team performance assessment should focus on processes and outcomes, and be linked to the specific scenario or context in which the team pursues a specific goal (Andersson et al., 2017; Valentine et al., 2015).

It was found that in the context of team cognition and performance, self assessment is seen as the more favourable choice (West, 2007; Wildman et al., 2014). However, both observable and self assessment reports are argued to be reliable methods for the assessment of team performance (Andersson et al., 2017). Therefore, in order to provide a complete view of the performance of the teams and to adequately assess the hypotheses formulated, it was chosen to incorporate both methods of performance assessment. The performance of the teams was measured in three separate ways: comparative performance through self-assessment, subjective performance through self-assessment and observable performance through an expert jury.

In the aim of incorporating the link to the specific scenario or context as stated by Andersson et al. (2017), it was needed to incorporate measurements for the relative performance. In other words, how the teams competed in comparison to their competitors. In the self assessments, the team members were therefore asked in three separate questions to rate their team performance compared to the other teams after the competition had ended, using a five point Likert scale. Furthermore, subjective performance was measured in the focus on the team processes, outcomes and the team’s effectiveness. Consequently, the individual members were asked in three other separate questions to subjectively rate the performance and effectiveness of their team using a five point Likert scale as well. It should be noted that the teams filled in the scales after they had presented their findings to the jury, but prior to receiving feedback and grading. In Figure 2 and Figure 3 it can be seen how the scales were presented to the team members.

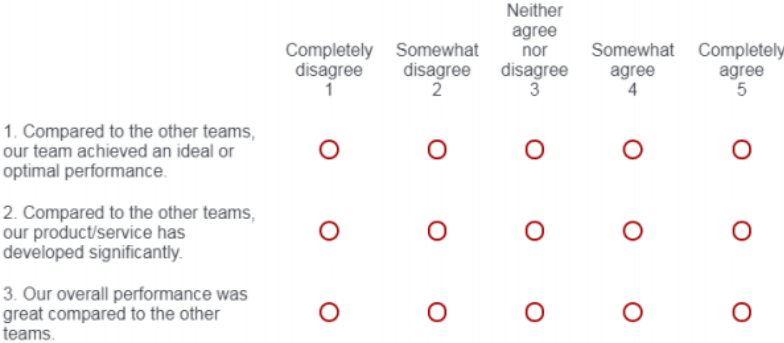


Figure 2: The five point Likert scale to comparatively assess the team performance.

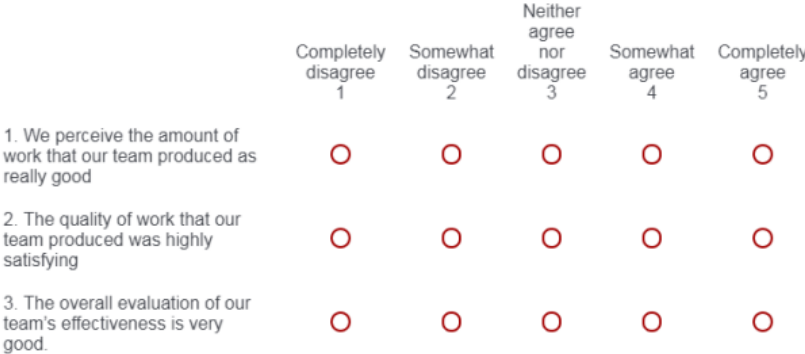


Figure 3: The five point Likert scale to subjectively assess the team performance.

In order to assess the reliability of the scales, the Cronbach's alpha coefficients were calculated. The comparative performance measurement was found to have a Cronbach's alpha coefficient of 0.83. The subjective performance measurement had a Cronbach's alpha coefficient of 0.85. After the data collection, the team members that did not fill in any question were omitted. Furthermore, it was found that several team members did not completely fill out the Likert scales, consequently resulting in several missing values. In order to establish whether there was not a specific reason for the missing values, a Little's MCAR test was performed. The test was found to be not statistically significant, implying that the values were missing completely at random. Additionally, the fraction of the missing data was found to be very small ($< 2.0\%$), and the Expectation-Maximization algorithm was therefore determined to be a suitable choice for the estimation of these values (Graham and Hofer, 2000; Leite and Beretvas, 2010).

Subsequently, the comparative individual performance assessment variable was derived by taking the mean Likert scale rating from the questions focused on comparative performance, and the subjective individual performance assessment variable was derived by taking the mean Likert scale rating from the questions focused on subjective performance. Additionally, the team comparative and subjective performance variables were then operationalized by taking the mean of the individual performance assessments from the team members of each team. Finally, the mean of the subjective and comparative performance variable of the team was used to represent the overall team performance variable.

Furthermore, in order to incorporate an observable performance assessment and to measure the relative performance in an additional manner, an expert jury was used to grade the teams as well. As stated earlier, each challenge had five teams competing in it, and the jury ranked the teams from 1 to 5. A 1 indicated that the team performed the best, and a 5 indicated that the team performed the least. Subsequently, the scores were reversed in order for them to match the Likert scales from the self assessments, indicating that a score of 5 is seen as the highest performance measurement and a score of 1 the lowest.

3.2.2 Shared cognition

In the creation of the measurement for the shared cognition present within the teams, it was essential that the focus was set on both a shared understanding and an agreement within the team, in order to comply with the definition formulated in the previous chapter. All team members of each team were asked to answer a total of nine shared cognition related questions, with the use of a five point Likert scale.

Furthermore, it was determined that solely a Likert scale rating did not fully capture the shared cognition within the team. Therefore, it was chosen to add three open-ended questions in the survey. The open-ended questions could then subsequently be compared with the other team members, to determine to what extent there is indeed a shared understanding and agreement present.

In order to fully analyze the influence of shared cognition, it was chosen to measure it in three different categories: shared cognition on the problem given to the teams, the solution that they are working on and their potential customers. The questions that accompanied the Likert scales and the open-ended questions both focused on these three categories.

In Figure 4, Figure 5 and Figure 6 it can be seen how the scales were presented to the team members.

	Completely disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Completely agree 5
1. My team created a shared understanding of the problem/challenge among all of the team's members.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. The members of my team agreed upon an in-depth definition of the problem/challenge .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. My team members <u>disagree</u> on crucial aspects of the problem/challenge .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 4: The five point Likert scale focused on a shared understanding and agreement of the problem.

	Completely disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Completely agree 5
1. My team created a shared understanding of the solution we want to pursue among all of the team's members.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. The members of my team agreed upon the final solution goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. My team members <u>disagree</u> on crucial aspects of the solution that is needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 5: The five point Likert scale focused on a shared understanding and agreement of the solution.

	Completely disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Completely agree 5
1. My team created a shared understanding among all of the team's members of what customers will use the solution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. The members of my team agreed upon what customers will pay for the solution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. My team members disagree on crucial aspects of who the customer will be.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 6: The five point Likert scale focused on a shared understanding and agreement of the potential customers.

It can be seen that every third question focused on a *disagreement*, subsequently resulting in the fact that the given score would represent the opposite of what was intended to be measured. Therefore, these scores were reversed in order to align with the intended measurement and obtain a homogenous dataset. Subsequently, the Cronbach's alpha coefficients were calculated to assess the reliability of the Likert scales. The coefficients are shown in Table 3.

Likert scale category	Cronbach's alpha
Shared cognition on the problem (self assessment)	0.607
Shared cognition on the solution (self assessment)	0.645
Shared cognition on the customer (self assessment)	0.450

Table 3: The calculated Cronbach's alpha values of the shared cognition Likert scales.

It can be seen that the coefficients that were calculated were rather low, which indicated that the scales are not seen as reliable. It was found that the removal of every third question resulted in a higher coefficient, due to the fact that the questions were formulated in an ambiguous manner. The new coefficients are shown in Table 4.

Likert scale category	Cronbach's alpha
Shared cognition on the problem (self assessment)	0.781
Shared cognition on the solution (self assessment)	0.681
Shared cognition on the customer (self assessment)	0.557

Table 4: The calculated Cronbach's alpha values of the shared cognition Likert scales after the removal of every third question.

It can be seen that the removal of the questions resulted in an increase of the coefficients, and thus the reliability. Furthermore, the Cronbach's alpha coefficient that corresponded to the Likert scale on shared cognition of the customer was still determined to be too low. Consequently, this scale and its corresponding answers were omitted from the data and this research.

The team members that did not fill in any question were omitted from the data as well. Additionally, it was again found that several team members did not completely fill out the Likert scales, consequently resulting in several missing values. In order to establish if there was not a specific reason for the missing values, a Little's MCAR test was performed. The test was found to be not statistically significant, indicating that the values were missing completely at random as well. Additionally, the fraction of the missing data was found to be very small ($< 1.6\%$), and the Expectation-Maximization algorithm was therefore determined to be a suitable choice for the estimation of these values (Graham and Hofer, 2000; Leite and Beretvas, 2010).

Subsequently, the average was taken from the individual answers per category, the shared cognition on the problem and the shared cognition on the solution, to obtain the individual scores. The average of the individual scores of the members of each team were then averaged as well to obtain the team scores per category. Finally, the overall shared cognition variable per team was then derived by taking the average of the shared cognition on the problem and the shared cognition on the solution team scores.

Furthermore, the three categories used for the Likert scales that measured the shared cognition on the problem given to the teams, the solution that they are working on and their potential customers were applied to the open-ended questions as well. Each team member was asked to describe their perception of each category in one sentence. The goal of the open-ended questions was to be able to determine to what extent there is an actual shared cognition present, through the assessment of the degree of similarity within the answers of each team. In Figure 7 it can be seen how the three questions were presented to the team members.

Problem
Please, describe in just one sentence the core problem that your team aims to solve

Solution
Please, describe in just one sentence the core solution that your team aims to develop
Potential customer(s)
Please, describe in just one sentence the potential customers for the solution your team aims to develop

Figure 7: The three open-ended questions for the measurement of the three shared cognition categories.

Subsequently, the provided answers were gathered and sorted by team. It was chosen to use a five point rating scale for the assessment of the degree of shared cognition. A score of 1 indicated no shared cognition present, and a score of 5 indicated full shared cognition present.

It was essential that the assessment of the answers was performed through an objective process. Therefore, it was chosen to create a framework that could be used as a guidance in the analysis of the open-ended answers. First, a random sample of 10 teams was analysed by two assessors separately. Second, the arguments of the assessors provided in the assessment were used to shed light on what measurements the assessors applied without the guidance of a framework. Finally, it was determined what criteria were suitable for the framework, provided that every group of answers could be given a shared cognition score.

The aim of the framework was to exhaustively describe any possibility of a group of answers, resulting in the fact that multiple assessments of the same group of answers would consistently provide an equal score. This would therefore enhance the objectiveness of the assessment. In Figure 8, the framework can be seen that was developed for the analysis.

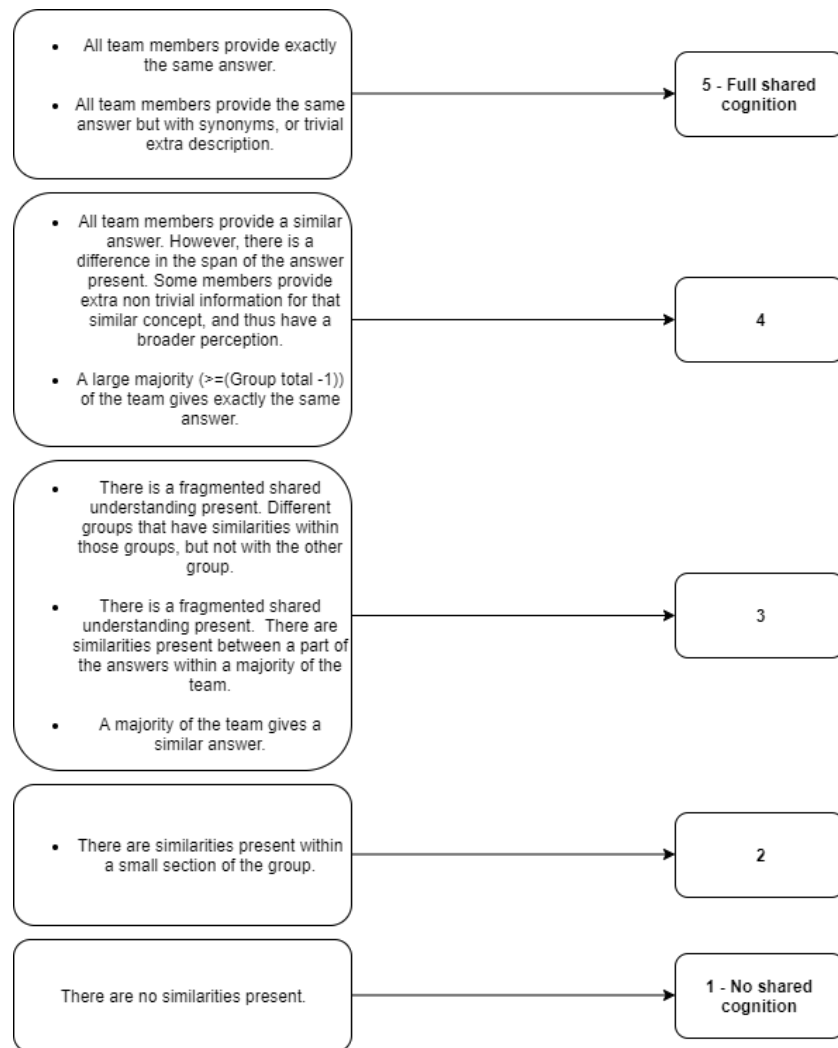


Figure 8: The assessment framework developed for the open-ended questions.

Each category score was subsequently derived from the group of answers the team provided on its associated question. Furthermore, the overall shared cognition score of the team was derived by taking the average of the three scores of the team.

3.2.3 Coordinated work

For the measurement of the coordinated work variable within the teams, it was chosen to incorporate a five point Likert scale in the post survey addressing four questions concerning team coordination. In Figure 9, it can be seen in what way the four questions were presented to the team members.

	Completely disagree 1	Somewhat disagree 2	Neither agree nor disagree 3	Somewhat agree 4	Completely agree 5
1. Our team worked together in a well-coordinated fashion.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Our team had very few misunderstandings about what to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Our team needed to backtrack and start over a lot.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. There was much confusion about how we would accomplish the challenge.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 9: The five point Likert scale focused on coordinated work within the teams.

It became apparent that question three and four focused on the opposite of coordinated work. Consequently, these scores were reversed in order to ensure that the intended concept was adequately measured and a homogenous dataset was again obtained. Furthermore, in the assessment of the reliability of the created questions the Cronbach’s alpha coefficient was calculated and found to be 0.684.

Subsequently, the scores were gathered and the team members that did not fill in any question were omitted. Furthermore, it was found that several scores were still missing from this set as well, consequently resulting in missing values. Before an estimation for these values could be made, it was again essential to establish if there was not a specific reason for the missing values. Therefore, a Little’s MCAR test was again performed. The test was found to be not statistically significant, implying that the values were missing completely at random.

Additionally, the fraction of the missing data was found to be extremely small ($< 0.8\%$), and the Expectation-Maximization algorithm was therefore again determined to be a suitable choice for the estimation of these values (Graham and Hofer, 2000; Leite and Beretvas, 2010).

The average of the scores provided by a team member was then taken to obtain an individual score. Subsequently, the average of every team member was then taken per team to obtain the team’s coordinated work score.

3.2.4 Focused team deliberation

The teams had the opportunity to retreat during the competition in a separate room, which enabled them to have a private discussion. In this room there were no computers present, consequently creating an atmosphere in which every team member could be fully focused and engaged in the discussion. Furthermore, at the entrance of each room, the teams had the opportunity to write down the day and the time the team had entered and left the room. Subsequently, the total duration each team was present in a deliberation room was used as the measurement for the focused team deliberation.

Furthermore, it was discovered that for several teams the check-in or the check-out time was not given, which resulted in incomplete data. Subsequently, it was determined that due to the small sample sizes per team, the Expectation-Maximization algorithm was not a suitable choice to estimate the values of these missing data. However, the teams with missing data all retreated multiple times to the deliberation room. Therefore, the average deliberation time of the team per check-in could be determined from the available data of the team. Subsequently, it was chosen to impute the average time of the team in the missing data of the team as the estimation.

Lastly, the total time in minutes the teams were present in the rooms during the entire competition was then subsequently derived per team through the check-in and out times. Finally, the data was standardized between values of 1 and 5 to comply with the rest of the data and enhance the interpretability of the results.

3.2.5 Descriptive statistics and correlation matrix

The mean, standard deviation and correlations that corresponded with each variable described in this chapter are shown in Table 6. The variable names were abbreviated due to the large size of the total table. To prevent any confusion for the reader, the abbreviations are explained in Table 5.

Abbreviation	Meaning
1. Comp perf self	Comparative performance derived from the self assessment measurement.
2. Subj perf self	Subjective performance derived from the self assessment measurement.
3. Overall perf self	Overall performance derived from the self assessment measurement.
4. Obs perf jury	Observed performance derived from the jury assessment measurement.
5. Overall SC self	Overall shared cognition derived from the self assessment measurement.
6. Overall SC open	Overall shared cognition derived from the open-ended questions.
7. Coordinated work	Coordinated work.
8. Foc Team Delib	Focused team deliberation.

Table 5: An explanation of the abbreviations used in Table 6.

Table 6: Correlations, means and standard deviations of variables.

Variable	mean	sd	1	2	3	4	5	6	7	8
1. Comp perf self	3.83	0.53								
2. Subj perf self	4.27	0.54	0.79**							
3. Overall perf self	4.05	0.50	0.95**	0.95**						
4. Obs perf jury	2.91	1.43	0.27*	0.19	0.25*					
5. Overall SC self	4.16	0.49	0.42**	0.42**	0.45**	0.09				
6. Overall SC open	2.80	0.85	0.22	0.25*	0.25*	0.03	0.27*			
7. Coordinated work	3.81	0.61	0.53**	0.63**	0.62**	0.16	0.42**	0.40**		
8. Foc Team Delib	1.86	1.0	-0.26 *	-0.27 *	-0.28 *	0.02	0.04	0.05	-0.17	

*Note *p<.05, **p<.01

The *Overall* performance variable obviously had a very strong significant positive relationship with the variables that were used in its derivation. Furthermore, it can be seen that the subjective performance self assessment had a significant positive relationship with the comparative performance self assessment ($r = .79, p < .01$). Additionally, the observable performance from the jury assessment had a significant positive relationship with the comparative performance self assessment ($r = .27, p < .05$) and the overall performance from the self assessment ($r = .25, p < .05$).

Furthermore, the overall shared cognition through the self assessment was significantly positively related with comparative performance self assessment ($r = .42, p < .01$), the subjective performance self assessment ($r = .42, p < .01$), the overall performance self assessment variable ($r = .45, p < .01$).

The overall shared cognition through the open-ended questions had a significant positive relationship with the subjective performance self assessment ($r = .25, p < .05$), the overall performance through self assessment ($r = .25, p < .05$), the overall shared cognition through the self assessment ($r = .27, p < .05$).

Furthermore, coordinated work had a positive significant relationship with the comparative performance self assessment ($r = .53, p < .01$), the subjective performance self assessment ($r = .63, p < .01$), consequently the overall performance through self assessment ($r = .62, p < .01$), the overall shared cognition through the self assessment ($r = .42, p < .01$) and the overall shared cognition through the open-ended questions ($r = .40, p < .01$).

Lastly, focused team deliberation had a significant negative relationship with the comparative performance self assessment ($r = -.26, p < .05$), the subjective performance self assessment ($r = -.27, p < .05$), and consequently the overall performance through self assessment ($r = -.28, p < .05$).

4 Results

In this chapter the results of the analysis on the operationalized variables as described in chapter 3 are presented. For the analysis, the statistical program SPSS was used to test the hypotheses formulated in chapter 2. First, the hypotheses were first tested in the main analysis through the assessment of the overall shared cognition variable from the open questions, and the overall performance variable from the self assessment. Subsequently, a robustness check was conducted via a change in independent and dependent variables. Furthermore, for the assessment of the moderation effect as described in Hypothesis 4, and the mediation effect as described in Hypothesis 2 and 3, the PROCESS extension by Hayes (2017) was installed and used.

4.1 Conceptual form

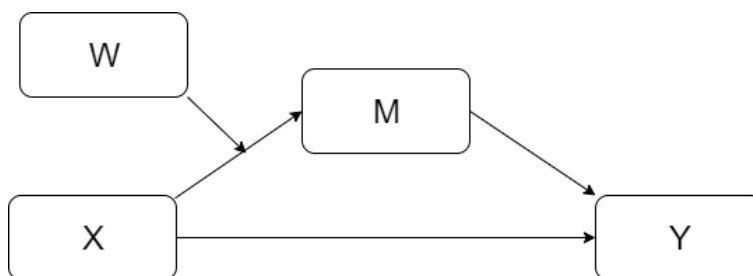


Figure 10: The conceptual form of the analysis.

The assumptions coupled with linear regression were first tested and met for all combination of variables, with the exception of the Observable performance assessment from the jury. Consequently, the Observable performance assessment from the jury was not used in further analysis. Further elaboration can be found in Appendix A. After the assessment of the assumptions, the hypotheses were tested. In Figure 10, the conceptual form of the analysis is shown. In the operationalization of the variables in the previous chapter, it was chosen to create several independent (X) and dependent (Y) variables. The several variables were chosen as such to gain a more complete view on the relationships present, and to subsequently better assess the hypotheses presented in chapter 2.

On the contrary, there is only one mediator and moderator variable. In Table 7, the variables are sorted to comply with the conceptual form from Figure 10. It can be seen that a total of two X variables are present and two Y variables. First, the main analysis was performed that solely focused on the overall shared cognition from the open questions and the overall performance from the self assessment variables. Subsequently, in order to gather a more complete understanding of the relationships present and to test the robustness, the remaining variables were analyzed.

For the analysis, model 4 of the PROCESS extension was used to analyse the simple mediation. This model gives insight on the indirect and direct relationship between X and Y, and was therefore used to test Hypothesis 1, 2 and 3.

Furthermore, model 7 of the PROCESS extension was used to analyse the simple moderation. This model can give insight on the moderating effect of W on the relationship between X and M. Consequently, this model was used to test Hypothesis 4.

X variable	W variable	M variable	Y variable
Overall shared cognition (open-ended)	Focused team deliberation	Coordinated work	Overall self assessment performance
Overall shared cognition (self-assessment)			Comparative self assessment performance

Table 7: The X, W, M and Y variables used in the analysis.

4.2 Main analysis

The X variable Overall shared cognition from the open ended questions was chosen for the main analysis. The scores used for that variable were derived through the assessment of the degree of similarity in the team members' answers to the open-ended questions, and were therefore determined to most accurately represent to what degree there was an actual Shared cognition present, rather than purely a perceived one. Furthermore, it was seen that the Overall performance from the self assessment best represented the total performance of the teams, due to the fact that it incorporated both relative performance and performance based on the team's own goals, and was therefore chosen as the Y variable in the main analysis.

4.2.1 Simple mediation

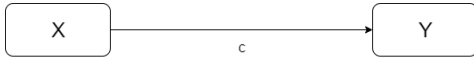


Figure 11: The total effect of X on Y.

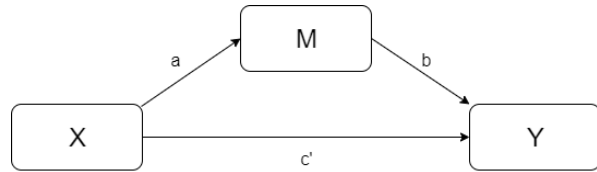


Figure 12: The simple mediation.

First, the simple mediation was analyzed. To do this, model 4 of the SPSS extension PROCESS by Hayes (2017) was used. There are four steps that needed to be followed in the assessment of mediation (Baron and Kenny, 1986):

- The significance of the relationship between X and Y needed to be confirmed. (path c)
- The significance of the relationship between X and M needed to be confirmed. (path a)
- The significance of the relationship between M and Y, in the presence of X, needed to be confirmed. (path b)
- The insignificance of the relationship between X and Y, in the presence of M, needed to be confirmed. (path c')

The results of the analysis are shown in the first three columns of Table 8. First, the total effect between Overall shared cognition from the open ended question (X) and Overall performance from the self assessment (Y) was calculated. This effect is the c-path as seen in Figure 11. The relationship was found to be significant and positive ($b = .146$, $t(73) = 2.18$, $p < .05$), thus supporting Hypothesis 1.

Next, the direct effect of Overall shared cognition from the open-ended questions (X) and Coordinated work (M) was calculated. This effect is the a-path as seen in Figure 12. The relationship was found to be significant and positive as well ($b = .288$, $t(73) = 3.76$, $p < .001$), thus supporting Hypothesis 2.

Table 8: The main analysis regression results for the testing on mediation and moderated mediation.

Variables	OP (c-path)	CW (a-path)	OP (b + c'-path)	CW (moderation)
OSC	.146*	.288***	-.000	.296***
CW			.510***	
FTD				-.112
FTDxOSC				-.024
R^2 :	.061	.162	.378	.198
F-ratio:	4.75*	14.2***	21.9***	5.84 **

N = 75.

OSC = Overall Shared Cognition (open); CW = Coordinated Work; OP = Overall Performance (self); FTD = Focused Team Deliberation.

*Note * $p < .05$, ** $p < .01$, *** $p < .001$.

Furthermore, the direct effect of Coordinated work (M) (b-path) and the direct effect of Overall shared cognition (X) (c'-path) on Overall performance from the self assessment (Y) were calculated. The paths are visualized in Figure 12. It can be seen in Table 8 that the relationship between Coordinated work and Overall performance from the self assessment, when controlling for Overall shared cognition, was significant and positive ($b = .510$, $t(73) = 6.06$, $p < .001$), thus supporting Hypothesis 3. It can be seen as well that the relationship between Overall shared cognition from the open-ended questions and Overall performance from the self assessment, when controlling for Coordinated work, was insignificant ($b = -.000$, $t(73) = -.007$, $p = .9945$).

The effect of Overall shared cognition from the open-ended questions diminished completely in the presence of the variable Coordinated work, indicating full mediation (Baron and Kenny, 1986). Subsequently, to assess this indication the 95% confidence interval of the indirect effect ($a*b$ -path) was obtained with 5,000 bootstrap samples (Hayes, 2017). It was found that the indirect effect was different from zero and equal to the c-path, thus confirming full mediation.

Next, the moderated mediation was analyzed. The potential moderating effect is visualized in Figure 10. For the analysis, model 7 of the SPSS extension PROCESS by Hayes (2017) was used. In this model, a regression analysis was performed that looked at the relationship of X with M, W with M and the interaction between W and X with M. The results are shown in the right most column in Table 8. It can be seen that relationship between Coordinated Work (M) and the interaction of Focused team deliberation (W) and Overall shared cognition from the open-ended question (X) was insignificant ($b = -.024$, $t(73) = -.292$, $p = .7713$). This therefore indicated no moderation, and thus Hypothesis 4 was rejected.

4.3 Robustness check

After the main analysis performed in the previous section, it was chosen to assess the robustness. A different independent variable (X) and dependent variable (Y) were used to determine whether or not the conclusions regarding the hypotheses still held.

4.3.1 Alternative dependent variable

In the main analysis, a relationship was found between Overall shared cognition from the open-ended questions and Overall performance from the self assessment. To assess the robustness, a different dependent variable that represented the performance was used. Since the Observable performance assessment from the jury was found to not comply with the assumptions regarding linear regression, it could not be used in the analysis. Furthermore, it can be seen in Chapter 3 that in the Likert scale questions used for the measurement of the Subjective performance the team's effectiveness was assessed as well, which is seen as one of the most important aspects of team performance (Andersson et al., 2017). Therefore, the Subjective performance variable from the self assessment was determined to be the most suitable choice for the alternative dependent variable.

Furthermore, in the analysis solely the c-path, b-path and c'-path were tested, due to the fact that the independent variable, and therefore the a-path, was unchanged. The results of the analysis can be seen in Table 9.

First, the total effect was calculated between the Overall shared cognition from the open-ended questions and the Subjective performance from the self assessment. The relationship was found to be significant and positive ($b = .154$, $t(73) = 2.16$, $p < .05$), thus supporting Hypothesis 1 and in line with the main analysis.

Table 9: The robustness check with Subjective performance.

Variables	SP (c-path)	SP (b + c'-path)
OSC	.154*	-.006
CW		.557***
R^2 :	.060	.394
F-ratio:	4.66*	23.4***

N = 75.

OSC = Overall Shared Cognition (open); CW = Coordinated Work; SP = Subjective Performance (self).

*Note * $p < .05$, ** $p < .01$, *** $p < .001$.

Next, the direct effects of Coordinated work (b-path) and Overall shared cognition (c'-path) on Subjective performance from the self assessment were calculated. It can be seen that the relationship between Coordinated work and Subjective performance from the self assessment, when controlling for Overall shared cognition, was significant and positive ($b = .557$, $t(73) = 6.30$, $p < .001$), thus supporting Hypothesis 3 and in line with the main analysis. It can be seen as well that the relationship between Overall shared cognition from the open-ended questions and Subjective performance from the self assessment, when controlling for Coordinated work, was insignificant ($b = -.006$, $t(73) = -.095$, $p = .9245$), indicating mediation.

Subsequently, the 95% confidence interval of the indirect effect (a*b-path) was again obtained with 5,000 bootstrap samples (Hayes, 2017). It was found that the indirect effect was different from zero and equal to the c-path, thus confirming full mediation with these variables as well (Baron and Kenny, 1986).

4.3.2 Alternative independent variable

An alternative independent variable was chosen as well to further assess the robustness. In the main analysis, the Overall shared cognition from the open-ended questions was used for the independent, or X, variable. Subsequently, the Overall shared cognition from the self assessment was determined to be the most suitable choice for the alternative independent variable, due to the fact that it represented the overall shared cognition as well. Furthermore, the alternative X variable was subsequently tested in combination with the Y variable of the main analysis. The results of the analysis can be seen in Table 10.

First, the total effect was calculated between the Overall shared cognition from the self assessment and the Overall performance from the self assessment. The relationship was found to be significant and positive ($b = .455$, $t(73) = 4.24$, $p < .001$), thus supporting Hypothesis 1 and in line with the main analysis.

Subsequently, the direct effect of Overall shared cognition from the self assessment and Coordinated work was calculated. It can be seen that the relationship was significant and positive ($b = .514$, $t(73) = 3.90$, $p < .001$). Thus, supporting Hypothesis 2 and in line with the main analysis.

Table 10: Robustness check on the mediation and moderated mediation with alternative independent variable.

Variables	OP (c-path)	CW (a-path)	OP (b + c'-path)	CW (moderation)
OSC-self	.455***	.514***	.234*	.608***
CW			.431***	
FTD				-.106
FTDXOSC-self				.337*
R^2 :	.198	.172	.422	.250
F-ratio:	18.0***	15.2***	26.2***	7.91***

N = 75.

OSC-self = Overall Shared Cognition (self); CW = Coordinated Work; OP = Overall Performance (self).

FTD = Focused Team Deliberation.

*Note * $p < .05$, ** $p < .01$, *** $p < .001$.

Next, the direct effects of Coordinated work (b-path) and Overall shared cognition from the self assessment (c'-path) on Overall performance from the self assessment were calculated. The relationship between Coordinated work and Overall performance from the self assessment, when controlling for Overall shared cognition from the self assessment, was found to be significant and positive ($b = .431$, $t(73) = 5.28$, $p < .001$), thus supporting Hypothesis 3 and in line with the main analysis as well.

Additionally, it can be seen that the relationship between Overall shared cognition from the self assessment and Overall performance from the self assessment, when controlling for Coordinated work, was significant ($b = .234$, $t(73) = 2.32$, $p < .05$), indicating partial mediation.

Subsequently, the 95% confidence interval of the indirect effect (a*b-path) was again obtained with 5,000 bootstrap samples (Hayes, 2017). It was found that the indirect effect was different from zero, thus confirming partial mediation with these variables, which is not in line with the main analysis (Baron and Kenny, 1986).

Furthermore, since the independent variable (X) was adjusted, the moderation effect was re-evaluated as well. The results are shown in the right most column of Table 10. It can be seen that relationship between Coordinated Work and the interaction of Focused team deliberation and Overall shared cognition from the self assessment was significant ($b = .336$, $t(73) = 2.03$, $p < .05$). This thus indicated moderation. Subsequently, the 95% confidence interval was obtained with 5,000 bootstrap samples. It was found that the null of 0 did not fall between the lower and upper limit, thus confirming moderated mediation (Hayes, 2017).

In further analysis of the moderation effect, the "Pick-up point" approach was used to determine the slopes (Hayes, 2017). In the Table 11, the simple slopes are shown at -1 standard deviation of Focused team deliberation, the mean and +1 standard deviation. It can be seen that at -1SD of Focused team deliberation, the effect of Overall shared cognition from the self assessment on Coordinated work was positive and marginally significant ($b = .319$, $p = .0530$). At the mean of Focused team deliberation, the effect of Overall shared cognition from the self assessment on Coordinated work was positive and significant ($b = .608$, $p < .001$). Furthermore, at +1SD of Focused team deliberation, the effect of Overall shared cognition from the self assessment on Coordinated work was positive and significant ($b = .942$, $p < .001$). These slopes are visualized in Figure 13. It can be seen that an increase of Focused team deliberation resulted in an enhancing effect, thus rejecting Hypothesis 4.

Table 11: Simple slopes of the moderation.

FTD	Effect	SE
- 1 Standard Deviation	.319 †	.162
Mean	.608***	.134
+ 1 Standard Deviation	.942***	.243

FTD = Focused Team Deliberation; SE = Standard Error.

*Note † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

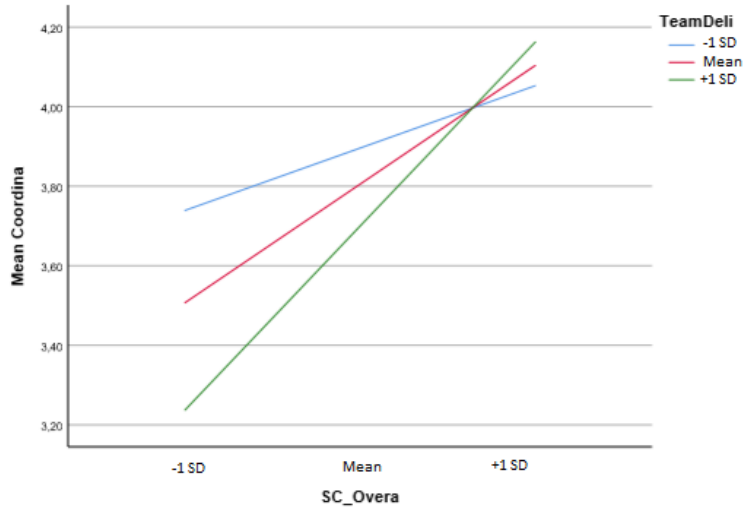


Figure 13: The simple slopes of the moderating effect from Focused team deliberation.

4.3.3 Alternative independent and dependent variable

Finally, to conclude the robustness check, the alternative independent and the alternative dependent variables were tested against each other. Furthermore, in the analysis only the c-path, b-path and c'-path were tested, due to the fact that the a-path with the alternative independent variable was already calculated in the previous section. The results are shown in Table 12.

It can be seen that the relationship between the Overall shared cognition from the self assessment and the Subjective performance from the self assessment was significant and positive ($b = .461$, $t(73) = 3.98$, $p < .001$), thus supporting Hypothesis 1 and in line with the main analysis.

Table 12: Robustness check on Hypothesis 1 and 3 with alternative independent and dependent variables.

Variables	SP (c-path)	SP (b + c'-path)
OSC-self	.461***	.213†
CW		.482***
R^2 :	.422	.426
F-ratio:	15.9***	26.7***

N = 75.

OSC-self = Overall Shared Cognition (self); CW = Coordinated Work; SP = Subjective Performance (self).

*Note † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Next, the direct effects of Coordinated work (b-path) and Overall shared cognition from the self assessment (c'-path) on Subjective performance from the self assessment were calculated. It can be seen that the relationship between Coordinated work and Subjective performance from the self assessment, when controlling for Overall shared cognition from the self assessment, was significant and positive ($b = .482$, $t(73) = 5.57$, $p < .001$), thus supporting Hypothesis 3 and in line with the main analysis.

It can be seen as well that the relationship between Overall shared cognition from the self assessment and Subjective performance from the self assessment, when controlling for Coordinated work, was insignificant, or marginally significant ($b = .213$, $t(73) = 1.99$, $p = .0504$), indicating full mediation. However, due to the fact that the threshold of $< .05$ is only marginally exceeded, one could argue that there is partial mediation (Baron and Kenny, 1986).

Subsequently, the 95% confidence interval of the indirect effect ($a*b$ -path) was again obtained with 5,000 bootstrap samples (Hayes, 2017). It was found that the indirect effect was different from zero, thus confirming mediation with these variables (Baron and Kenny, 1986).

4.4 Hypotheses results

Furthermore, in Table 13 the hypotheses are shown that were proposed and tested in this thesis. In Table 14, the results of this Chapter are summarized and it can be seen which hypotheses found support in the analysis and which hypotheses were rejected.

Table 13: The hypotheses proposed in this thesis.

Hypothesis	Description
Hypothesis 1	Shared cognition has a positive influence on start-up team performance.
Hypothesis 2	Shared cognition has a positive influence on coordinated work.
Hypothesis 3	Coordinated work has a positive influence on start-up team performance.
Hypothesis 4	A focused team deliberation has a diminishing effect on the relationship between shared cognition and coordinated work.

Table 14: An overview on which hypotheses are supported and rejected in the analysis.

Hypothesis	Main Analysis OSC + OP	Robustness check 1 OSC + SP	Robustness check 2 OSC-self + OP	Robustness check 3 OSC-self + SP
Hypothesis 1	Supported	Supported	Supported	Supported
Hypothesis 2	Supported	Not tested	Supported	Not tested
Hypothesis 3	Supported	Supported	Supported	Supported
Hypothesis 4	Rejected	Not tested	Rejected	Not tested

OSC = Overall Shared Cognition (open); OP = Overall Performance (self); SP = Subjective Performance; OSC-self = Overall Shared Cognition (self).

5 Discussion

In this chapter, the results of the regression analysis as presented in Chapter 4 are further discussed. Furthermore, the hypotheses that have found support in the analysis of this thesis are linked back to the available literature, and the possible reasons for the rejection of Hypothesis 4 are explored. Subsequently, the theoretical and practical contributions of this thesis are further outlined. Lastly, the limitations of this thesis are given and possible areas for further research are suggested.

5.1 Hypotheses

Hypothesis 1, which proposed that shared cognition has a positive influence on start-up team performance, found support in the main analysis of this thesis. The regression analysis revealed a significant positive relationship between shared cognition and start-up team performance, and this perceived relationship was even further fortified due to the fact that in all three robustness checks support was found as well. The support found for Hypothesis 1 builds further on what prior researchers have argued to be present, but did not find (Ensley and Pearce, 2001; de Mol et al., 2015).

It seems that shared cognition does in-fact help prevent a fragmented approach, whereas the individual actions of team members differ in implementation of the team's strategy. The positive effect of such a unified and consistent approach had been argued in the past, in which it was found that ventures that pursue a distinct strategy and are consistent in their strategy implementation will perform better than ventures which are inconsistent (Porter, 1980).

Subsequently, a significant positive relationship and thus support was found as well for Hypothesis 2, which stated that shared cognition has a positive influence on coordinated work. It seems that the possession of a shared agreement and understanding of the team goals benefits the collaboration within the team, since every team member has an equivalent view on how to achieve these goals. The support found for Hypothesis 2 is in line with the view that shared cognition would ensure that a team functions as a unit through planning and communication, consequently being an important aid in facilitating coordinated work (Blatt, 2009; Zheng and Mai, 2013). Furthermore, it is in line with the research by Ensley et al. (2003), in which they hinted that shared cognition could provide the basis for good coordination, but in which the researchers did not provide any empirical evidence. Additionally, it seems in line with strategic literature that argued that coordinated work could be an important result of agreeing on strategic decisions (West and Meyer, 1998). Subsequently, a robustness check resulted in support for Hypothesis 2 as well, enhancing the argument that a positive relationship is indeed present.

Next, through Hypothesis 3 it was proposed that coordinated work has a positive influence on start-up team performance. The regression analysis found a significant positive relationship in the main analysis, as well as all three robustness checks. The support found corresponded with what earlier research had shown, i.e. that highly coordinated and flexible teams perform well in difficult scenarios, due to the fact that the team easily adapts to the dynamic environment in which it operates (Eisenhardt, 1989; Eisenhardt and Bourgeois, 1988; Stout et al., 1999).

It seems that due to the fact that the individual approaches on how to achieve the team goals are coordinated, adaptations can be made more easily within the team in the presence of obstacles (Paul et al., 2016). In other words, coordinated teams are more agile, which has been argued to be a contributing factor towards the enhancement of overall team performance (Andersson et al., 2017).

Furthermore, despite the fact that the combination of Hypothesis 1, Hypothesis 2 and Hypothesis 3 consequently described mediation, it was not specifically hypothesized whether this envisioned mediation was full or partial.

In the main analysis, the mediation analysis revealed that coordinated work fully mediated the positive relationship between shared cognition and start-up team performance.

In other words, the positive effect shared cognition has on the start-up team performance is exhaustively explained by the enhancement of coordinated work. This is an interesting finding, due to the fact that the positive effect shared cognition arguably has on start-up team performance has its roots in the prevention of a fragmented approach, and the enabling of a consistent strategy implementation by all team members (de Mol et al., 2015; Porter, 1980). It can be therefore argued that such a unified approach and consistent implementation are in fact aspects of coordinated work by the team members, revealing that a shared understanding and agreement is beneficial towards the performance of the team purely due to the fact that the team works in a more coordinated manner when such a shared understanding and agreement is present.

However, a full mediation was only present in two of the three robustness checks. The other robustness check showed that there was only a partial mediation present, indicating that coordinated work does not exhaustively accounts for the positive relationship between shared cognition and start-up team performance. Furthermore, another robustness check was only marginally insignificant ($p = 0.504$), which could thus indicate a partial mediation as well.

Lastly, Hypothesis 4 proposed that focused team deliberation has a diminishing effect on the relationship between shared cognition and coordinated work. The hypothesis was rejected in the main analysis, as well as in a robustness check. However, interestingly so, in the robustness check a positive moderation was found rather than the negative moderation hypothesized.

The rejection of Hypothesis 4 is not in line with shared cognition literature that, during an assessment in which extensive communication was present between the team members, found shared mental models within the team had little to no link with performance (Bierhals et al., 2007). It seems that the deduction that the extensive communication negated the positive effect of a shared perspective could thus not find support in this thesis, indicating that there might be other factors that could have been of influence on the results in that research.

Furthermore, it was argued in the formulation of Hypothesis 4 that a deliberation with all team members, where every individual is fully focused and not simultaneously busy with other tasks, can be used to help align the agreement and understanding within the team if it was not as present. Thus, the existence of a deliberation session would diminish the advantage a team with more shared cognition has. However, the rejection of Hypothesis 4 hints at the fact that the origin of shared cognition could be more complex than perceived, and that a focused team deliberation is not an adequate replacement. This lack of knowledge, and perhaps even underestimation, of the complexity on the processes that fuel shared cognition is in line with the absence of literature that focuses on the exploration of this subject (de Mol et al., 2015).

Subsequently, in the robustness check the opposite of what was hypothesized was found. An explanation could be that when shared cognition is present, a focused team deliberation is beneficial and subsequently results in an even more coordinated manner of working. Thus, it might be that in the presence of a shared understanding and agreement, a focused team deliberation would help ensure that it translates to an efficient unified approach on how to continue. This view is in line with research that argued that start-up teams are likely to perform well when the individuals within the team exchange information with one another in a clear and comprehensive way (Amason et al., 2006). On the contrary, when there is not a shared cognition present, such a deliberation could perhaps only ensure an agreement and not an understanding, thus not preventing a fragmented approach.

In addition to that, it should be noted that the results for the assessment of Hypothesis 4 could have been influenced as well due to methodological considerations. As stated in Chapter 3, several check-in or check-out data was missing, which consequently resulted in incomplete data. It was chosen to impute the missing time frames with the mean duration of the team’s known deliberation sessions as an estimation. However, this imputation method might result in a certain bias as well.

5.2 Theoretical contribution

Despite the fact that it had been hinted at in start-up team literature (Knight et al., 2019), or proposed in shared cognition literature (Ensley and Pearce, 2001), empirical evidence had not been provided for the positive effect shared cognition has on start-up team performance. Therefore, the support found in an extensive analysis, consisting of a main analysis and robustness checks, for Hypothesis 1, Hypothesis 2 and Hypothesis 3 contribute greatly to this field of research and pave way for future scholars. This thesis provides an answer to questions raised in literature such as ”how desirable is like-mindedness?” (Schneider and Angelmar, 1993), confirming that it does indeed seem a positive team trait. Additionally, the discovery of coordinated work as a full mediator of shared cognition and start-up team performance is unprecedented, and provides new knowledge in the understanding of the relationship between shared cognition and start-up team performance, consequently creating an interesting area for future researchers to expand on.

Furthermore, it was identified in this thesis that a cause for contradicting or lack of decisive results has its roots in the ambiguous manner in which the definitions of shared cognition and start-up team performance are formulated (Knight et al., 2019; de Mol et al., 2015). This thesis aimed to tackle this issue through the formulation of clear definitions at the start of the research, to provide future researchers a comprehensive view on how the results of this thesis can be interpreted and even expanded on.

Additionally, the creation of a framework to objectively convert open-ended questions of a team in to a shared cognition score provides a new method for the measurement of shared cognition. The framework provides a start to an objective assessment method that can help quantify the cognitive concept, and could help future researchers in the assessment of shared cognition.

5.3 Practical contribution

This thesis provided more clarity, through empirical evidence, on what the actual influence is of shared cognition on start-up team performance. This information is therefore very useful for start-up teams, and institutions that provide guidance for aspiring start-up companies.

The identification of the positive relationship between shared cognition and start-up team performance provides start-up teams with an additional tool to enhance its chance to succeed. It can be that some start-up teams have never given their level of shared cognition any consideration, due to the fact that the positive effects it might have were unknown. The extra insights provided by this thesis can help start-up teams choose to actively search for methods to improve their shared cognition, or to periodically assess the state of their shared cognition, with now more signs that it will provide beneficial results. As stated in Chapter 1, it could help provide start-up teams an increased feeling of control, due to the fact that the performance differences between ostensibly similar ventures depend less and less on randomness, but rather on factors that can be influenced.

5.4 Limitations and further research

In this section, the limitations of this thesis are discussed, as well as some topics that could be of interest for future research in the expansion of knowledge concerning shared cognition.

This research had some limitations, which could be interesting for future researchers to focus or improve on. First, for the assessment of the start-up team performance the Objective jury measurement failed to comply with the assumptions of linear regression, consequently resulting in its omission. Despite the fact that team performance literature suggests that both self assessment and observable assessment are reliable methods, its inclusion would have provided a more complete view on the actual performance of the team (Andersson et al., 2017). Additionally, as stated in Chapter 5, in the operationalization of team deliberation the mean was used as an imputation method, due to the small size of the samples. Therefore, it is not certain if any bias was prevented. In further research more attention could be given in the prevention of missing data upfront.

Furthermore, it should be noted that this research purely focused on start-up teams positioned in the framework of Knight et al. (2019) that have a high *Ownership of Equity*, high *Entitativity* and high *Autonomy of Strategic Decision Making*, and thus one must be cautious in attempts to generalize the results to start-ups that do not comply with this definition. Deviations of other start-up definitions in the dimension of *Autonomy of Strategic Decision Making* could possibly have the most impact on the results, since it is reasonable to assume that the importance of a shared understanding and agreement on certain strategic decisions will diminish if such decisions can not even be fully taken by the team. Additionally, a lower *Entitativity* would entail that the team is part of a bigger whole, which would thus mean that the team's performance influences, but is not equal to, the performance of the new venture. Therefore, the importance of the start-up team's performance would be significantly less than the case in which the team and the venture are of equal constructs. Furthermore, a deviation in the dimension of *Ownership of Equity* seems to arguably have the least impact on a change in results. However, it should be noted that a lower *Ownership of Equity* can go hand-in-hand with a lower *Autonomy of Strategic Decision Making*, since the investors that own a large share of the equity could want to have influence in the decisions as well.

Additionally, it could be interesting to see if the results of this thesis still hold for start-up teams of different sizes, due to the fact that in this thesis the teams had on average around six team members. It has been found that team cohesion is a contributing factor to team performance, and that for a larger team it is more difficult to achieve a high level of cohesion (Paul et al., 2016). It could therefore be interesting to see if the size of the team has any effect on the relationship of shared cognition and start-up team performance, and if that reduction in cohesion has any significant effect as well.

Furthermore, this thesis provides new insights in the relationship between shared cognition and start-up team performance, but still leaves several questions to be answered. As priorly stated, the rejection of Hypothesis 4 exposed the lack of knowledge present on the antecedents of shared cognition. It became apparent that a focused team deliberation is not a sufficient replacement for shared cognition. Therefore, further research could explore what factors are present at the roots of shared cognition, and could assess whether shared cognition emerges from individual factors such as gender, age and personal experience or from group factors such as team composition, team cohesion, shared prior experience and diversity in skills.

Lastly, this research revealed a promising full mediation effect provided by coordinated work, which could be further researched and assessed in order to help better understand the underlying reason why shared cognition positively influences start-up team performance.

6 Conclusion

This thesis aimed to provide more scientific support on what the actual impact of shared cognition is on the performance of a start-up team. In addition to that, the aim is to determine if that impact is mediated by the level of coordinated work within the team, and if a focused team deliberation has any diminishing effect on the relationship between shared cognition and coordinated work. The main research question is therefore formulated as:

- **RQ:** *To what extent does shared cognition influence the performance of a start-up team, and how does coordinated work and a focused deliberation within the team influence that relationship?*

It became apparent through an extensive analysis that the effect shared cognition has on the performance of a start-up team is a positive one. Regression analysis showed a significant positive relationship in both a main analysis and in robustness checks, providing new arguments that can be used in both theoretical fields as well as in practice.

Furthermore, the extend to what shared cognition influences the performance of a start-up team was even further explored, and the mediating effect of coordinated work was significantly supported in a regression analysis. It was argued that the positive effect shared cognition has on start-up team performance is exhaustively explained by the enhancement of coordinated work of the start-up team, a claim supported by two of the three robustness checks. Additionally, no support was found for a hypothesized negative moderating effect of focused team deliberation, subsequently revealing that shared cognition can not be replaced by merely a discussion and thus confirming its complexity.

To conclude, this thesis provided new insights on to what extent shared cognition influences the performance of a start-up team. Support was found for a positive relationship, fully mediated by coordinated work, and provides scholars interesting results to expand on and start-up teams an additional manner to maximize their performance.

Appendix

Assumptions

The assumptions associated with regression analysis needed to be assessed for the variables used in the analysis, in order to establish whether or not the regression results from this chapter and its subsequent conclusions could be generalized.

Normality assumption

In linear regression, normality is assumed for the residual errors (Sen and Srivastava, 1990). To be able to check this assumption, histograms and P-P plots were created in SPSS. In Figure 14 and Figure 15, the histogram and P-P plot are shown for the combination of the overall performance through self assessment, and the overall shared cognition through self assessment. It can be seen that normality could be reasonably assumed for the analysis of these two variables. Subsequently, histograms and P-P plots were produced for all possible combinations, and the assumption was only violated for the combinations with the observable jury performance measurement, as can be seen in Figure 16 and Figure 17. Consequently, results and conclusions derived from analysis with the observable performance jury variable should be more conservative in the assessment of its significance.

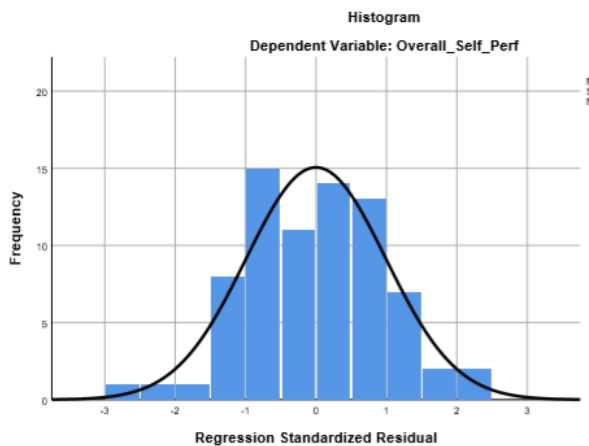


Figure 14: Histogram of the residuals between overall performance through self assessment and the overall shared cognition through self assessment.

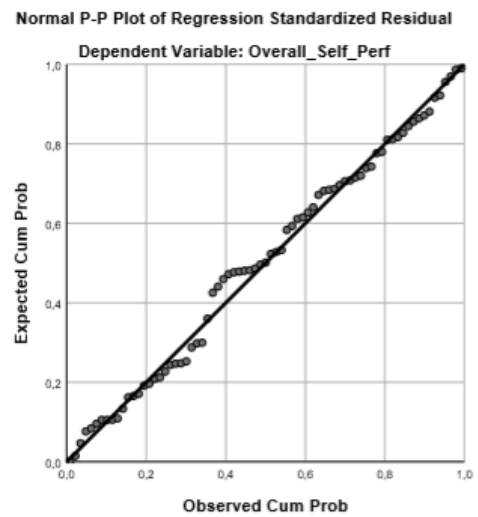


Figure 15: P-P plot of the residuals between overall performance through self assessment and the overall shared cognition through self assessment.

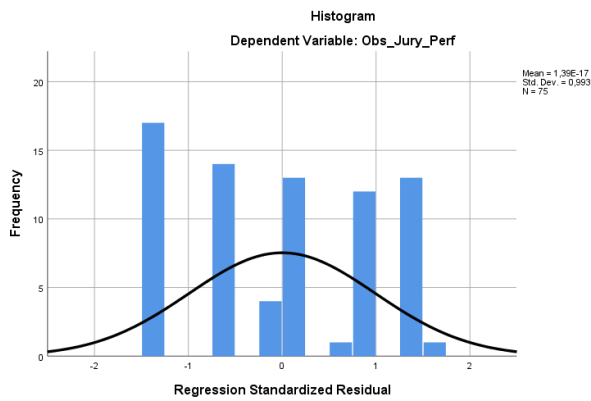


Figure 16: Histogram of the residuals between Observable performance through jury assessment and the overall shared cognition through open questions.

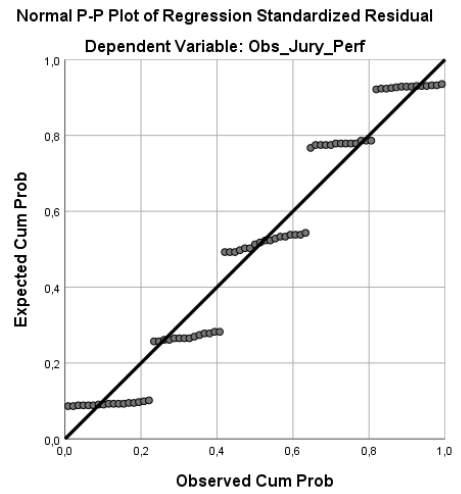


Figure 17: P-P plot of the residuals between Observable performance through jury assessment and the overall shared cognition through open questions.

Linearity and homoscedasticity

In order to be able to generalize the results, it is also assumed in linear regression that there is linearity and homoscedasticity. In SPSS, the standardized residuals (*ZRESID) were plotted against the standardized predicted values (*ZPRED) for the assessment of these assumptions. In Figure 18, these values were plotted against each other for the variables overall performance from the self assessment and the overall shared cognition from open questions. It can be seen that the points in the Figure are randomly and evenly dispersed, which indicated that the assumptions are met. Subsequently, these plots were again produced for all possible combinations and it reasonably held for the majority of variable combinations. It became evident that the assumption was only violated for the combinations with the observable jury performance measurement, as can be seen in Figure 19. Therefore, taking in to account that this variable violated the normality assumption as well, it is apparent that the results and conclusions derived from analysis with the observable performance jury variable are not generalizable.

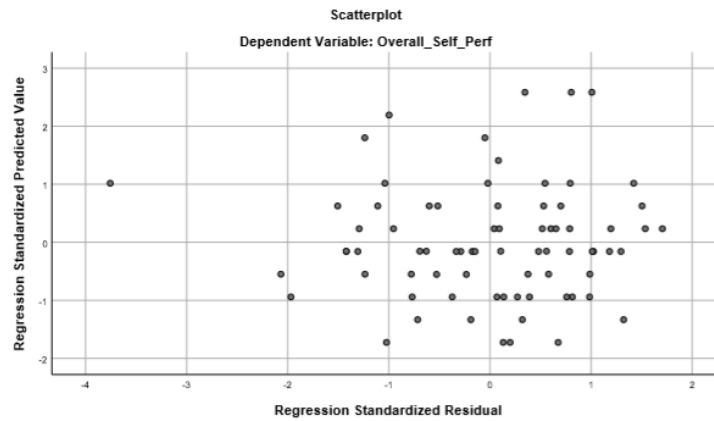


Figure 18: Plots of the *ZRESID against *ZPRED between overall performance from the self assessment and the overall shared cognition from open questions.

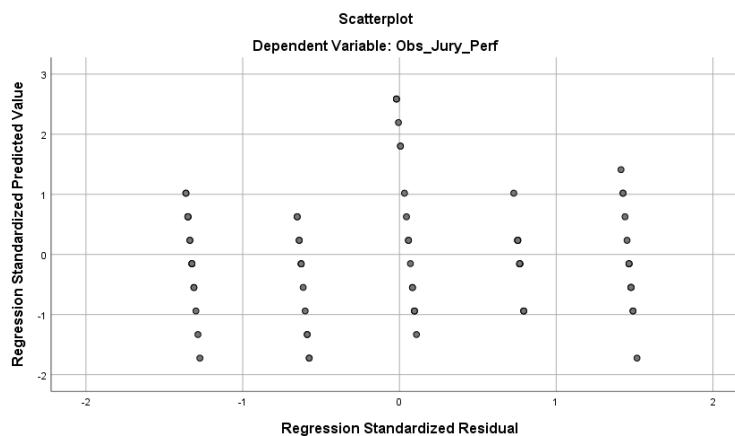


Figure 19: Plots of the *ZRESID against *ZPRED between Observable performance through jury assessment and the overall shared cognition through open questions.

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