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TRUST IN INTER-ORGANIZATIONAL CONSTRUCTION DESIGN TEAMS: THE EFFECT OF INTERPERSONAL TIES AND THE MODERATING ROLE OF VIRTUAL MEETINGS

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DEVELOPING A GUIDELINE TO IMPROVE TRUST VIA PRIOR AND FUTURE TIES

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Trust in inter-organizational construction design teams: The effect of interpersonal ties and the moderating role of virtual meetings

Developing a guideline to improve trust via prior and future ties

by

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Executive summary

The COVID-19 pandemic has affected the construction industry in the Netherlands as projects came to a stop and project teams struggled to collaborate remotely (European Construction Sector Observatory, 2021). It resulted in a change in the way of working from a predominantly face-to-face setting to a virtual environment. As projects in the construction industry are by nature complex and dynamic, efficient collaboration in project teams is crucial (Demirkesen and Ozorhon, 2017). Especially when considering construction design teams, which take part in the initial stages of the project. It is widely known that decisions and actions in the early phases of a project have a significant influence on the outcomes of a project (Hutchinson and Wabeke, 2006). Thus, to cope with the effects of the COVID-19 pandemic and consequential virtual work environment, it is crucial to have effectively collaborating design teams. Design teams are characterised by a cross-functional composition of members with varying expertise coming from different organizations, who have to collaborate intensively to reach their goal (Svalestuen et al., 2015). A renowned contributor to team success in design teams is trust. Trust contributes to project success as it aligns the interest of stakeholders, increases the willingness to share information and improves team performance. As design teams take place in the initial phases of a project, no experience is present between the design team members in which trust could be developed. However, Buvik and Rolfsen, 2015 found that prior ties, or interactions in previous working relations could result in an improved level of trust in the design team. Moreover, Chen et al., 2018 found that expectations of future collaboration, or future ties, improve the levels of trust in teams. These ties could therefore be used to increase the levels of trust and subsequently result in more efficient team processes. In addition, as the design team members were subjected to the restrictions related to the pandemic, it is important to investigate how this virtual work environment affects trust development. Currently, no research is performed on the effect that prior and future ties have on trust in inter-organizational construction design teams. This research aims to fill this research gap and utilize its results in order to enable design team members to improve the levels of trust in their teams while coping with the effects of the change to a virtual work environment. The main question of this research is:

“What is the effect of ties on trust in inter-organizational construction design teams?”

The structure of the research can be divided into three phases. The first phase considers the contextual background of the research topic, which is investigated by performing a literature review. This literature review explores the concepts of ties and trust in the context of construction design teams. It reviews the importance of trust and the factors to it. Also, it evaluates the potential effects that ties have on trust. Lastly, the literature review tries to discover the interrelatedness between ties, trust and aspects of the virtual work environment. The second phase considers the empirical analysis. The empirical analysis examines the relationships between the concepts of ties, trust and virtual meetings.

This empirical analysis is performed with the use of a survey. The survey is developed with the help of the literature review and is sent out to 132 individuals that participate in varying design teams. The results of the survey are finally analyzed with a correlation and moderation analysis using the SPSS software. For the moderation analysis, use is made of the PROCESS macro which enables a multiple regressions analysis to find potential moderating effects. In the third and final phase of the report, all results are synthesised in order to find answers to the research question. Moreover, the results of the research are used to develop a trust guideline. The guideline contains recommendations which enable design team members to improve the levels of trust in their teams. The practicability and relevance of the guideline is evaluated with an expert interview. The trust guideline is displayed in figure 1 below. The third phase ends with the discussion and the conclusion. In the discussion, all results are combined and compared. Moreover, potential limitations are highlighted. In the conclusion, the sub- and main questions are answered followed by the recommendations for future research.

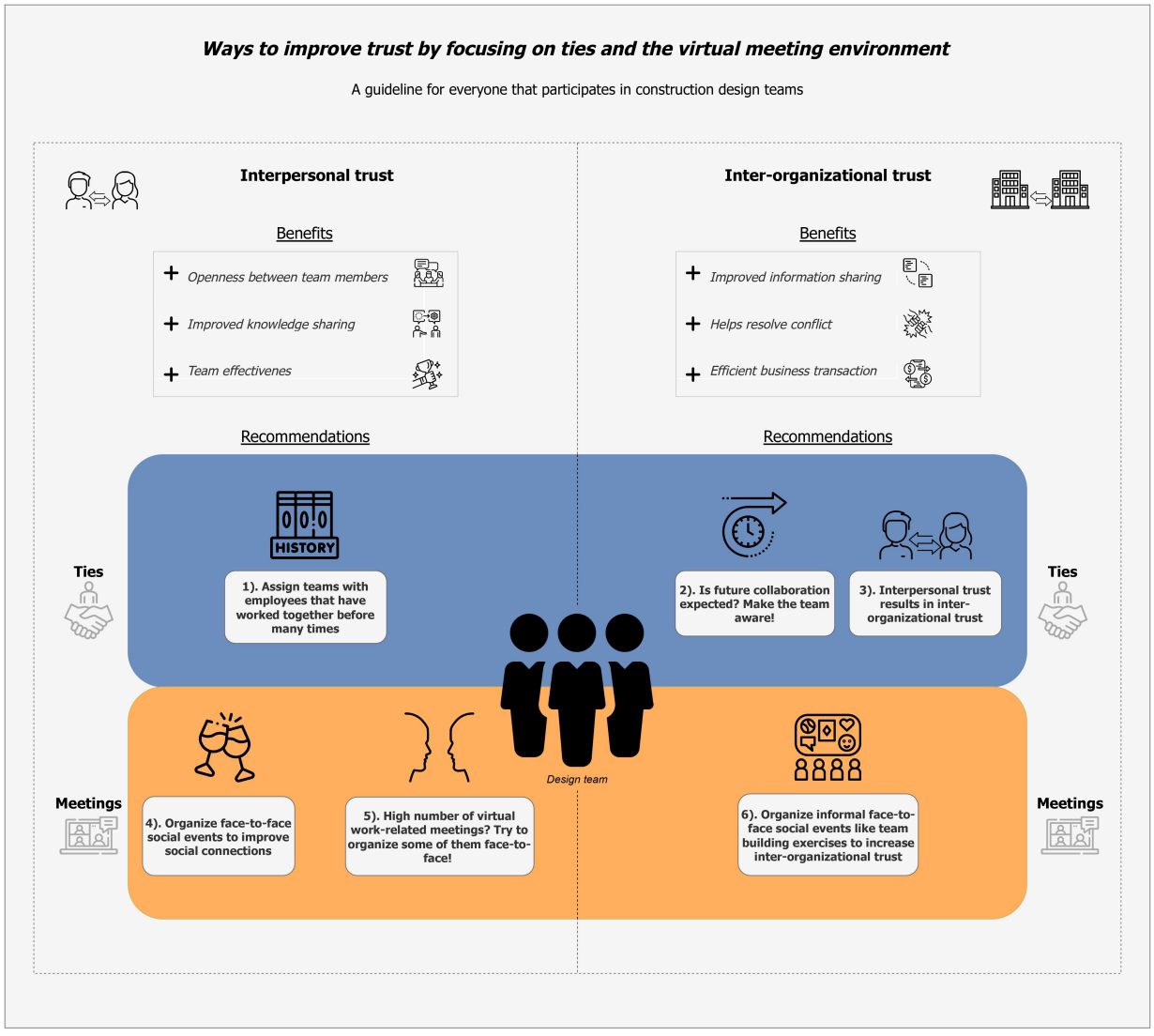

Figure 1: Trust guideline for design team members

The results of the literature review show that trust can be categorized into two main types; interpersonal and inter-organizational trust. Interpersonal trust is the level of trust between individuals. Inter-organizational trust considers the level of trust between two or more different organizations. Improved interpersonal trust in the design teams results in more openness between the design team members, improved knowledge sharing and team effectiveness. Inter-organizational trust helps to resolve conflicts and enables efficient business transactions. It is found that prior ties contribute to both interpersonal and inter-organizational trust, while future ties only contribute to inter-organizational trust. Furthermore, increased interpersonal trust will result in an increase in inter-organizational trust according to the literature review. Due to this, it is argued that prior ties have a more significant effect on the amount of trust in design teams. However, due to a low response rate of 49% and an absolute number of just 49 usable responses, the survey analysis resulted in many non-significant results. Therefore, the argument can not be substantiated by empirical evidence. Moreover, as mentioned by the literature review, prior ties do not always have a positive effect on trust. Prior interactions might results in a negative effect on trust when expectations regarding competence are not met, or when expectations are not clearly expressed at the start of the project.

It is found in the literature review that virtual meetings can affect the levels of trust in teams. The results of the analysis indicate that virtual work-related meetings specifically, have a non-beneficial effect on the levels of interpersonal trust in teams. On the contrary, virtual work-related meetings do not affect inter-organizational trust. It is argued that this is due to the irrelevance of the lack of social interactions to the amount of trust an individual has for organizations. Social face-to-face meetings, on the other hand, show significant positive effects for both trust types. Thus, to improve trust, design teams are advised to organize face-to-face social meetings to develop interpersonal connections.

Taking into account the results of the literature review and the survey analysis, it is concluded that ties are an important factor in the development of trust. By utilizing the individual aspects of these ties, design team members can improve the levels of trust. It is suggested that prior ties are more important for trust development than future ties. However, it should be mentioned that prior ties are no silver bullet. Prior experiences may induce unmet preexisting expectations and laxity. In addition, the potential non-beneficial effects of virtual meetings on trust in the design team should be considered. To deal with these effects it is advised to organize social and face-to-face meetings as these improve interpersonal connections. The research results indicate that this knowledge is not yet common and should therefore be emphasised. Lastly, it has to be mentioned that when considering this conclusion, it is important to recognize that certain limitations are present. Especially the considerable small sample size of the survey, which resulted in many other limitations like an unequal representation in personal and organizational roles, should be considered.

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Introduction

1.1. Background

The global construction industry accounts for around 13% of the global GDP and therefore is one of the largest industries in the world. About 7% of working-age population is employed by the global construction sector. When looking at the Dutch construction industry specifically, the share of the GDP is around 4% (European Construction Sector Observatory, 2021). However, the industry has a wide-ranging productivity problem. Would the construction industries productivity catch up with the rest of the global economy, it could increase their total GDP share by 2%. The lack in productivity in the construction industry has many reasons. Some of them are high regulation standards, little digitalisation, bad project management and poorly functioning design processes (Mckinsey&Company, n.d.). Design processes are the focus of this research.

Design processes in the building construction context of this research are performed by inter-organizational design teams. The design teams are positioned in the early phases of construction projects. Decisions and actions in the front-end phases of a project can have a significant influence on the outcomes of a project. Having a completed and a well-finished design phase allows to develop a more precise budget and planning which increases the potential for project success. It is therefore of high importance that design team members' views on the project are aligned and the team collaborates efficiently (Fong and Lung, 2007). Unfortunately, this alignment often falls short, which results in a adverse impact on the continuation of projects (Tombesi and WhyTe, 2011). Design teams require intense collaboration in order to achieve group processes. Especially because design teams experience the first collaboration between participating organizations, this means that design team members have limited experience working with each other. Also, their project phase has a short time span so there is little time to get to know each other (Svalestuen et al., 2015).

One of the most important attributes of construction design teams which helps to develop effective working relationships is trust (Smyth, 2005, Svalestuen et al., 2015). The importance of trust is not just true in the construction sector. The importance of trust encompasses varying sectors and industries.

As Joyner (1996) stated it; "Without trust you can have forgiveness, and even love, but there can be no genuine relationship. The strength of trust will determine the strength of every relationship." Trust is seen as major contributor to project success as it aligns the interest of stakeholders, increases the willingness to share information and improves team performance (Khalfan et al., 2007, Yan and Zhang, 2020). Thus, improving trust in design teams could reinforce team processes and subsequently project success.

As mentioned by Svalestuen et al. (2015) design teams are present in the early stages of projects, where no collaboration between the organizations has taken place yet. There are no preceding phases of the project in which trust could be formed between individuals or the organizations (Smyth, 2005). However, according to Buvik and Rolfsen (2015) prior ties between team members due to past collaboration could result in increased trust levels within the design team. Poppo et al. (2008) and Chen et al. (2018) on the other hand, found that when organizations expect that they will work together again in the future, this could also improve the amount of trust on an organizational level. The concept of prior and future ties in the context of design teams is schematically depicted in figure 1.1. Prior ties are known prior interactions between the members of the current design team, while future ties represent the expected future collaborations between the design team members. According to Poppo et al. (2008), does the positive effect of future ties on trust come from the idea that expected future payoff from honest, trustworthy cooperation outweighs the gain from short period self-interested behaviour. To place this in the context of inter-organizational construction design teams it could be explained with the following example. In a situation where two companies have a long standing framework agreement, the employees of these companies know that they will probably work together on future projects. This expected future collaboration makes it less likely for the employees to show opportunistic behaviour as this could damage their collaboration in the future. Short term opportunistic acts reduce the achieved value in future situations as the trust is damaged. Due to this, the employees of both companies are more likely to trust each other as they do not expect untrustworthy behaviour coming from the other party. Poppo et al. (2008) summarizes this idea with the following statement: "Cooperative assurances are built through reciprocal acts and depend critically upon a significantly long time horizon of future exchange. Without a window of continuity, short-term gains would derail trust." Yet, research performed by Poppo et al. (2008) and Chen et al. (2018) is not founded on the context of inter-organizational design teams in the building construction industry. More research on this topic is needed to identify with certainty if and how prior and future ties improve trust within these teams.

During the last few years, the COVID-19 pandemic has wreaked havoc on societies globally. The pandemic had a severe impact on the construction industry in the Netherlands and the recovery is expected to take some time (European Construction Sector Observatory, 2021). Due to this pandemic, organizations changed from an office based work environment to a virtual environment. Colleagues were limited to cooperate through digital platforms like Zoom, Microsoft Teams and Google meet. Inter-organizational teams also had to arrange their meetings in a virtual environment as they were prohibited to meet in person. The change from face-to-face meetings to virtual meetings is of particular importance when considering the development of trust in teams. Aissa et al. (2022) conclude in

their research that a lack of face-to-face interactions makes trust development between team members difficult. Especially when team members do not have prior experiences or did not had the chance to participate in team building exercises. The empirical research performed in this thesis is based on construction projects that took place during this pandemic. It is therefore crucial to take the potential influence of the pandemic into account when delving into the topic of trust within inter-organizational design teams. The pandemic is hopefully coming to an end. But nevertheless, the way of working has changed to a hybrid model, where employees work partly from home and partly in the physical workplace (Aissa et al., 2022). Due to this, the current research will stay relevant.

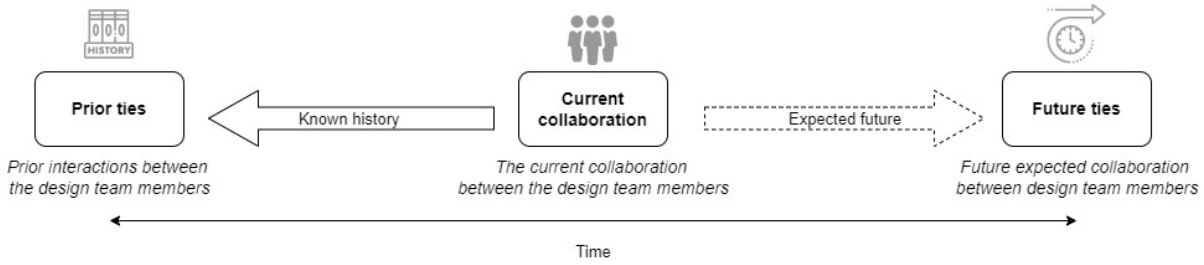

Figure 1.1: Prior and future ties

1.2. Problem statement

The importance of trust in the construction industry is acknowledged by literature (Svalestuen et al., 2015, Smyth, 2005). Due to the widely known importance of trust, much research has been performed on this specific topic. It has been found that prior ties arising from past collaboration can have a positive influence on the amount of trust in teams. Furthermore, expected collaboration between team members in the future could likewise have a beneficial effect on the levels of trust. However, the relationship between prior ties and trust has not yet been researched in the context of inter-organizational design teams (Buvik and Rolfsen, 2015, Guo et al., 2021, Wang et al., 2017). Also, the effect of future ties on trust only received little academic research (Poppo et al., 2008, Chen et al., 2018). Besides, the COVID-19 pandemic changed the way inter-organizational teams organize their meetings. Development of trust could be impacted by this shift and should therefore be considered. As the construction industry is still recovering from the pandemic, little research has been performed on the influence of the change in work environment.

The decisions and actions made by design teams can have a significant influence on the outcomes of a project. Thus, discovering the potential of ties in this context may help to realise the much needed increase in productivity in the construction industry as a whole. When insights are provided regarding this issue, maybe the increase of 2% of total GDP share could be achieved (Mckinsey&Company, n.d.).

The problem statement of this research is:

"Trust is known to be beneficial for design team processes and project success. Prior and future ties have been proven to contribute to the amount of trust in teams. However, this relationship has not yet been investigated in the context of inter-organizational construction design teams. The effect that the change from face-to-face to virtual team meetings, due to the COVID-19 pandemic, has on this relationship is also still unknown."

This study aims to identify the effect of prior, and expected future ties on trust in inter-organization design teams and investigates what effect virtual meetings, induced by the COVID-19 pandemic, have on this relationship. The study is performed by both literature and empirical research. The results of the study are used to develop a guideline which can be applied to influence team levels of trust by focusing on the potential of ties. This guideline could be used by the team members that participate in design teams to improve team trust and to cope with the effects of the virtual setting of meetings.

1.3. Research goal and research questions

In order to solve the research problem stated in section 1.2, the problem and objective of this research are converted into a main research question.

The main-question of this research is:

“What is the effect of ties on trust in inter-organizational construction design teams?”

To answer the main-question, several sub-questions have been formulated. These sub-questions act as a guideline throughout the research. Answering these sub-questions provides the necessary information to answer the main-question and achieve the goal of this research. The sub-questions and their relevance are formulated as follows:

1. What does trust in the construction industry entail and which factors contribute to this?
2. What is the effect of prior and future ties on trust in inter-organizational teams according to literature?
3. What is the effect of prior and future ties on interpersonal and inter-organizational trust in inter-organizational construction design teams?
4. How do virtual meetings, during the course of a project, influence the effect of ties on trust in inter-organizational construction design teams?
5. How can design teams members enhance the amount of trust present in inter-organizational construction design teams?

Sub-question 1:

The definition of trust varies greatly throughout current scientific literature. Thus, before empirical research can be performed, the definition used for this research should be determined. Moreover, this literature review will help to operationalize the concepts of trust in order to measure the amount of trust during the empirical analysis. Besides, relevant literature should be investigated with regard to the factors contributing to trust. These findings will subsequently be used to test the results from the empirical analysis. The theoretical background generated by answering this question will help to identify the true effect that ties have on trust and provides understanding about why this effect comes into play.

Sub-question 2:

Before the effect of prior and future ties on trust within inter-organizational design teams could be empirically researched, it is necessary to review relevant literature on this topic. The findings from this literature review will be compared to the findings of the empirical analysis to come to a conclusion about the effects that ties have on trust.

Sub-question 3:

The operationalized concepts of trust and ties are used for analysis. The analysis identifies the effect that prior and future ties have on both interpersonal and inter-organizational trust in design teams. This effect is compared to findings in literature. The literature review and the analysis provide information to find the proportionate effect that both types of ties have on interpersonal and inter-organizational trust. This proportionate effect provides a complete view on the relationship between ties and trust.

Sub-question 4:

The shift to virtual meetings resulting from the COVID-19 pandemic, may have an influence on the effect that ties have on trust. The influence that virtual meetings potentially have on this effect is investigated.

Sub-question 5:

The insights gained by answering the four sub-questions will provide information on how to utilize this knowledge in the form of a guideline. This guideline is evaluated by performing an expert interview. As the experts are experienced professionals, they provide more insights into the practicability and feasibility of such a guideline.

1.4. Research scope

This research is conducted for the Delft University of Technology (TU Delft) and Drees & Sommer Netherlands. The Drees & Sommer Netherlands Building Performance team will provide professional experience, additional supervising, and the necessary data for the empirical research. Thus, overall supporting this research. Drees & Sommer is an international consulting company working in the building and real estate sector. The company has its origins in Germany. The company has 4000 em-

ployees in 46 locations around the world of which approximately 100 are in the Netherlands. The company provides several services including Project Management, Construction Management, Real Estate Consulting, and Cost Consulting. Drees & Sommer's projects predominantly entail building construction and no infrastructure. Therefore, the scope is narrowed down to building construction projects in the Dutch construction industry. Also, Drees & Sommer takes part in inter-organizational teams which is therefore considered in the scope of this research.

As the topic of this research considers teams working in the design phases of projects, the scope of this research focuses solely on inter-organizational design teams working on building construction projects in the Netherlands. The design process of a typical Dutch construction project consists of the following phases: the sketch phase ("Schetsontwerp (SO)"), the preliminary design phase ("Voorlopig Ontwerp (VO)"), the final design phase ("Definitief Ontwerp (DO)") and the technical design phase ("Technische Ontwerp (TO)"). This research focuses on the whole design stage, thus taking each of the phases into account. Thus, providing a complete view of the effect of ties on trust in the design process of design teams in the construction industry.

1.5. Relevance

1.5.1. Scientific relevance

The wide ranging contributions to trust in the construction industry found in literature lay the basis for this research. Svalestuen et al. (2015) for example, stated the importance of trust in design teams as one of the key elements for an effective team. In the current research, that knowledge is expanded by focusing on the effect that prior and future ties have on trust in design teams.

Prior ties have been researched in other research contexts and situations. Guo et al. (2021) for example, found that interpersonal prior ties resulted in inter-organizational trust in construction projects. However, research by Guo et al. (2021) was focused on the relationships and role differences between team members and team leaders. Wang et al. (2017) has the same conclusion but only looked at the role of contractor and not trust in teams in general. Moreover, research by Guo et al. (2021) and Wang et al. (2017) took place in China, which may influence the results of the research as the Chinese culture emphasises on the concept of harmony (Guo et al., 2021). Maurer (2010) researched the effect of prior ties in the context of German engineering projects and Buvik and Rolfsen (2015) looked at one specific case of a Norwegian construction project. The effect of future ties on trust has also been researched in a different context. Poppo et al. (2008) looked into the purchasing relationship between buyers and manufacturers. They found that both prior and future ties have a positive effect on trust development. In the context of the research by Poppo et al. (2008), the effect of future ties seemed more significant. Research by Chen et al. (2018) on the other hand, looked at the effect of future ties in contractual relationships in the construction industry.

To conclude, the effect of ties on trust has not yet been analyzed in the context of inter-organizational construction design teams. These papers do provide necessary information on the concepts of ties and trust and help to identify the mechanics of the trust building process. However, as mentioned by

Svalestuen et al. (2015), design teams are special as they need intense collaboration in order to achieve group success. Design teams experience the first collaboration between participating organizations, meaning that design team members will only have very limited experience working with each other. These team specifics may result in different trust building mechanics. It is therefore important to learn more about this context. Especially because of the importance of the design phase in construction projects (Fong and Lung, 2007)

Moreover, due to the increase in the adoption of the hybrid working model as a result of the COVID-19 pandemic, it is important to discover the influence that virtual meetings have on the trust levels in design teams. Only little research has been done on the effect of virtual meetings in teams. The research that is done on this topic primarily focuses on virtual teams, which do not only use virtual meeting platforms but also use other systems to work together efficiently. The virtual teams are often established because they are geographically dispersed (Hacker et al., 2019). This is not the case for the teams in the scope of this research. The reason for their virtual collaboration is due to the limitations induced by the pandemic. It has been found by Aissa et al. (2022), Rogers et al. (2021) and Choi and Cho (2019) that trust in virtual teams is fragile as the lack of social connections restrains the development of trust. However, the specific influence of virtual meetings solely has not yet been investigated. Also, these studies have not been performed in the context of the construction industry.

Hence, this research will fill the gap in the current scientific literature by investigating the effect of prior and future ties on trust in inter-organizational design teams. The potential effect of virtual meetings due to the COVID-19 pandemic is also considered.

1.5.2. Practical relevance

The results of this research contributes to design team practices in organizations active in construction design processes. By answering the main research question, information is provided on the effect of ties on trust in teams, including the current influence of the pandemic. This information provides understanding on the effects that team members' previous working experiences have on the development of trust. It can also show the potential importance of an expected future cooperation and why team processes may be affected by this. Moreover, it gives insights in the effect that the change to virtual meetings has on trust in teams. This information could be used by companies working in this context. In fact, to facilitate the application of the information discovered in this research, a guideline is composed. This guideline will provide suggestions on how to cope with certain situations. If there are many or few prior ties or future ties present in a design team, how could this be utilized or remedied in order to maintain a high level of trust in the team? When there is no other option than to meet the team online, which measures should be taken to ensure the same levels of trust are realised? The guideline is designed for professionals that participate in design teams to improve trust and to cope with the effects of the virtual setting of meetings.

1.6. Outline of thesis

The structure of the report can be divided in three phases. Figure 1.2 provides an oversight of the different research phases and describes the sub-questions that are considered in each phase. The answers to the main and sub-questions are provided in the conclusion of the report.

Phase 1 considers the theoretical background of the research topic. In the literature review found in chapter 2, the concepts of trust and ties are investigated and their definitions are provided. Moreover, the potential interrelated of these concepts is explored. As virtual meetings are considered due to the context of this research, the potential effect of these meetings on trust is also examined. The results of the literature review are used to develop the research hypothesis.

Phase 2 starts in chapter 3 with the development of the methodology. The methodology describes the research design and the data gathering and data analysis methods.. The operationalizations of the concepts originating from the literature review are used in the research survey to measure the relationships between the different variables. Also, the sample characteristics that represent the sample group are examined. The results of the survey are displayed and analyzed in chapter 4. At the end of phase 2, the results of the analysis are used to test the research hypothesis.

The third and final phase of the report brings the results of the literature review and the empirical analysis together. The results of the analyses are used to develop a concept guideline in chapter 5. In order to test the concept, an expert interview is performed. The results of the expert interview are used to finalize the guideline and evaluate its usefulness. The research findings are discussed in chapter 6. Phase 3 is finished with a conclusion and recommendations.

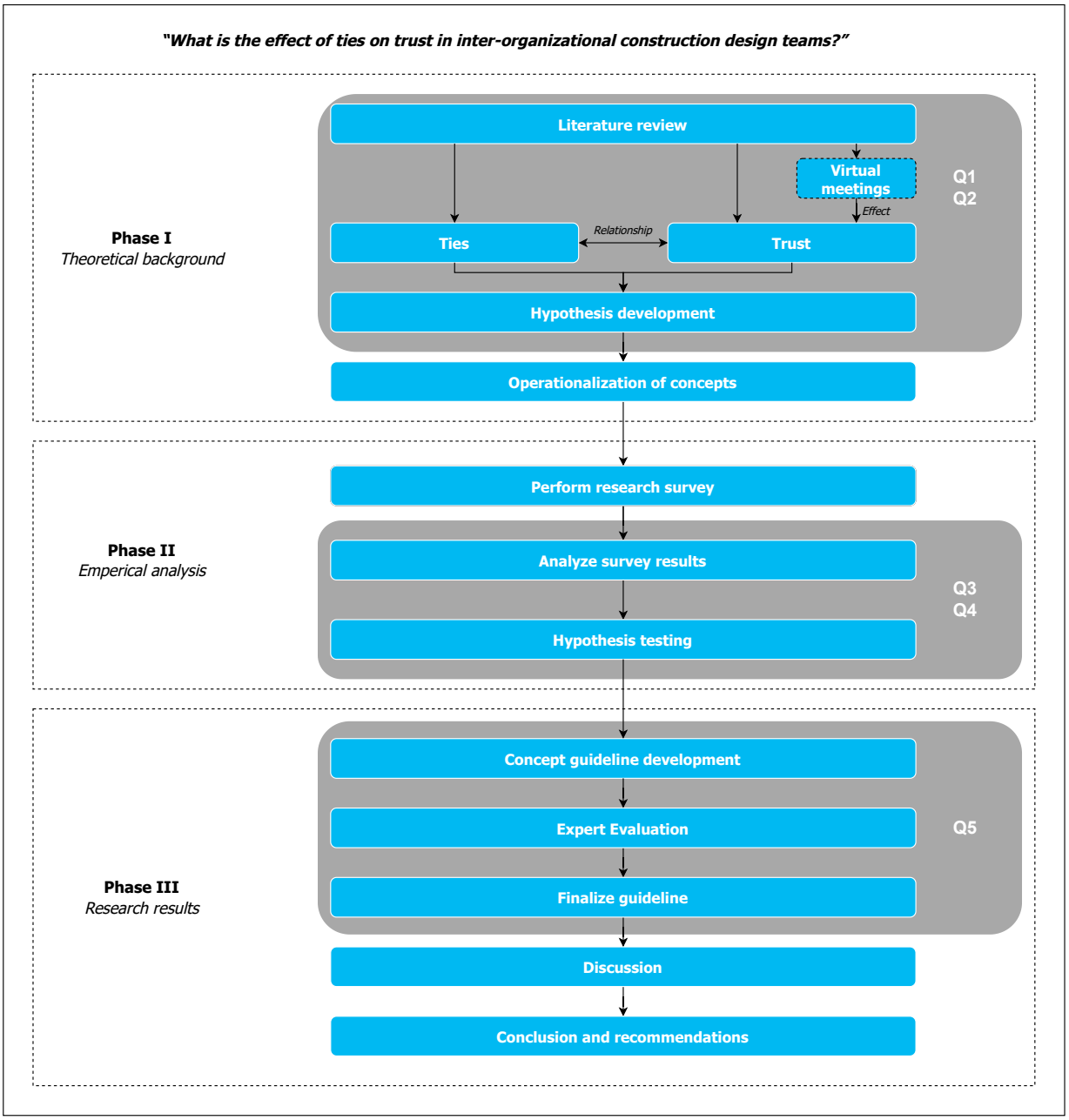

Figure 1.2: Thesis outline

2

Theoretical background

2.1. Research concepts and hypothesis development

This study aims to identify the effects of prior and future ties on trust in inter-organizational design teams and investigates what effect the COVID-19 pandemic has on this relationship. The main concepts that are associated with this goal are trust, ties and virtual meetings. In this chapter, each concept is examined by performing a literature review. The concept of trust is examined in section 2.2 by defining trust in general and categorizing the different types of trust relevant for the construction industry. Subsequently, the importance of trust and the factors contributing to trust are elaborated upon. In section 2.3, the ties relevant for this research are defined and the classification of these ties is described. After that, the influence of these specific ties on trust in teams according to relevant literature is discussed. Virtual meetings as a concept are explored in section 2.4. The reason why virtual meetings are considered in this research is substantiated and the potential influence that these meetings have on the relationship between ties and trust is described. The investigated relationships between the concepts of ties, trust and virtual meetings are schematically displayed in figure 2.1. The investigation of these relationships in the literature review enable the development of hypotheses. A hypothesis provides a statement about the proposed effect between concepts (Verschuren et al., 2010). The different hypotheses are described throughout the chapter. A description and substantiation is provided for each of the relevant hypotheses. Lastly, the chapter is finalized with a conclusion which summarizes the main findings of this literature review. Moreover, reasoning is provided on how the concepts of trust, ties and virtual meetings could be measured as variables.

The steps taken to perform the literature review are described in appendix A. This description includes methodical steps, the main keywords used and queried databases.

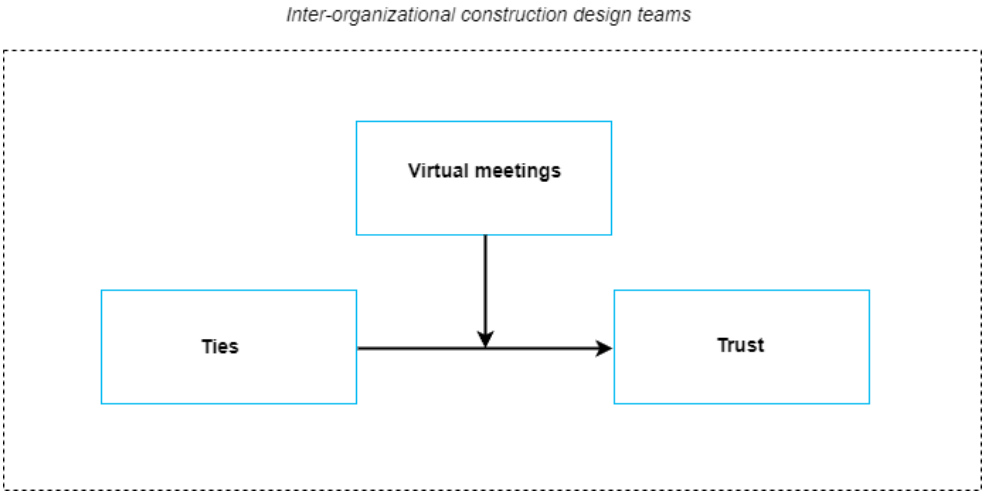

Figure 2.1: Conceptual model for inter-organizational construction design teams

2.2. Trust

The concept of trust is investigated in this section. First the concept of trust in the construction industry specifically is described in section 2.2.1. Then the different types of trust are elaborated upon in section 2.2.2. Subsequently the importance of trust is stated in section 2.2.3. Lastly, the factors contributing to trust are examined in section 2.2.4.

2.2.1. Trust in the construction industry

Extensive research on the subject of trust, has resulted in varying definitions. Pinto et al. (2009) describe trust as the belief in the competence, dependability and ability of the other party with regards to performing a task. Maurer (2010) describes trust as the other party's intent and competence to meet their obligations. Another aspect of trust according to McDermott et al. (2005) is that it is a dynamic concept. Trust is subject to change and can vary during events. Events can reinforce or damage the level of trust within cooperation. Poppo et al., 2008 define trust as the result of a cost benefit assessment; "How much risk are we willing to take in order to reach a certain result?" Chow et al. (2012) have a different view on the definition of trust within construction contracting. Their definition of trust is "A trustor's willingness to become vulnerable to a trustee whose behavior is beyond his control." This definition originates from the research of Mayer et al. (1995). The definition of Mayer et al. (1995) suggests that trust is a mental state within a person's character which may lead to a certain behaviour and the trustworthy behaviour of the other party. The origin of trust can thus be found on two sides. Namely the amount of trust which is present on the side of the trustor and the trustworthiness of the trustee (Nooteboom, 2006). The definition proposed by Mayer et al. (1995) is used in this research.

2.2.2. Types of trust

The types of trust vary in current literature. According to Laan et al. (2011) and Guo et al. (2021), trust can be divided in inter-organizational trust and interpersonal trust. This is in line with the statement by Lau and Rowlinson (2010) who describe trust as a quality of inter-organizational and interpersonal relationships. Interpersonal trust is the level of trust between individuals. Interpersonal trust depends

on the willingness of an individual to be vulnerable for the other party and accept the risks that accompany the collaboration (Guo et al., 2021). Ding and Ng (2010) state that interpersonal trust "is the willingness of one party, with a risk awareness that anticipates negative outcomes to be greater than favorable expectations, to be vulnerable to the actions of the other party in an environment of mutuality." This statement is in line with the definition of Mayer et al. (1995) which mentions the importance of the mental state of the trustor regarding the relationship with the trustee. According to Guo et al. (2021), Ding and Ng (2010) and Webber (2008), interpersonal trust can be decomposed in two categories, namely cognitive trust and affective trust. Cognitive trust is the belief of an individual regarding the reliability, dependability, and competence of the other party. This type of trust is based on relevant experience and reasoning (Guo et al., 2021). When putting cognitive trust in the construction context, cognitive trust depends on the risks that an individual wants to take in a project after judging the other party's competence. This judgement is supported by knowing the other party's experience on similar projects. Affective trust is the more emotional side of trust. It is described as the confidence of an individual regarding the levels of concern and care of the other party (Webber, 2008). It is a subjective judgement that is influenced by the other party's personality and the informal interaction between the trustor and the trustee (Guo et al., 2021). If the behaviour of the trustee is regarded as positive and if the motives seem selfless this results in a higher affective trust between the trustor and trustee (Webber, 2008).

Inter-organizational trust is the level of trust between two or more different organizations. Inter-organizational trust originates from the reputation and prior experiences with the organization of the other party (Guo et al., 2021). Inter-organizational trust can be divided in three categories (Seppänen et al., 2007). Integrity trust, competence trust, and intuitive trust. These three categories combine the economical, sociological and psychological aspects of inter-organizational trust (Hartman, 2002). Research by Pinto et al. (2009) provides a clear definition of these three categories. According to Pinto et al. (2009), integrity trust is the belief that a party looks after the interests of the other party. When putting integrity trust in the project or construction context, it can be explained as the expectation that the other party complies with the interests of both of the participating organizations. A high level of integrity trust will be obtained when there is a believe that the organization will try to achieve the goals of both organization and not only consider their own benefit (Guo et al., 2021). Competence trust on the other hand, is the belief that the other party can perform the needed work. This belief depends on multiple observable indicators. These could be the financial capabilities of an organization, the key personnel and equipment or the relevant experience on similar projects. Lastly, intuitive trust is the emotional feeling that one party can trust the intentions of the other party (Pinto et al., 2009). It depends on the formal and informal experienced relationships. Guo et al. (2021) explains intuitive trust with an example where two organizations enter a communication process and one of the organizations always shows some negligence. This negligence results in a low level of intuitive trust as the other party may think that their counterpart does not take their collaboration seriously (Guo et al., 2021). The decomposition of trust, illustrated in table 2.1 is used in this research.

Table 2.1: Types of trust considered in this research (Pinto et al., 2009, Laan et al., 2011, Guo et al., 2021, Seppänen et al., 2007, Webber, 2008)

Interpersonal trust	Cognitive trust
	Affective trust
Inter-organizational trust	Competence trust
	Integrity trust
	Intuitive trust

2.2.3. Importance of trust in inter-organizational design teams

The importance of trust as a sociological concept in formal or informal relations is well known. As construction projects entail long lasting professional relationships which influence costly investments, the concept of trust within inter-organizational design teams is of high concern in the industry (Guo et al., 2021). In this section, the importance of trust in inter-organizational design teams within the construction industry is elaborated upon.

The effect of trust on project outcomes has been extensively researched. According to Khalfan et al. (2007) and Yan and Zhang (2020)) trust is seen as a major contributor to the success of construction projects. Trust can align the interest of stakeholders, support stakeholder satisfaction, and help achieve the goals within a project (Maurer, 2010). Moreover, trust increases the willingness and motivation to share information within a situational agreement between varying organizations (Maurer, 2010). Next to the effect on project outcomes, trust also improves team performance. Khalfan et al. (2007) stated in their research that trust is a contributor to open and honest communication within a team. This open communication is a necessary component for team effectiveness. Lau and Rowlinson (2010) describe trust as "the glue that binds the partners together and as the lubricant that makes relationship management smooth." Galaz-Delgado et al. (2021) researched the information flow in design teams and found that trust is a central element to open communication. Also, as design teams in construction projects consist of multiple varying parties, these parties need to work together on a regular basis. When no trust is present within this collaboration it results in extensive discussions and resolution of disagreements (Ryciuk, 2017). Trust positively affects efficiency as communication is improved which will reduce the time of negotiations and results in constructive disagreement resolutions (Ryciuk, 2017). This will reduce monitoring costs and increase the potential of mutual gain (Khalfan et al., 2007, Chow et al. (2012)). Svalestuen et al. (2015) researched the key elements that influence the performance of construction design teams. The results of the research by Svalestuen et al. (2015) indicate that trust between team members and commitment to the project are the most important elements for the effectiveness of a design team. Trust seems to be beneficial in a multitude of situations. However trust is not needed when an individual or organization has certainty and control over a situation (Ryciuk, 2017). By trusting other individuals or organizations, the risks of the trustee are accepted and one is exposed to this risk. It should be therefore considered when trust is needed and when someone can control the situations themselves in order to reduce potential risk related to trust.

When looking specifically at the influence of inter-organizational trust, Guo et al. (2021) found

that inter-organizational trust improves the performance of the collaboration between organizations by enhancing information sharing and commitment. Trust improves efficient business transactions and the resolving of conflicts. All in all, it increases the competitive edge of collaborating companies (Guo et al., 2021). Interpersonal trust on the other hand, has been researched in many different disciplines ranging from psychology, sociology, and organizational studies (Webber, 2008). Researchers have found that interpersonal trust is an important component of teamwork, team performance and effective team processes. Mayer et al. (1995) found that interpersonal trust is critical in work relations and leadership as it creates openness between team members and improves the absorption of knowledge received by others. Ding and Ng (2010) have stated in their research that in construction design teams specifically, interpersonal trust is an important factor with regards to the improvement of the teams performance. This is due to the typical composition of design teams. The design teams consist of members coming from a multitude of organizations and have to work together to achieve desirable outcomes. Trust enhances communication and collaboration within these teams (Ding and Ng, 2010). As described, many studies have been performed on trust in the construction industry. In these studies, trust is seen as a contributor to project success and team effectiveness. Inter-organizational trust improves the sharing of information and the resolving of conflicts. Interpersonal trust ensures open communication and results in team performance. Thus, finding ways to increase the levels of inter-organizational and interpersonal trust would be beneficial for the construction projects as a whole.

2.2.4. Factors contributing to trust

As has been said before, trust is a dynamic concept and can change over time (McDermott et al., 2005, Khalfan et al., 2007). Trust can be reinforced, but there are also events or activities that may damage the levels of trust. In the construction sector specifically, trust can develop over the course of a project or many different projects. Organizations and individuals built experience and relationships with each other over time. When looking at the factors contributing to trust in construction projects, Rousseau et al. (1998) stated that trust can be developed over multiple levels of context. McDermott et al. (2005) combined these different layers of trust development in a schematic model (figure 2.2). As can be seen in the model, the contextual layers of the industry context, the organizational context, the project context and the interpersonal context are overlapping. According to McDermott et al. (2005), trust can be developed within each of these contexts separately. However, the amount of trust developed in a certain context influences the levels of trust in other contexts. Interpersonal and inter-organizational contextual factors contributing to trust for example, can reinforce or weaken each others effect McDermott et al. (2005). The factors contributing to trust in multiple sectors have been extensively researched. In order to grasp and analyze the multitude of factors, all trust contributing factors in relevant literature have been summarized in table 2.2 and table 2.3. As the terms vary from paper to paper, in some cases similar definitions are grouped even if their denomination in the source paper can differ slightly. As mentioned in section 2.2.2, trust in the construction industry is divided in two main categories, namely interpersonal and inter-organizational trust. This categorisation is also used for the summary of trust contributing factors in relevant literature. As can be seen in table 2.2 and table 2.3 more research has been performed on factors contributing to inter-organizational trust than interpersonal trust.

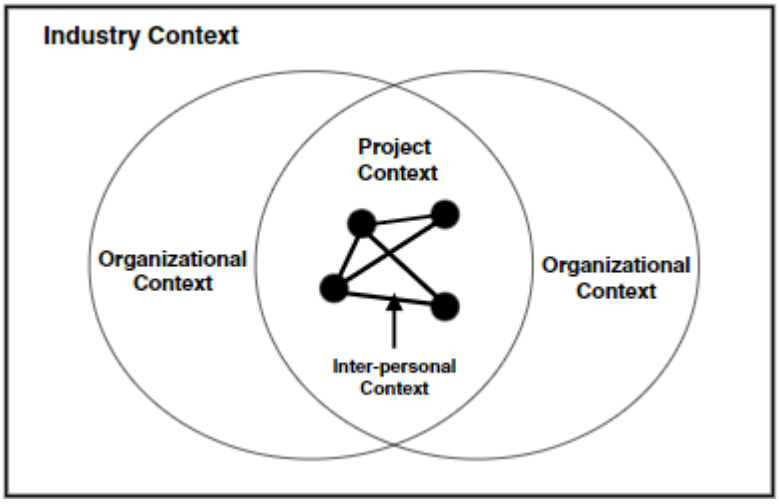

Figure 2.2: Layers of trust development (McDermott et al., 2005)

Table 2.2: Factors contributing to interpersonal trust according to literature

Factors contributing to interpersonal trust	Source
Work attitude	Ding and Ng, 2010
Prior ties	Wang et al., 2017; Guo et al., 2021; Maurer, 2010; Buvik and Rolfsen, 2015
Pleasant social interactions	Ding and Ng, 2010; McDermott et al., 2005
Common philosophy	Buvik and Rolfsen, 2015; Maurer, 2010
Open communication	Buvik and Rolfsen, 2015
Early and clear role expectations	Buvik and Rolfsen, 2015

Some of the factors summarized in the tables are found in multiple literature. In factors contributing to interpersonal trust, the experienced prior ties, the common philosophy and the pleasant social interactions are reoccurring. For factors contributing to inter-organizational trust, this is clearly the case for no blame culture, sharing of risk and investment commitment, active project participation, interpersonal trust and also the experienced prior ties. In general, all factors contributing to trust on the interpersonal or inter-organizational level are related to communication, actions or outcomes. Figure 2.3 by Khalfan et al. (2007) shows these trust emerging concepts which are communication, actions and outcomes. As Khalfan et al. (2007) elaborates in their research, trust emerges when the information shared between collaborators can be relied upon, the expected outcomes are reached and individuals or organizations keep the promises that they made.

The results of table 2.2 and table 2.3 show the interrelation of factors contributing to trust as mentioned by Rousseau et al. (1998). There are for example similar factors contributing to interpersonal and inter-organizational trust like experienced prior ties and a common philosophy. Also, transparency and open communication could also be related to both. Besides, McDermott et al. (2005), Noordin et al. (2012) and Guo et al. (2021) found that interpersonal trust is a contributing factor to the

Table 2.3: Factors contributing to inter-organizational trust according to literature

Factors contributing to inter-organizational trust	Source
Positively experienced prior ties	Lee and Chong, 2021; Guo et al., 2021; Poppo et al., 2008
Expected continuing relations (future ties)	Poppo et al., 2008; Chen et al., 2018
Active project participation	McDermott et al., 2005; Chow et al., 2012
Interpersonal trust	McDermott et al., 2005; Noordin et al., 2012; Guo et al., 2021
No blame culture	Khalfan et al., 2007; Koolwijk et al., 2020; McDermott et al., 2005
Problem solving culture	Khalfan et al., 2007
Sharing of risk and mutual investment commitment	Laan et al., 2011; Ryciuk, 2017;Chow et al., 2012
Transparency	Laan et al., 2011; Chow et al., 2012
Shared social, institutional and psychological norms and culture	Noordin et al., 2012
Organizations reputation regarding quality of service and financial situation	Chow et al., 2012

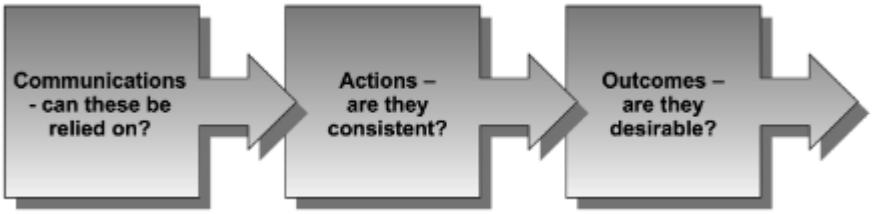

Figure 2.3: Key trust emerging concepts (Khalfan et al., 2007)

development of inter-organizational trust. This is in line with the findings of Schilke and Cook (2013) who found that interpersonal trust can lead to the reinforcement of inter-organizational trust through a diffusion process between the different contextual layers. This positive correlation between interpersonal trust and inter-organizational trust is also proven by Ashnai et al. (2016) albeit in a general business relationship and not in construction design teams. Guo et al. (2021) researched the effect of interpersonal ties on inter-organizational trust between the team member and team leader role. In this research they found that both cognitive and affective trust, which are types of interpersonal trust, influence inter-organizational trust in construction projects. They stated that the reason for this was the prove of competence and affective care by multiple individuals in a company which results in an increase of inter-organizational trust for the specific organization as a whole.

As described, ties are an important factor in the development of trust within teams. Which ties are present in construction design teams and how these ties affect trust according to literature is elaborated upon in the next section.

2.3. Ties

The concept of ties is investigated in this section. First the concept of ties in inter-organizational construction design teams is described in section 2.3.1. Then the different types of ties are elaborated upon in section 2.3.2. Finally, influence of ties on trust is examined in section 2.3.3.

2.3.1. Ties in inter-organizational construction design teams

There are many definitions in literature for teams. This research uses the definition by Albanese and Haggard (1993), who define a team in the construction sector as "a group of people sharing a common mission or reason for working together, interdependent in effectively achieving the shared goals, and sharing a commitment to working together toward identifying and solving problems." Inter-organizational teams specifically refer to "a team which is made up of representatives from the owner, designer, and/or contractor organizations that are involved together in producing the results" (Albanese and Haggard, 1993). The focus of this research is on inter-organizational design teams in the Dutch construction industry. The design teams which are approached for the survey are design teams active in the building construction industry. As projects vary, the members of design teams vary. However, as in line with the definition by Albanese and Haggard (1993) the design teams will consist of at least a client/owner, designer/architect and contractor. Other members like a structural engineer and/or installation technician could also participate in the design team. This potentially large amount of design team members coming from a multitude of organizations play different roles in the design team. Their specialities vary and in order to reach the common goals these specialities have to be combined. This requires a high level of interaction between the members (Galaz-Delgado et al., 2021). These interactions can take place in only one project, but also in multiple projects when the organizations have long history or expected future with regards to their collaboration. As the interactions of individual members of the design teams are reviewed, the focus of this research is laid on interpersonal ties. These are ties between individuals. The definition for interpersonal ties, that is used in this research is that of Huang et al. (2016); "Interpersonal ties refer to the subjective perception of interpersonal social interaction due to inter-organizational cooperation in construction projects." The ties which the design team members develop are elaborated upon in this section. Moreover, the effect of these ties on trust in the design teams are reviewed with the use of relevant literature.

2.3.2. Types of ties

The members of inter-organizational design teams in the construction industry can develop a wide variety of ties. These ties can be solely based on professional interactions but also social or family based. In this research the focus is laid on interpersonal prior and future ties. Prior ties are interactions that have occurred before the current collaboration took place. Future ties on the other hand are expectations of collaboration in the future. To place it in the context of the inter-organizational design teams in the building construction industry, a future tie occurs when a designer knows that he/she will col-

laborate with the same person in a future project. This knowledge about potential future interactions may or may not have an influence on the trust between this designer and the design team members. Poppo et al. (2008) defined this in their research as trust emerging from the 'shadow of the past' and the 'shadow of the future' which are prior ties and future ties respectively. Poppo et al. (2008) states that the shadow of the past and the shadow of the future are intertwined as the contributors to trust. When the experience of individuals with each other develops over time this may lead to expectations of continuity. However, when no future collaboration is expected, the expected way of working may be deviated from to reach the individual benefit instead of the shared goals. Hence, potential mutual effect of prior and future ties will also be taken into account in this research.

2.3.3. Influence of ties on trust

As can be seen in table 2.2, there are multiple factors contributing to interpersonal trust. A factor that is mentioned in several queried literature, is the effect of prior ties on interpersonal trust. Wang et al. (2017) mention in their research that due to the social nature of trust, the existence of prior ties breeds interpersonal trust as interpersonal connections are already developed. This notion is supported by Buvik and Rolfsen (2015) and Guo et al. (2021) who mention the more aligned philosophy and improved communication respectively as a result of prior ties. Maurer (2010) adds to this that the increased opportunities to interact between team members results in behavioural expectations between the team members. According to Maurer (2010), do these qualities result in a higher level of interpersonal trust within the team. The effect that prior ties have on inter-organizational trust is researched by Lee and Chong (2021), Guo et al. (2021). Their findings are in line with the statement that prior ties result in more flexibility regarding inter-organizational issues and the resolving of conflicts. Moreover, as stated by McDermott et al. (2005), Noordin et al. (2012) and Guo et al. (2021), interpersonal trust can result in inter-organizational trust. Thus, interpersonal trust originating from prior ties could increase the amount of perceived inter-organizational trust by design team members.

It should be noted that all of the mentioned literature has not researched the effect of prior ties on trust in the context of inter-organizational design teams in the Dutch construction industry. However, as mentioned by Mayer et al. (1995), trust is a concept that relates to the mental state within a person's character which may lead to trusting behaviour. Moreover, due to the characteristics of design teams, team members only have a short time span to get to know each other. This makes trust development more difficult (Svalestuen et al., 2015). It is therefore expected that prior interactions and the resulted interpersonal ties improve the development of trust. It therefore seems that the contextual differences between this research and that of the queried literature are not expected to influence the trusting behaviour in such a way that the effect of prior ties on trust changes. Therefore, it is hypothesized that prior ties in construction design teams positively affect interpersonal and inter-organizational trust.

H1: Prior ties in construction design teams have a positive effect on interpersonal and inter-organizational trust.

Poppo et al. (2008) and Chen et al. (2018) researched the effect of expected future collaboration between organizations, or future ties, on inter-organizational trust. They found that when team members

expect that they will work together again in the future, the levels of inter-organizational trust increase as team members do not expect self-interested behaviour. The short term payoff of self-interested behaviour does not outweigh the long term benefits of trustworthy cooperation (Poppo et al., 2008). The research by Poppo et al. (2008) and Chen et al. (2018) however, does not consider the effect that future ties have on the trust between individuals. The expectancy of future collaboration between individuals is the focus of this research. This could come into play when companies have an agreement to work together on future projects. The employees of these companies would then expect that they will work together on future projects. Due to this expected future collaboration between the individuals, the employees may think that their team members will disregard self-interested behaviour as this may affect their future collaboration. Due to these findings, it is hypothesized that future ties in the construction design teams have a positive effect on interpersonal and inter-organizational trust.

H2: Future ties in the construction design teams have a positive effect on interpersonal and inter-organizational trust.

Research by Poppo et al. (2008) did also look at the relationship between prior ties and inter-organizational trust. They found that prior ties did not have a direct effect on the levels of trust. It only increased the positive effect that expectations of continuity have on trust due to the learning effect between the organizations. Moreover, the notion that expectancy of future collaboration results in a belief in trustworthy behaviour from the other party according to Poppo et al. (2008). When relating this to the definition of trust proposed by Mayer et al. (1995), it directly relates to the mental state of the trustee resulting in trusting behaviour. The effect that prior ties have on trust according to the queried sources all relate to improved team qualities and processes like open communication, clear role expectations and more efficient resolving of conflicts which in return result in interpersonal or inter-organizational trust. The hypothesis about the relative effect of prior and future ties on interpersonal and inter-organizational trust corresponds therefore with the research by Poppo et al. (2008), which states that expectations of continuity are the main contributor to trust.

H3: Future ties have a more significant positive influence on interpersonal and inter-organizational trust than prior ties.

Lastly, most research suggests that the influence of prior ties and future ties is predominantly positive. However, according to Sorenson and Waguespack (2006) this is not always the case. They argue that due to the prior interactions, the members of teams could hold biases with regards to the competences of the other members of the team. Potential overestimates could result in disappointments which will reduce in a loss of trust in the team members. When looking at the inter-organizational level, Jap (2005) found that as close relationships are built on expectations of benefits, the organizations will only continue this collaboration if it stays beneficial. When a deviation is made, it could immediately result in a decrease of inter-organizational trust. Current studies on the effect of prior and future ties on trust predominantly infer that these ties result in trust development in teams. Some studies differ from this perception, like Sorenson and Waguespack (2006), which state that biases regarding competences could result in trust reduction. Empirical research on the relationship between ties and trust helps test the stated hypotheses and unravel the true impact that prior and future ties

have on trust in inter-organizational construction design teams.

2.4. Virtual meetings

Virtual meetings are investigated in this section. First, the virtual meetings in inter-organizational design teams are inspected in section 2.4.1. After that, the influence of virtual meetings on trust is examined in section 2.4.2.

2.4.1. Virtual meetings in inter-organizational construction design teams

The COVID-19 pandemic has changed the way teams meet and work together. Organizations changed from an office based work environment to a virtual environment. This resulted in virtual meetings between employees at the same company, but also between inter-organizational teams (Prasetyo et al., 2022). In the Netherlands, the government imposed a policy which said that workers had to work at home as much as possible. Therefore the amount of virtual meetings increased enormously (Karl et al., 2022). Virtual meetings provide a platform for people to stay connected despite physical and geographical constraints (Prasetyo et al., 2022). Virtual meeting platforms like Zoom, Microsoft Teams en Google meet were utilized widely in organizations to keep business processes going (Prasetyo et al., 2022). The empirical analysis performed in this research focuses on construction project in the Netherlands taking place after the start of the COVID-19 pandemic. This means that these projects could have been impacted by the COVID-19 restrictions. The construction design teams in this research therefore could have experienced a certain amount of virtual meetings during the course of their projects. This chapter will describe the effect of virtual meetings on teams according to literature.

Before the pandemic, virtual meetings were already used in practice to facilitate cooperation between geographically dispersed teams. However, the difference is that before COVID-19, the use of virtual meetings was essentially a choice. This choice was made by companies who wanted to access globally dispersed talents or experts regardless of their location (Aissa et al., 2022, Chamakiotis et al., 2021). Besides, individuals could also make the choice to work with the use of virtual meetings, as it could satisfy their need to work flexibly (Chamakiotis et al., 2021). Research on the effect of virtual meetings on teams had also already been performed before the pandemic. These papers primarily focused on Virtual Teams. Virtual Teams are frequently defined as "groups of geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task" (Hacker et al., 2019). Virtual teams not only use virtual meetings platforms but also use other systems to work together efficiently in a virtual environment (Hacker et al., 2019). However, the definition by Hacker et al. (2019) implies that teams can be virtual or not. Is does not leave room for a certain level of virtuality. Teams could both work together in a virtual and face-to-face environment on one specific project. It is therefore important to measure both the amount of virtual meetings and the amount of face-to-face meetings in order to find their influence (Choi and Cho, 2019). To add to this, Aissa et al. (2022) mentions that not only the quantity but also the quality of virtual meetings plays a central role in virtual teams. This is in line with the research of Prasetyo et al. (2022). In their research the perceived effectiveness of virtual meetings during the COVID-19 pandemic under Filipino professionals was analyzed. The effectiveness was

categorized by the perceived effectiveness of virtual meetings as a collaboration tool and the perceived effectiveness of virtual meetings as a social tool. Prasetyo et al. (2022) found that in terms of being a collaboration tool, virtual meetings were seen as effective however, the meetings lacked in the ability to teach and learn. It was perceived that it was difficult to demonstrate or observe certain tasks virtually. The perceived effectiveness of virtual meetings as a social tool on the other hand, was neutral. The Filipino professionals found it difficult to maintain casual conversations when their collaboration switched to the virtual environment.

In this research the effect of virtual meetings is analyzed. Thus, no other means of virtual collaboration by virtual teams is considered. The quantity of virtual meetings is measured and their effectiveness as a social tool and a collaboration tool is taken into account.

2.4.2. Influence of virtual meetings on trust

Shahzad and Imran (2021) conclude in their research that inter-organizational trust can become fragile during uncertain situations like the pandemic. How companies and individuals react to these changes determines fragility or resilience of the organization. It is therefore important to develop or at least maintain the levels of trust between the organizations (Shahzad and Imran, 2021). Also, Choi and Cho (2019) found that the trust is crucial for teams working in the virtual context since interactions on the virtual meeting platforms tend to be very impersonal and superficial. When trust is present this improves collaboration within the team and increases the potential for team success (Choi and Cho, 2019). Therefore, to increase trust in teams working in the virtual context, Choi and Cho (2019) state it is necessary to focus on the development of interpersonal connections within the team. Interpersonal connections are however not solely influencing the amount of trust. The knowledge regarding the systems through which virtual meetings are organized is also a key element in the development of trust. Moreover, team members should comprehend why the meetings should take place and what the goals of these meetings are Choi and Cho (2019).

In the literature review performed by Hacker et al. (2019), options to create and maintain trust in virtual teams are proposed. Hacker et al. (2019) mentions that allowing team members to share social experiences on an online platform could develop a shared context which increases the levels of trust in the teams. Also, arranging face-to-face team building meetings will develop shared understanding between team members. Aissa et al. (2022) also concludes in their research that the lack of face-to-face interactions makes trust development between team members difficult. Moreover, it could lead to an insufficient tacit knowledge sharing and task coordination within the team. This weakened trust development comes from a lack of shared understanding and social context. It is therefore essential for virtual teams to develop this social context and interaction (Aissa et al., 2022). Especially if the team members do not have prior experiences or did not had the chance to participate in team building exercises, this shared understanding could be absent. During the COVID-19 pandemic, social face-to-face get-togethers were often not possible. Face-to-face team building sessions were therefore no option. The social context and interpersonal interaction could only be developed in the virtual environment. Positively experienced and effective meetings can foster interpersonal trust between team members

(Aissa et al., 2022). Rogers et al. (2021) empirically researched how workers' reactions differ in virtual or face-to-face contexts. They concluded that the presence of social ties exert a higher influence on teams working in the virtual context. In the face-to-face context on the other hand, workers predominantly rely on the perceptions on the skills of their peers. Rogers et al. (2021) suggests that it originates from the expectancy of virtual team members that their peers should do their best to overcome the digital divide.

When combining insights of the investigated literature a shared opinion about the effect of virtual meetings on trust can be found. Namely, the investigated literature agree that virtual meetings have a detrimental effect on the amount of trust between team members. The interpersonal or inter-organizational trust within a team, originating from prior or future ties, is thought to reduce when the frequency of virtual meetings is high. It is therefore hypothesized that a higher amount of virtual work-related meetings negatively moderates the positive effect of prior ties and future ties on interpersonal and inter-organizational trust.

H4: A higher amount of virtual work-related meetings has a negative influence on the positive effect of prior ties and future ties on interpersonal and inter-organizational trust.

Moreover, as can be derived from Aissa et al. (2022) and Rogers et al. (2021), social meetings seem to have a positive effect on interpersonal trust. Furthermore, as interpersonal trust is a known contributing factor to inter-organizational trust, it is hypothesized that social meetings positively moderate the effect of prior ties and future ties on both interpersonal and inter-organizational trust.

H5: A higher amount of social meetings positively moderates the effect of prior ties and future ties on interpersonal and inter-organizational trust.

2.5. Summary

This literature review has examined the importance and specifics of trust and ties within inter-organizational design teams. Understanding has been developed considering the different types of trust and the factors contributing to trust in the construction industry. The types of ties are specified and their effect on trust is stipulated. As the context of this research is affected by the COVID-19 pandemic, the impact of virtual meetings on the relationship between ties and trust within the design teams is also considered.

The context of this research considers the interpersonal ties between members of inter-organizational teams, therefore trust is decomposed into interpersonal trust and inter-organizational trust. Interpersonal trust consists of cognitive trust and affective trust. Inter-organizational trust is further decomposed as competence trust, integrity trust and intuitive trust. The performed literature review has told us that the factors contributing to trust on the interpersonal or inter-organizational level are related to communication, actions or outcomes. The importance of interpersonal trust for design teams mainly comes from the enhancement of open communication and information sharing between team members. The benefits of inter-organizational trust predominantly arise from easy resolving of conflicts and efficient business transactions.

The interpersonal ties that are examined in this research are prior ties and future ties. Prior ties are interactions that have occurred before the current collaboration takes place. Future ties on the other hand are expectations of collaboration in the future. A beneficial effect of experienced prior ties and potential future ties on the trust development in teams has been found. Prior ties for help to develop a shared understanding between team members, while potential existing future ties reduce opportunistic behaviour. On the other hand, literature available on the effect that virtual meetings have on trust correspond to the notion that the levels of trust within teams could be at risk by a lack of social interaction. Interpersonal connection development could resolve this issue.

The stated findings of the literature review enabled the development of hypotheses regarding the inter-relatedness of the research concepts. The hypothesized relationship between ties and trust is a direct relationship in which ties are the independent variable and trust is the dependent variable. Virtual meetings on the other hand, are hypothesized to have an impact on the relationship between ties and trust. The concept of virtual meetings is therefore taken as a moderating variable. Figure 2.4 shows the relationships between the independent, dependent and moderating variables.

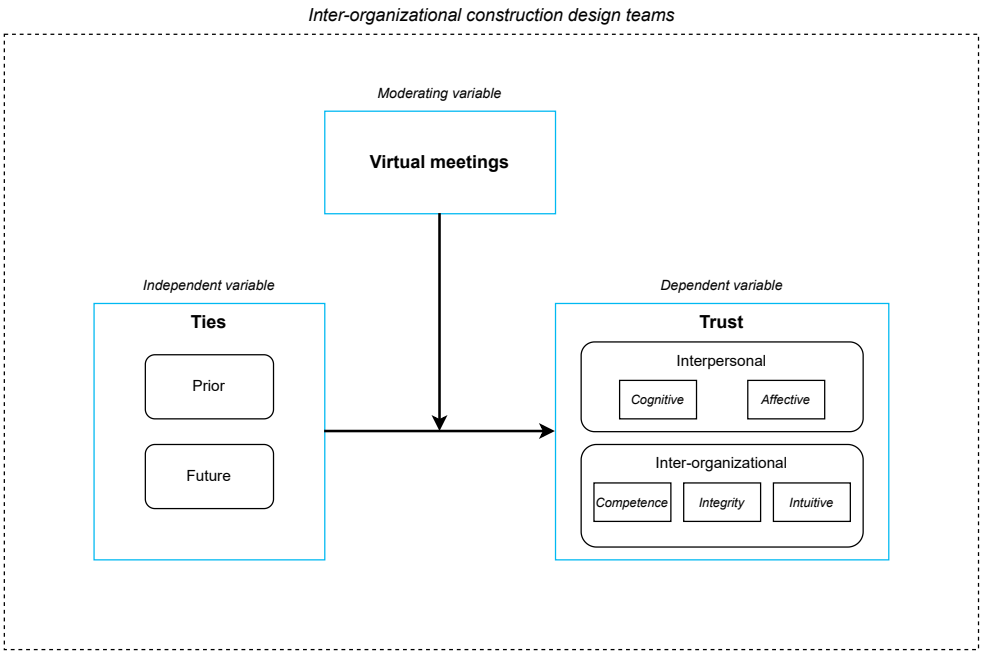

Figure 2.4: Variables overview

3

Methodology

3.1. Research method

The method used for answering the research question and finding the relationships between the independent, dependent and moderating variables as displayed in figure 2.1, is a mixed research method. This means that use is made of both qualitative and quantitative analysis (Creswell, 1999). The first stage of the mixed research method is performed in the literature review which can be found in chapter 2. The relationships between the variables that are discovered in the literature review are used to develop hypotheses. In order to test the hypothesis of chapter 2, a survey is designed in section 3.3. The survey provides data related to the relationships between the variables. Moreover, it enables investigation of other factors that might influence these relationships. By analyzing the data generated by the survey, the developed hypotheses are tested in chapter 4. The survey analysis enables the investigation of the exact direct relationships between the independent and dependent variables. Moreover, it facilitates the analysis of potential moderating effects on the relationships between the independent and dependent variables. The quantitative additions of the survey analysis facilitate a holistic understanding of the studied relationships (Baxter, Jack, et al., 2008). The results of the literature review and the survey analysis are compared in the discussion of this research in chapter 6. A schematic overview of the research method is displayed in figure 3.1.

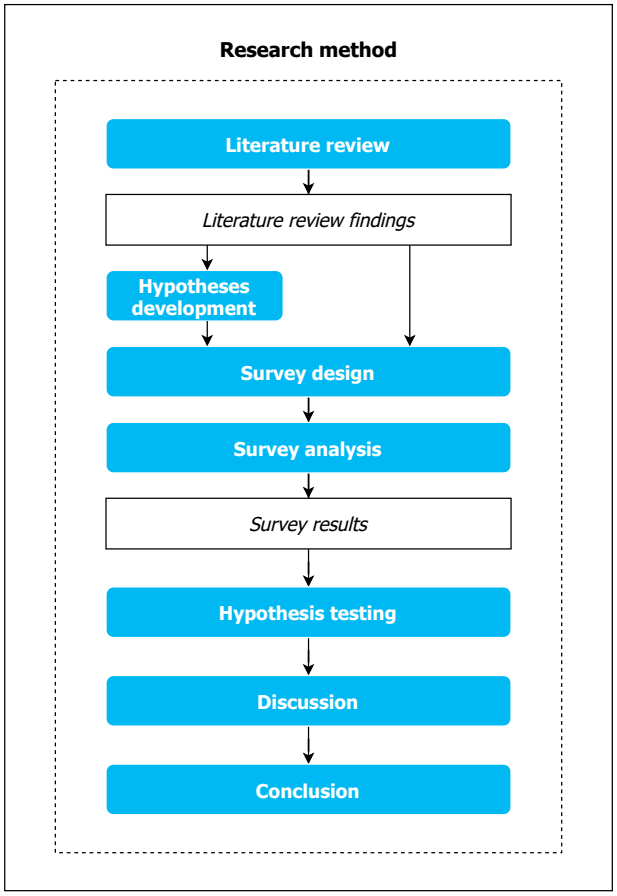

Figure 3.1: Research method

3.2. Data Analysis Method

The data retrieved with the survey is analyzed with the use of SPSS. In SPSS it is possible to display the demographics of the respondents and identify the direct effects between the independent and dependent variables. This direct effect is analyzed with the use of correlation analysis. The correlation analysis is a statistical model that finds potential relationships between variables and indicates how strong the relationship is (Field, 2013). The relationship may be negative, positive or not related at all. When there is a positive correlation between the independent and dependent variable, it means that when the independent variable increases this results in an increase in the dependent variable. When the relationship is negative, an increase in the independent variables results in a decrease in the dependent variable. The correlation analysis allows quantitative research on the effect of ties on trust in inter-organizational design teams.

The potential moderating effect of the moderating variables on the relationship between the independent and dependent variables is analyzed by using the PROCESS macro. PROCESS is a custom dialogue box which is a macro that can be downloaded and implemented in SPSS (Field, 2013). The PROCESS macro enables the possibility to find moderating effects between variables. The PROCESS macro computes multiple regression analyses to find the moderating effect of a certain variable on the effect between the independent and dependent variables. A moderating effect is described as a

variable that changes the strength and/or direction of the relationship between the independent and dependent variable (Field, 2013). The effect of this moderating variable is also called the interaction. In order to find the specific interaction effect of this moderating variable the interaction needs to be centered around a fixed point. This fixed point is the grand mean of the moderating variable. By centring the moderating variable around this fixed point, a difference can be observed between the effect of a high, medium and low value of the moderating variable. Thus, enabling to find how strong the interaction effect is of a certain moderating variable. The PROCESS tool does this centring automatically. PROCESS typically takes the grand mean of the moderating variable values and states the upper and the lower bound as one standard deviation above and below the mean (Field, 2013).

The book of Field (2013) is used to perform the correlation and PROCESS analysis and ensure that the data is prepared correctly and reliable. The results of the analysis can be found in chapter 4. These results are used to test the developed hypothesis. It has to be mentioned that the hypothesis testing is performed by only using the results of the survey analysis. The comparison of the findings in the literature review and the survey analysis results is performed in the discussion of this research.

3.3. Survey design

The research survey consists of multiple open and closed questions. Closed questions enable more efficient analysis while open questions prevent limiting the amount of answers that can be provided by the respondents (Field, 2013). The variables relating to the independent, dependent and moderating variables are all measured on an ordinal Likert scale. This Likert scale is used to rate the degree to which survey participants agree with statements (Sullivan and Artino Jr, 2013). These statements relate to the relationships between the variables. The ordinal scale enables the use of statistical tests that are performed in the analysis (Field, 2013). There are also sample characteristics that indicate the background and demographics of the sample population. The sample characteristics are analyzed with a variation of open and interval questions.

In order to find the relationships between the concepts, the concepts first have to be translated into measurable variables. These operationalizations are based on examples of existing measures found in current literature. The examples are subsequently altered to fit in the context of this research. Before the survey is send out under the sample population, it is tested with the use of a pre-test. This pre-test reviews the comprehensibility of the survey questions and the suitability for the context of this research. The pre-test is executed under three students and two junior project managers. This pre-test resulted in adjustments related to the choice of words, sentence structure and completeness of background information. The operationalizations of the concepts are described in this section. The findings in literature that form a basis for these variables are stated and the resulting survey questions are displayed.

3.3.1. Operationalization of concepts

Independent variables

The operationalization of the independent variables; prior and future ties are composed with the use of research by Chen et al. (2018). The items related to these variables can be found in table 3.1. The research by Chen et al. (2018) explores the effect that prior ties have on contract enforcement in construction projects. However, Chen et al. (2018) considers the inter-organizational ties between the parties. Therefore, the measures Chen et al. (2018) are adjusted to fit the interpersonal ties that exist between design team members. Prior ties, or past collaboration between individuals, are measured with the use of the item "PT1". The "PT1" item considers the amount of times someone has worked together before including the possibility to have zero prior ties. Thus indicating the quantity of prior ties. Moreover, as the mere existence of prior ties is relevant for analysis, the data of item "PT1" is subsequently used to construct a new variable "PT0or1". This item has two outputs, namely 0 and 1, which relate to the nonexistence and existence of prior ties respectively. As the composition of design teams varies from project to project, no question is asked regarding how many of the design team members have had previous collaboration. Item "PT1" therefore indicates the overall level of prior ties throughout the whole design team.

The expectancy of future collaboration on the other hand is measured by the item "FT1". "FT1" considers the expectancy of future collaboration with the current design team members by individuals that fill in the survey. "FT1" describes the concept of future ties. This item originates from research by Chen et al. (2018). However, it is adapted to fit the interpersonal context of the ties considered in the current research. The item "FT1" is measured with a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree". As can be seen in appendix D, item "FT2" was added to the survey. This item is used to measure the willingness of one to collaborate again in the future with his/her design team members. However, the willingness to collaborate in the future does represent expected future collaboration. It is therefore decided to leave item "FT2" out of the analysis.

Table 3.1: Independent variables

Label	Question	Answer options
PT1	How many times have you worked before with these design team members	0 times / 1-2 times / 3-5 times / more than 5 times
FT1	I expect future cooperation between the design team members and me.	Strongly disagree / Somewhat disagree / Neutral / Somewhat agree / Strongly agree / Do not know

Dependent variables

Research by Guo et al. (2021) investigated the effect of interpersonal ties on trust in construction projects by comparing the role differences in teams. The operationalization of Guo et al. (2021) considers the same categorization of trust as the current research. The items constructed by Guo et al. (2021) are therefore used to measure the dependent variables of interpersonal and inter-organizational trust. However, the use of words is slightly adjusted to make the items more clear for the participants. Table 3.2 shows the items relating to each trust categorization. As can be seen, trust is divided into interpersonal and inter-organizational trust. The interpersonal trust consists of affective and cognitive based trust, while inter-organizational trust is made up of competence, integrity and intuitive based trust. Each trust type has three or four items which measure the amount of trust with a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree".

The items that relate to interpersonal and inter-organizational trust are combined to form the variables IPT_full and IOT_full respectively. When combining items to form a new variable, the reliability of this new variable should be analyzed. The method used to analyze this reliability is by calculating the Cronbach's alpha reliability coefficient. The Cronbach's alpha reliability coefficient measures the consistency of items in a variable. In other words, it looks at how closely related the items are (Field, 2013). A threshold value which is commonly used for the Cronbach's alpha value is 0.7. If the Cronbach's alpha value of a certain variable is above 0.7, the variable is reliable and can be accepted. The variable of interpersonal trust (IPT_full) is constructed by combining the items IPTA1, IPTA2, IPTA3, IPTC1, IPTC2, IPTC3 and IPTC4. The accumulated value is then divided by the total number, which are 7, items. This results in the mean value. By taking the mean value of the interpersonal trust items, a generalized view of the amount of interpersonal trust is provided. When using SPSS to find the Cronbach's alpha of the new variable IPT_full, the reliability coefficient is determined as 0.728 thus exceeding the threshold value. IPT_full passes the reliability test and can be used for analysis. The inter-organizational trust variable (IOT_full) on the other hand, is constructed by combining the items IOTC1, IOTC2, IOTC3, IOTIY1, IOTIY2, IOTIY3, IOTI1, IOTI2 and IOTI3 (see 3.2). The accumulated value is then divided by nine, which results in the mean value. The Cronbach's alpha of the new variable IOT_full, is 0.870 thus exceeding the threshold value. IOT_full also passes the reliability test and can be used for analysis.

Table 3.2: Dependent variables

Label	Type	Question
IPTA1	Interpersonal - Affective	Within the design team we had a sharing relationship. We could all freely share our ideas, feelings, and hopes.
IPTA2	Interpersonal - Affective	I could talk freely to my design team members about the difficulties I had at work and know that they wanted to listen.
IPTA3	Interpersonal - Affective	I would have to say that my design team members and I, have all made considerable emotional investments in our working relationship.
IPTC1	Interpersonal - Cognitive	My design team members approached their job with professionalism and dedication.
IPTC2	Interpersonal - Cognitive	My design team members were very capable of performing their job.
IPTC3	Interpersonal - Cognitive	I could rely on my design team members not to make my job more difficult by careless work.
IPTC4	Interpersonal - Cognitive	Given my design team members' track records, I saw no reason to doubt their competence and preparation for the job.
IOTC1	Inter-organizational - Competence	During the project, the other participating organizations were professional and dedicated.
IOTC2	Inter-organizational - Competence	The staff of the other participating organizations were competent.
IOTC3	Inter-organizational - Competence	The results the other organizations have achieved in the project were within its sphere of competence.
IOTIY1	Inter-organizational - Integrity	The other participating organizations were credible and integrate throughout the project.
IOTIY2	Inter-organizational - Integrity	The other participating organizations strictly adhered to ethical standards during the project.
IOTIY3	Inter-organizational - Integrity	The other participating organizations always cared about our interests and will not easily cause our interests to suffer losses.
IOTI1	Inter-organizational - Intuitive	During the project, my "intuition" told me that we could deal with the other participating organizations with ease.
IOTI2	Inter-organizational - Intuitive	During the project, I was able to foresee that our cooperation with the other participating organizations would achieve good results.
IOTI3	Inter-organizational - Intuitive	During the project, I felt I could trust the other participating organizations employees.

Moderating variables

The moderating variables in this research represent the presence and quantity of virtual work-related meetings and social meetings. Research of Aissa et al. (2022) investigated the effect of virtual teams on creative processes. The items related to virtual meetings in the research of Aissa et al. (2022) formed the basis for the variables that are used in the current research. Item "VMW2" represents the amount of virtual work-related meetings in the design team. This item is answered by a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree".

No items related to the quantity of social meetings have been found in the literature review. The items that represent the social meetings in the design teams are therefore constructed in consultation with Drees & Sommer Netherlands and the supervisors of this research. The items "VMS1" and "VMS2" represent the amount of social virtual and social face-to-face meetings respectively. The items are constructed in a similar style as the other moderating variables and are answered with the same 5-point Likert scale.

As can be seen in appendix D, the survey contains more items relating to potential moderating relationships. However, it has been decided to not use these items for analysis as they do not represent the main focus of this research and do not relate to the stated hypotheses.

Table 3.3: Moderating variables

Label	Type	Question
VMW2	Virtual work-related - Quantity	We often had online work-related meetings with the design team.
VMS1	Face-to-face social meetings - Quantity	We often had face-to-face social meetings, such as coffee breaks, lunches, teambuilding activities, etc.
VMS2	Virtual social meetings - Quantity	We often had online social meetings, such as digital coffee breaks, online pubquizzes, etc.

3.3.2. Sample characteristics

The sample characteristics are analyzed to provide a view of the demographics of the research sample. The selection of analyzed characteristics is displayed in table 3.4. It has to be mentioned that this list is not exhaustive as there may be other sample characteristics that can represent the demographics of the sample population. Still, the sample characteristics chosen for this research are expected to give a broad view of the background of the survey participants and the projects that they have participated in. Table 3.4 shows the labels, questions and answer options of the survey questions related to the sample characteristics. As can be seen the participants are asked to provide the name of the project, the used contract type and the design phase that they participate in. When analyzing the answers to these questions, it can be determined if the sample population provides a broad view on construction

design teams in general. For example, when only a few projects or contracts are represented in the sample population, it could affect the generalisability of the results of this research. Specific factors of these projects, contracts or design phases may influence the effect of ties on trust. Similarly, the work experience, and personal and organizational role of the design team members are considered as these differences might affect the results of the analysis. For example, when only a few roles are represented this would only provide information about the effect that ties have on trust according to individuals and organizations with these roles in the design teams.

Table 3.4: Sample characteristics

Label	Question	Answer options
C1	Which project design team did you participate in?	Open answer
C2	In which phase did you participate in the design process?	The sketch design phase / The preliminary design phase / The final design phase / The technical design phase / Do not know
C3	Which contract type was used between you and the client in the project?	Open answer
C4	What was your role in the design team? Client, designer, project manager, technical advisor, financial advisor, etc.	Open answer
C5	What was the role of your organization?	Designer/architect / Contractor / Project/process manager / Consultant / Client / Other
C6	How many years of work experience do you have?	0 - 5 years / 5 - 10 years / 10 - 15 years / 15 - 20 years / More than 20 years

3.4. Sample and data collection

3.4.1. Target population

The target population of this survey includes workers in the Dutch construction industry that participate in inter-organizational building construction design teams. Moreover, the target population considers each role in the design team. The scope of the research considers current or recently finished design phases and could therefore have been affected by the COVID-19 pandemic. The current research is supported by Drees & Sommer Netherlands. The employees of Drees & Sommer are asked to fill in the survey for multiple design teams that they have participated in. However, as the employees of Drees & Sommer Netherlands only participate in design teams as project managers this would only provide a one sided view of the effect that ties have on trust. In order to ensure that the whole spectrum of this effect in inter-organizational design teams is explored, the employees of Drees & Sommer Netherlands are asked to distribute the survey to the members of the design teams that they participate in or have participated in. As these project managers participate in inter-organizational design teams, their design team members work for other organizations. Thus, resulting in responses from

individuals that do not work for Drees & Sommer Netherlands.

3.4.2. Data collection

The data is collected by using the online survey platform Qualtrics. To safely store the collected data, the responses are transferred to the TU Delft webdrive. The survey is provided in English and Dutch to ensure that the questions are understandable for every design team member in the target population. The translation is checked by the supervisors of the current research and fellow students. At the beginning of the survey, an introduction is provided. This introduction gives background information and states the main purpose of the survey. Moreover, it is made clear to the participants that the survey responses are kept confidential and handled anonymously. IP address tracking is disabled in Qualtrics to ensure anonymous responses. The participants are never asked to provide personal information, but using their responses on certain sample characteristics could identify which individual filled in the survey. It is therefore important to ensure that the individual responses are kept safely and can only be accessed by the researcher that received the consent from the participants. The Human Research and Ethics Committee of the TU Delft approved the methods used in this research.

3.5. Statistical data preparation

Before the survey results can be analyzed, the data is cleaned and the data is checked for suspicious responses. The software used for this process is SPSS. The survey is sent out to 132 individuals and received 65 initial responses. Thus resulting in a response rate of 49%. However, 16 of these responses are not usable as they are only filled in for 20%. The participants that filled in the survey for 20% or less only answered the questions regarding the sample characteristics and quit the survey when answers regarding the relationships between the variables started. Thus, these 16 responses are removed from the data set. This results in a final response quantity of 49.

In order to ensure that no response patterns are present, the results are checked for straight lining and diagonal lining. To check straight lining incidents, the variance of each response is measured. If the variance of this response is close to 0, it is possible that straight lining happened. In the data set of this research, no straight lining incidents are observed. When verifying potential diagonal lining, each response is individually examined by the researcher. During this examination, no diagonal lining incidents have been observed. Moreover, the 49 usable responses contain no missing data. Thus, the analysis is continued with 49 usable responses.

4

Results

4.1. The survey results

The results of the survey are displayed in this chapter. An overview is provided regarding the descriptive statistics of the survey analysis in section 4.2. The results of the direct effects between the variables are stated in section 4.3. Finally, the moderating effects are elaborated upon in section 4.4 which provides the necessary information to test the hypothesis in section 4.5.

4.2. Descriptive statistics

The descriptive statistics of the sample characteristics, independent variables and moderating variables are summarized in this section.

Outliers are not checked in the data of the current research. Outliers in sample data, show scores that are very different from the rest of the answers and lies at an abnormal distance from other values in the distribution. An outlier is described as a value that falls below or above one standard deviation from the mean (Field, 2013). However, as this research considers data from multiple different design teams, a score that is very different from scores measured in other projects does not mean that it is abnormal. It is related to a different project and design team which may result in a significantly different value. Thus, the outliers are not considered in the survey analysis.

4.2.1. Sample characteristics

Projects

The respondent of the survey are asked to fill in the project in which they have participated in a design team. As displayed in figure B.2 of appendix B, the sample population participated in 34 different projects. The project names, in figure B.2, are changed into numbers in order to ensure the anonymity of the respondents and potential confidentiality of project partnerships. The highest frequency respondents participating in a single project is 4. Thus, a wide range of design teams is surveyed.

Contract types

As displayed in table 4.1 the respondents gave varying answers on the question related to the used contract type between the design team and the client. Some of these answers consider the model agreements or terms and conditions in contracts like UAV-GC and 'De Nieuwe Regeling' (DNR) respectively. Answers that do relate to contract types show that the Design and Build contract type is used most by the investigated design teams. This contract type has a frequency of 9 and a percentage of 18.4%. However, as there is no uniform interpretation of this item by the respondents it does not provide a valid representation of the sample characteristics related to used contract types.

Table 4.1: Contract types used by the design teams

Type	Frequency	Percent	Cumulative percent
Bouwteam	1	2.0%	2.0%
Design and Build	9	18.4%	20.4%
DNR	29	59.2	79.6
Engineer and Construct	2	4.1%	83.7%
EPCM	1	2.0%	85.7%
Traditional	4	8.2%	93.9%
UAV-GC	3	6.1%	100%
Total	49	100%	100%

Personal and organizational role

As can be seen in table 4.2, a considerable large amount of the respondents has the role of the project manager (71.4%). The next largest group of project roles is the role of the client with 8.2%. The same results apply to the role of the organization, which is displayed in figure B.3 in appendix B. Project/process manager and consultant organizational roles have a combined share of 77.5% of the whole sample.

Table 4.2: Overview of personal roles in design teams

Role type	Frequency	Percent	Cumulative percent
Architect	1	2.0%	2.0%
Client	4	8.2%	10.2%
Contractor	1	2.0%	12.2%
Designer	2	4.1%	16.3%
Firesafety advisor	1	2.0%	18.4%
Installation advisor	1	2.0%	20.4%
Project developer	1	2.0%	22.4%
Project manager	35	71.4%	93.9%
Technical advisor	3	6.1%	100%
Total	49	100%	100%

Work experience

When considering the work experience of the respondents, it is found that individuals with a relatively low (< 10 years) and relatively high (>20 years) are represented the most by the respondents. Individuals with work experience between 10 and 20 years are represented the least. The frequencies the work experience results can be seen in figure B.4 of appendix B.

Project phase

The survey participants are asked to fill in which phase of the design process they participated in. Multiple answers can be provided as respondents can participate in several phases of a design process. The results show that there is a fairly even distribution in design phases. The sketch and technical design phase are the least represented phases, but this difference is not considered as significant. The frequencies of the projects phases is displayed in figure B.2 of appendix B.

4.2.2. Independent variables

Prior ties

Prior ties are measured with the variables PT1 and PT0or1. PT1 indicates if prior ties are present and how many times these individuals have worked together before. PT0or1 only relates to the presence or absence of prior ties. Table 4.3 shows the frequency of the different responses. This shows that more than half (63.3%) of the respondents did not have prior ties in their design teams.

Table 4.3: Overview of prior ties PT1 (amount of times individuals have worked together)

Amount of times worked together	Frequency	Percent	Cumulative percent
0 times	31	63.3%	63.3%
1 - 2 times	11	22.4%	85.7%
3 - 5 times	5	10.2%	95.9%
More than 5 times	2	4.1%	100%
Total	49	100%	100%

Future ties

Future ties are measured using the variable FT1. FT1 is related to the expectancy of future collaboration with design team members according to the respondents. As can be seen in table 4.4 79.6% of the respondents agree with the statement that they expect future cooperation between them and their design team members.

Table 4.4: Overview of expectation future ties (FT1)

Opinion on statement that futures cooperation is expected	Frequency	Percent	Cumulative percent
Strongly Disagree	1	2.0%	2.0%
Somewhat Disagree	2	4.1%	6.1%
Neutral	7	14.3%	20.4%
Somewhat Agree	19	38.8%	59.2%
Strongly Agree	20	40.8%	100%
Total	49	100%	100%

4.2.3. Moderating variables

Virtual work-related meetings

The moderating variable VMW2 indicates the frequency of virtual work-related meetings. The statement "We often had virtual work-related meetings with the design team." is also answered with the 5-point Likert scale. As displayed in table 4.5, 75.5% of the respondents answered "Somewhat agree" or higher. This result seems logical as it is expected that many respondents worked predominantly online.

Table 4.5: Virtual work related meetings frequency (VMW2)

Opinion on statement whether individual had frequent virtual meetings	Frequency	Percent	Cumulative percent
Strongly Disagree	4	8.2%	8.2%
Somewhat Disagree	5	10.2%	18.4%
Neutral	3	6.1%	24.5%
Somewhat Agree	13	26.5%	51.0%
Strongly Agree	24	49.0%	100%
Total	49	100%	100%

Social meetings

The quantity of social meetings is measured using the variables VMS1 and VMS2. VMS1 relates to the amount of social face-to-face meetings. The statement used for VMS1 is "We often had face-to-face social meetings, such as coffee breaks, lunches, teambuilding activities, etc." As can be seen in table 4.6, there are only a few respondents who experienced social face-to-face meetings. VMS2 relates to the amount of virtual social meetings. The statement used for this variable is "We often had virtual social meetings, such as digital coffee breaks, online pubquizzes, etc." As displayed in table 4.7, five respondents did not answer "Somewhat disagree" or "Strongly disagree". This indicates that online social meetings did barely occur in the sample group.

Table 4.6: Overview of frequency social face-to-face meetings (VSM1)

Opinion on statement that frequent face-to-face social meetings occurred	Frequency	Percent	Cumulative percent
Strongly Disagree	24	49.0%	49.0%
Somewhat Disagree	15	30.6%	79.6%
Neutral	4	8.2%	87.8%
Somewhat Agree	5	10.2%	98.0%
Strongly Agree	1	2.0%	100%
Total	49	100%	100%

Table 4.7: Overview of frequency social virtual meetings (VSM2)

Opinion on statement that frequent virtual social meetings occurred	Frequency	Percent	Cumulative percent
Strongly Disagree	37	75.5%	75.5%
Somewhat Disagree	7	14.3%	89.8%
Neutral	2	4.1%	93.9%
Somewhat Agree	2	4.1%	98.0%
Strongly Agree	1	2.0%	100%
Total	49	100%	100%

4.2.4. Correlation between variables

The data set is analyzed using SPSS. The correlation between the dependent, independent and moderating variables is inspected and the results are depicted in table 4.8. Spearman rho is used for this correlation analysis because the data considers ordinal answers. Moreover, a two-sided analysis is chosen as this includes the possibility of finding both a negative and a positive influence of ties on trust. A one-sided analysis only looks at the increase or decrease (Field, 2013). The numbers in red show the significant correlation coefficients. ** shows significance on the p = 0.01 level (strong evidence) and * shows significance on the p = 0.05 level (moderate evidence). The p-value, or probability value, indicates the significance of the data. This significance can be explained as the probability that the null hypothesis is true. The null hypothesis predicts that no effect is present between variables or that the relationship between the variables is random. So when considering a threshold of p-value < 0.05, this means that there is less than a 5% chance that the null hypothesis is correct and there is no effect between the variables. A low p-value thus indicates a greater significance and therefore a stronger evidence for a relationship (Field, 2013). The correlation coefficient, on the other hand, the r-value, is the rate of covariance between elements. The height of the correlation coefficient represents the amount of correlation between the variables. The maximum and minimum of the correlation coefficient are +1 and -1 respectively. A correlation coefficient of +1 represents a perfect positive correlation, while a correlation coefficient of -1 shows a perfect negative correlation. When a positive value of the correlation coefficient is present between the independent and dependent variable, this indicates that when the value of the independent variable increases this increases the dependent variable. With a negative correlation, an increase in the independent variable will result in a decrease in the dependent variable. Correlation coefficients with a value of r=±0.1 relate to a small effect, r=±0.3 represents a medium effect and r=±0.5 shows a large effect (Field, 2013). The correlation coefficients may not exceed 0.8, as this is the threshold for multicollinearity. Multicollinearity occurs when independent variables correlate too much. This will result in interpretation issues as no distinction can be made between the effect on the dependent variables (Field, 2013). The correlation analysis is performed in order to test if there are significant relationships between the variables. If there is no significant relationship between two variables this means that moderation testing on this relationship will have no use. Thus, the correlation analysis tests potential significance before further investigation commences. The correlation overview of all variables and the items that they derive from is displayed in appendix B.2. As

can be seen in table 4.8, the variable of the amount of prior ties (PT1) and the existence of prior ties (PT0or1) have a correlation coefficient of 0.867, thus indicating multicollinearity. However, as these independent variables represent the same concept, this is expected and does not result in interpretation issues.

Table 4.8: Correlation matrix

Correlations											
	mean	st.dv.	Significance and correlation	PT1	FT1	PT0or1	VMW#2	VMS#1	IPT _full	IOT _full	VMS2
PT1	1.55	0.843	Correlation Coefficient (r)	1,000	0,085	,974**	-,365**	0,236	,308*	0,115	-0,025
			Significance (p)		0,563	0,000	0,010	0,103	0,031	0,431	0,865
FT1	4.12	0.949	Correlation Coefficient (r)	0,085	1,000	0,010	-,347*	,326*	0,202	,430**	-0,073
			Significance (p)	0,563		0,948	0,015	0,022	0,163	0,002	0,619
PT0or1	1.37	0.487	Correlation Coefficient (r)	,974**	0,010	1,000	-,384**	0,220	,337*	0,096	-0,054
			Significance (p)	0,000	0,948		0,007	0,128	0,018	0,510	0,714
VMW2	3.98	1.315	Correlation Coefficient (r)	-,365**	-,347*	-,384**	1,000	-,432**	-,428**	-0,226	-0,140
			Significance (p)	0,010	0,015	0,007		0,002	0,002	0,119	0,337
VMS1	1.86	1.080	Correlation Coefficient (r)	0,236	,326*	0,220	-,432**	1,000	,354*	,283*	0,275
			Significance (p)	0,103	0,022	0,128	0,002		0,013	0,049	0,055
IPT _full	4.04	0.56	Correlation Coefficient (r)	,308*	0,202	,337*	-,428**	,354*	1,000	,601**	0,104
			Significance (p)	0,031	0,163	0,018	0,002	0,013		0,000	0,479
IOT _full	4.12	0.58	Correlation Coefficient (r)	0,115	,430**	0,096	-0,226	,283*	,601**	1,000	0,013
			Significance (p)	0,431	0,002	0,510	0,119	0,049	0,000		0,928
VMS2	1.43	0.913	Correlation Coefficient (r)	-0,025	-0,073	-0,054	-0,140	0,275	0,104	0,013	1,000
			Significance (p)	0,865	0,619	0,714	0,337	0,055	0,479	0,928	

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

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

PT1 is the amount of prior ties

FT1 is the expectancy of future collaboration

PT0or1 is the existence of prior ties

VMW2 is the frequency of virtual work-related meetings

VMS1 is the quantity of social face-to-face meetings

IPTfull is the amount of interpersonal trust

IOTfull is the amount of inter-organizational trust

VMS2 is the quantity of social virtual meetings

4.3. Direct effect

The results of correlation analysis show the direct effect between independent, dependent and moderating variables. The direct effect between the different variables of this research is explored in this section. The correlation effect and the significance of the relationship are elaborated upon. The factors that may play a role in potential non-significant relationships are investigated in the discussion of this research, which can be found in chapter 6. The effect of VMS2, which represents the amount of online social meetings, will not be further investigated as the variable does not have a significant relationship with any of the other variables (see table 4.8).

4.3.1. Prior ties

Effect of PT1 on IPT_full

PT1 indicates if prior ties are present in the design team and how many times these individuals have worked together before. As displayed in table 4.8, there is a medium positive correlation between prior ties (PT1) and interpersonal trust (IPT_full) (r=0.308, p=0.031).

Effect of PT1 on IOT_full

There is a non-significant small positive correlation between prior ties (PT1) and inter-organizational trust (IOT_full) (r=0.115, p=0105) (see table 4.8).

Effect of PT0or1 on IPT_full

PT0or1 indicates if prior ties are present in the design team. As can be seen in table 4.8, there is a significant medium positive correlation between prior ties (PT0or1) and interpersonal trust (IPT_full) (r=0.337, p=0.018).

Effect of PT0or1 on IOT_full

Table 4.8 shows that there is a non-significant small positive correlation between prior ties (PT0or1) and inter-organizational trust (IOT_full) (r=0.096, p=0.510).

4.3.2. Future ties

Effect of FT1 on IPT_full

FT1 indicates the expectancy of future collaboration with the design team members. As displayed in table 4.8, there is non-significant small to medium positive correlation between future ties (FT1) and interpersonal trust (IPT_full) (r=0.202, p=0.163).

Effect of FT1 on IOT_full

There is a significant medium to large positive correlating effect between future ties (FT1) on inter-organizational trust (IOT_full) (r=0.430, p=0.002) (see table 4.8).

4.3.3. Virtual work-related meetings

Effect of VMW2 on IPT_full

VMW2 indicates the frequency of virtual work-related meetings. As displayed in table 4.8, there is a significant medium to large negative correlation between the frequency virtual work-related meetings (VMW2) and interpersonal trust (IPT_full) (r=-0.428, p=0.002).

Effect of VMW2 on IOT_full

As can be seen in table 4.8, there is a non-significant small to medium negative correlation between the frequency virtual work-related meetings (VMW2) and inter-organizational trust (IOT_full) (r=-0.226, p=0.119).

4.3.4. Social meetings

Effect of VMS1 on IPT_full

VMS1 indicates the quantity of social face-to-face meetings. As displayed in table 4.8, there is significant medium to large positive correlation between the quantity of social face-to-face meetings (VMS1) and interpersonal trust (IPT_full) (r=0.432, p=0.013).

Effect of VMS1 on IOT_full

Table 4.8 shows that there is a significant medium positive correlation between the quantity of social face-to-face meetings (VMS1) and inter-organizational trust (IPT_full) (r=0.283, p=0.049).

4.4. Moderating effect

The effect of the moderating variables on the relationship between the independent and dependent variables is analyzed by using PROCESS in SPSS. The result of the PROCESS analysis shows the significance and the interaction effect of the moderating relationship. The p-value that indicates the significance also has the threshold value of $p < 0.05$. Moderating effects that have a p-value higher than 0.05 are not perceived as significant. The interaction effect relates to the change in the effect of the independent variable on the dependent variable when the value of the moderator changes (Field, 2013). The factors that can play a role in non-significant relationships are elaborated upon in the discussion of this research, which can be found in chapter 6.

The potential moderating effects on significant relationships between the independent and dependent variables are investigated in this section. However, the potential moderating effect on the relationships between the amount of prior ties and inter-organizational trust (PT1 → IOT_full), the existence of prior ties and inter-organizational trust (PT0or1 → IOT_full) and future ties and interpersonal trust (FT1 → IPT_full) are not considered as these direct relationships are not significant (see table 4.8).

4.4.1. Virtual work-related meetings

The interaction effect and the significance of the moderating effects of the frequency virtual work-related meetings (VMW2) on the relationship between the independent and dependent variables are displayed in table 4.9. The output of the PROCESS analysis for the moderating relationships can be found in appendix B.4.1.

Table 4.9: Significance of moderating effects of virtual work-related meetings (VMW#2)

Relationship	Interaction effect	p-value
PT1 → IPT_full	-0.0329	0.6826
PT0or1 → IPT_full	-0.0928	0.0000
FT1 → IOT_full	-0.0383	0.9193

In table 4.9, the interaction effects and p-values are displayed relating to the PROCESS outputs of the different moderating relationships. As can be seen the only significant moderation is the moderating effect of the frequency virtual work-related meetings (VMW2) on the relationship between the existence of prior ties (PT0or1) and interpersonal trust (IPT_full). The other p-values are too high and therefore the interaction effect of the frequency of virtual work-related meetings on these relationships is not significant.

As mentioned in the data analysis method (section 3.2) the PROCESS macro enables performing multiple regression analyses on the independent, dependent and moderating variables. These regression analyses indicate if a variable has an impact on another variable. By performing a multiple regression analysis, a potential moderating effect can be investigated. As can be seen in the output at the "model summary" section of the PROCESS analysis (see appendix B.4.1), the dependent variable of interpersonal trust (IPT_full) has a multiple correlation R-value of 0.4172, which relates to the correlation between the variables in the model, and a R-squared value of 0.174 which indicates the percentage of variation of the dependent variable that can be explained by the independent variable. On the other hand, in the "model" section of the output, the regression coefficients of prior ties (PT0or1) and the frequency of virtual work-related meetings (VMW2) are displayed, which are 0.6871 and 0.2014 respectively. These values indicate the average functional relationship between the moderating variable and the dependent variable. Moreover, as can be seen the p-values of the regression analyses indicate significance. Thus, on itself the variables of PT0or1 and VMW2 have a significant effect on interpersonal trust.

The Int_1 variable found in the "model" section of the PROCESS output relates to the interaction term, or the moderating effect of the VMW2 variable. This interaction term has a regression coefficient of -0.0928 and is also significant. This significance indicates that the frequency of virtual work-related meetings has a moderating effect on the relationship between the existence of prior ties and interpersonal trust. Moreover, as can be seen in "The test of the highest order unconditional interaction:" of the PROCESS output, the interaction value has an R-squared change of 0.0101 which means that by implementing the interaction term into the model, the R-squared of interpersonal trust, or the percentage of variation increases by 1.01%. This means that by implementing the interaction term, or the moderating value, in the model, the percentage of variation of the dependent variable is explained for 1.01% more by the independent variable. Thus, the implementation of the moderating variable results in a more significant change and increase in an effect of prior ties on interpersonal trust.

Lastly, the section "Data list free" shows the values of interpersonal trust (IPT_full) as a result of a value of the existence of prior ties (PT0or1) and three different values of the moderating variable. Thus the output of the PROCESS analysis gives information about the moderating effect of the frequency virtual work-related meetings (VMW2) on three levels; low, mean and high. The interaction effect and significance for these levels can be found in table 4.10. The information is plotted in figure 4.1. This figure shows the multiple line graph of the moderation effect of the frequency of virtual work-related meetings (VMW2). On the horizontal axis, the presence of prior ties is displayed. Ranging from not present ("No") or present ("Yes"). On the vertical axis the amount of trust is stated. The numbers correspond to the answers on the statements of the existence of interpersonal trust in the design teams. Number 5 relates to "Strongly agree" and 1 relates to "Strongly disagree". As can be seen, the moderating effect of a high VMW2 value has the highest moderating effect on the relationship between PT0or1 and IPT_full. When the existence of prior ties (PT0or1) changes from not present to present, the increase in interpersonal trust (IPT_full) will increase less when the frequency of virtual meetings is higher (VMW2). In other words, when the frequency of virtual work-related meetings is higher this has a higher negative moderating effect on the positive relationship between the existence of prior ties and the amount of interpersonal trust in the design team. If the frequency of virtual meetings decreases, the negative moderating effect of virtual work-related meetings will decrease.

Table 4.10: Moderation levels of virtual work-related meetings (VMW2)

VMW2 value	Interaction effect	p-value
2.0000	0.4515	0.0000
4.0000	0.2659	0.0000
5.0000	0.1731	0.0000

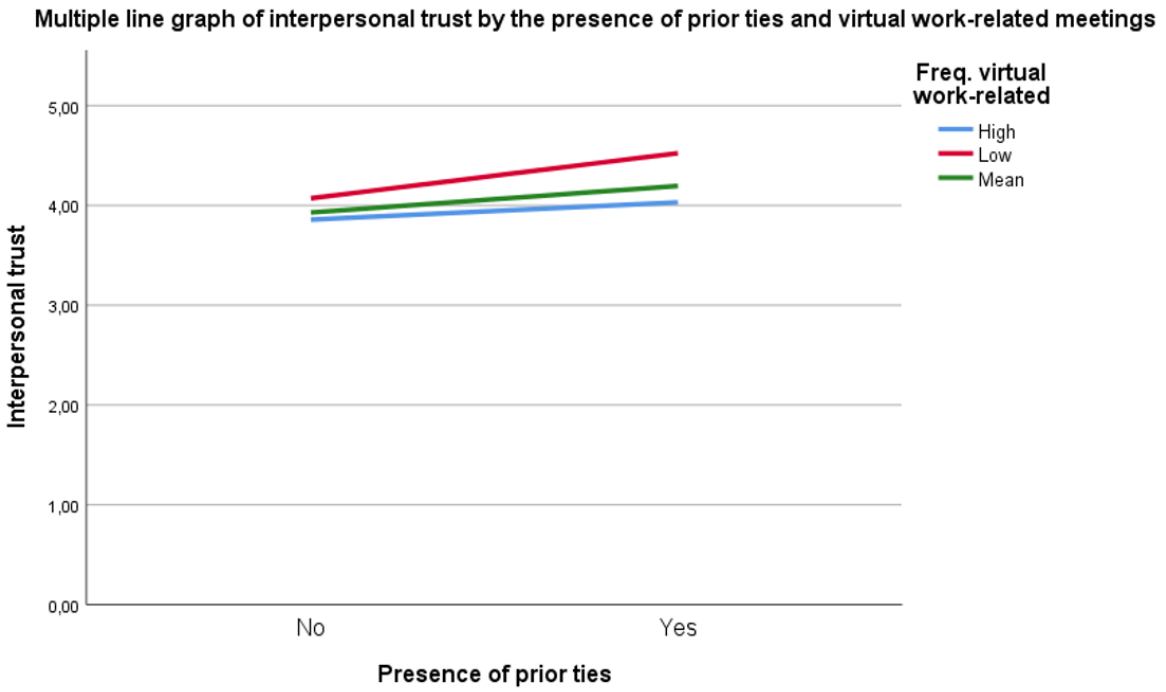

Figure 4.1: Moderating effect of VMW2 on PT0or1 → IPT_full

4.4.2. Social face-to-face meetings

The significance of the moderating effects of the quantity social meetings (VMS1) on the relationship between the independent and dependent variables can be seen in table 4.11.

Table 4.11: Significance of moderating effects of social meetings (VMS1)

Relationship	p-value
PT1 → IPT_full	0.5369
PT0or1 → IPT_full	0.5508
FT1 → IOT_full	0.4270

As displayed in table 4.11, there is no significant moderating effect of the quantity social meetings (VMS1) on any of the relationships between ties and trust. The results of the PROCESS analysis for the non-significant moderating relationships can be found in appendix B.4.2.

4.5. Hypotheses testing

In order to test the hypotheses, the results of the survey analysis are evaluated. A substantiation is provided for each hypothesis in this section. The hypotheses are subdivided to show the results regarding each individual relationship. The results of the hypotheses testing are summarized in table 4.12. The results of the hypothesis testing are compared with findings in literature in the discussion of this research, which can be found in chapter 6.

Table 4.12: Results of the hypotheses testing

No.	Hypothesis	Result
H1a	Prior ties in construction design teams have a positive effect on interpersonal trust	**Accepted**
H1b	Prior ties in construction design teams have a positive effect on inter-organizational trust	**Rejected**
H2a	Future ties in the construction design teams have a positive effect on interpersonal trust	**Rejected**
H2b	Future ties in the construction design teams have a positive effect on inter-organizational trust	**Accepted**
H3	Future ties have a more significant positive influence on interpersonal and inter-organizational trust than prior ties	**Rejected**
H4a	A high frequency of virtual work-related meetings negatively moderates the positive effect of prior ties on interpersonal trust	**Accepted**
H4b	A high frequency of virtual work-related meetings negatively moderates the positive effect of prior ties on inter-organizational trust	**Rejected**
H4c	A high frequency of virtual work-related meetings negatively moderates the positive effect of future ties on interpersonal trust	**Rejected**
H4d	A high frequency of virtual work-related meetings negatively moderates the positive effect of future ties on inter-organizational trust	**Rejected**
H5a	A large number of social face-to-face meetings positively moderates the effect of prior ties on interpersonal trust	**Rejected**
H5b	A large number of social face-to-face meetings positively moderates the effect of future ties on inter-organizational trust	**Rejected**

4.5.1. Direct effect

H1: Prior ties in construction design teams have a positive effect on interpersonal and inter-organizational trust

The results of the analysis in section 4.3.1 show that the presence of prior ties (PT0or1) and the amount of prior ties (PT1) both have a significant positive effect on interpersonal trust (IPT_full). The effect is of medium strength for both independent variables. This illustrates that design team members that have prior ties with one another experience a higher level of interpersonal trust. The relationship between prior ties and inter-organizational trust on the other hand is not significant. Moreover, this non-significant relationship between prior ties and inter-organizational trust only has a small correlation coefficient. The results of the analysis accept the hypothesis that prior ties have a positive effect on the levels of interpersonal trust in design teams (H1a). The effect of prior ties on inter-organizational trust however does not show a significant relationship. This hypothesis is therefore rejected (H1b) based on the SPSS analysis.

H2: Future ties in the construction design teams have a positive effect on interpersonal and inter-organizational trust

When considering the effect of future ties on interpersonal and inter-organizational trust, the results of the analysis in section 4.3.2 show that the expectancy of future collaboration (FT1) has a medium to a large significant effect on inter-organizational trust (IOT_full). On the contrary, the expectancy of future collaboration does not have a significant relationship effect on interpersonal trust (IPT_full). Due to this result, the hypothesis that future ties have a positive effect on inter-organizational trust is accepted (H2b). The hypothesis related to the effect of expected collaboration in the future on interpersonal trust is rejected (H2a).

H3: The positive effect of future ties on trust is higher than the positive effect of prior ties

The results of the analysis on the effect of prior and future ties on interpersonal and inter-organizational trust show only significant relationships between prior ties and interpersonal trust and between future ties and inter-organizational trust. It is therefore not possible to find significant differences between the effects of both tie types on interpersonal and inter-organizational trust. Therefore no evidence is found to accept the hypothesis that future ties have a more significant positive influence on interpersonal and inter-organizational trust than prior ties. Thus, this hypothesis is rejected (H3).

4.5.2. Moderating effect

H4: A high frequency of virtual work-related meetings negatively moderates the positive effect of prior and future ties on interpersonal and inter-organizational trust

No significant direct effect is found between prior ties and inter-organizational trust and between future ties and interpersonal trust. Due to this, no moderation effect on these relationships could be analyzed. The hypotheses related to these moderating effects (H4b and H4c) are therefore rejected. As illustrated in section 4.4.1, the moderating effect of virtual work related meetings is significant for the relationship between the existence of prior ties (PT0or1) and interpersonal trust (IPT_full). When the frequency of virtual work-related meetings becomes higher, this reduces the positive effect of these prior ties on the levels of interpersonal trust. Thus, the result of the analysis leads towards the acceptance of the hypothesis that a high frequency of virtual work-related meetings negatively moderates the positive effect of prior ties on interpersonal trust (H4a). The moderating effect of virtual meetings on the relationship between future ties (FT1) and inter-organizational trust (IOT_full) shows no significance. Thus, no evidence is found which is in line with the hypothesis that a high frequency of virtual work-related meetings negatively moderates the positive effect of future ties on inter-organizational trust. This hypothesis is therefore rejected (H4d).

H5: A large number of social face-to-face meetings positively moderates the effect of prior and future ties on interpersonal and inter-organizational trust

As illustrated in section 4.3, no significant direct effect has been found between prior ties and inter-organizational trust and between future ties and interpersonal trust. No potential moderation effect on these relationships is analyzed. The hypotheses related to these moderating effects (H5b and H5c) are therefore rejected. Section 4.4.2 shows that there is no significant moderating effect of the amount of social face-to-face meetings on the relationship between future ties (FT1) and inter-organizational

trust (IOT_full). Thus the hypothesis that social face-to-face meetings positively moderate the positive effect of future ties on inter-organizational trust is rejected (H5b). Furthermore, the moderating effect of social face-to-face meetings on the relationship between the amount and existence of prior ties (PT1 or PT0or1) and interpersonal trust (IPT_full) shows no significance. Thus, no evidence is found which is in line with the hypothesis that a high number of social face-to-face meetings positively moderates the positive effect of prior ties on interpersonal trust. This hypothesis is therefore rejected (H5a).

4.6. Summary

The results of the analysis provide a deeper understanding regarding the direct effect of ties on trust in inter-organizational design teams. The results of the correlation analysis show that the presence and amount of prior ties have a significant medium positive effect on interpersonal trust. The relationship between the presence and amount of prior ties and inter-organizational trust is not significant. When looking at the effect of the expectancy of future collaboration, it has a medium to a large significant effect on inter-organizational trust. On the contrary, the expectancy of future collaboration does not have a significant relationship effect on interpersonal trust. Due to these results it is not possible to find differences between the effects of both tie types on interpersonal and inter-organizational trust relatively.

The moderating effect that the quantity of virtual work-related meetings has on the relationship between ties and trust only shows significance for the relationship between the existence of prior ties and interpersonal trust. It is found that when the frequency of virtual work-related meetings becomes higher, the positive effect of prior ties on interpersonal trust is reduced. Besides, the direct effect of the moderating variables on the amount of interpersonal and inter-organizational trust are also examined. The results show that when the frequency of virtual work-related meetings increases, the amount of interpersonal trust in design teams will decrease with a medium to large significant effect. The effect on inter-organizational trust showed no significance. The quantity of social face-to-face meetings on the other hand, has a significant medium to large direct positive effect on both interpersonal and inter-organizational trust.

Lastly, as displayed in table 4.12, many of the relationships showed no significance and could therefore not be considered as evidence for the hypothesis. This non-significance can have multiple reasons. For example, it could be related to the small simple size of the research, but it could also simply be the case that no relationship is present between the variables. The non-significance of the relationships and the limitations related to these findings are addressed in the discussion of this research.

5

Deliverable

5.1. The design team trust guideline

As mentioned before, one of the most important attributes of construction design teams which helps to develop effective working relationships is trust. Trust increases the willingness to share information, aligns the interest of stakeholders and improves team performance. Thus, improving trust could reinforce team processes and subsequently project success. In this section, a guideline is developed that helps to improve trust in design teams. The results of the theoretical background and the survey analysis are used as recommendations for the development of the guideline. These recommendations are elaborated upon in section 5.2. The recommendations of the guideline are subsequently used for designing a guideline in section 5.3. The guideline is finally evaluated with the use of an expert interview in section 5.4. The experts provide professional knowledge and experience which is needed to assess the practical relevance and the feasibility of the guideline.

5.2. Developing the recommendations for the guideline

In this section, the recommendations for the guideline are developed. The recommendations relate to the effect that ties and virtual and social meetings have on interpersonal and inter-organizational trust. The recommendations are categorized into ties and meetings. The category "Ties" consist of the effect that prior and future ties have on trust. The category "Meetings" on the other hand, consist of the effect of virtual work-related meetings and social face-to-face meetings. Besides, the categories are evaluated regarding the effect that they have on interpersonal and inter-organizational trust separately.

5.2.1. Ties

Interpersonal trust

1. The literature review of chapter 2 has taught us that prior ties are beneficial for interpersonal trust in teams. The beneficial effect originates from the developed social content between individuals (Wang et al., 2017). Moreover, prior ties result in mutual behavioural expectations and open communication which are contributors to interpersonal trust (Mau-

rer, 2010, Guo et al., 2021, Buvik and Rolfsen, 2015). The results of the survey analysis in chapter 4 are in line with the findings in the literature review. When the number of prior ties increases, the amount of interpersonal trust increases according to the survey analysis. To apply these findings in the context of inter-organizational construction design teams and increase the amount of trust, it is recommended to actively compose design teams with a high number of prior ties. Thus the recommendation is as follows; focus on the development of a design team composition in which prior ties are present between the design team members. The existence of prior ties has a direct positive effect on the levels of interpersonal trust within the team.

Inter-organizational trust

2. The effect of future ties on inter-organizational trust is examined in the literature review of chapter 2. It is found that expectation of future collaboration, or future ties, increases inter-organizational trust (Poppo et al., 2008, Chen et al., 2018). This notion is supported by the result of the survey analysis in chapter 4. The expectation of future collaboration between design team members has a positive effect on the amount of inter-organizational trust. To apply these findings and increase the inter-organizational trust in design teams, it is recommended to make design team members aware of expected future collaboration. It may be possible that future collaboration between individuals is expected as the two organizations have a long standing framework agreement, but the design team members are not aware of this agreement. It is then recommended to address this existence and notify the design team members.

3. As found in the literature review in chapter 2, interpersonal trust results in inter-organizational trust as the trustworthiness of employees of organizations portray the trustworthiness of their organization (McDermott et al., 2005, Noordin et al., 2012, Guo et al., 2021). It is therefore recommended to focus on the development of prior ties when the goal is to increase the level of both trust types in the design team.

5.2.2. Meetings

Interpersonal trust

4. As can be found in the literature review of chapter 2, it is found that a lack of face-to-face interactions makes trust development in teams difficult. Organizing face-to-face social events should help to develop interpersonal ties, which are the foundation for interpersonal trust (Aissa et al., 2022). Moreover, it is found that online social meetings could also develop a shared understanding between individuals which is beneficial for interpersonal trust (Hacker et al., 2019, Choi and Cho, 2019). However, the effect of online social events could not be evaluated due to the non-significant relationship. This non-significance comes from the absence of online social meetings in the sample. It therefore concluded to not add social virtual meetings in the recommendation. As displayed in chapter 4, the direct effect of the amount of social face-to-face meetings showed a positive effect

on interpersonal trust. Thus, organizing social face-to-face social events results in higher levels of interpersonal trust within the design team. The recommendation is as follows; organize face-to-face social events for the design team members to develop interpersonal ties and a shared understanding between the team members. This will result in a higher level of interpersonal trust within the team.

5. According to the literature review of chapter 2, virtual meetings do impair the development of trust as it makes it difficult for individuals to create interpersonal connections (Aissa et al., 2022, Rogers et al., 2021). The survey analysis of chapter 4 supported this notion as it showed a negative moderating effect of the frequency of virtual work-related meetings on the positive effect of the existence of prior ties on the interpersonal trust within a design team. When the frequency of virtual work-related meetings increases, the positive effect of the existence of prior ties on interpersonal trust decreases. Moreover, when looking at the direct effect of virtual work-related meetings on interpersonal trust, it showed a negative effect. Thus, virtual work-related meetings seem to have a detrimental effect on the amount of trust in a design team. It is therefore recommended to try to organize as many face-to-face work-related meetings as possible to improve the amount of interpersonal trust within the design team.

Inter-organizational trust

6. Research by Aissa et al. (2022), Choi and Cho (2019) and Hacker et al. (2019) focused on the effect that virtual and social meetings have on trust between individuals, or interpersonal trust. In the literature review of chapter 2, no research is found describing the effect of virtual and social meetings on inter-organizational trust. However, the results of the survey analysis show a direct positive effect from the amount of social face-to-face meetings on the levels of inter-organizational trust in the design teams. Moreover, as found in the literature review. Social face-to-face meetings are beneficial for interpersonal trust development (Aissa et al., 2022, Rogers et al., 2021). Furthermore, interpersonal trust is believed to transform into inter-organizational trust (McDermott et al., 2005, Noordin et al., 2012, Guo et al., 2021). It is therefore recommended to organize face-to-face social events for the design team members to increase the levels of inter-organizational trust in the design team. No evidence is found in literature of the survey analysis which indicates that virtual work-related meetings influence the inter-organizational trust in teams. This is therefore not included in the recommendation.

5.3. Designing the guideline

The design team trust guideline is designed by combining the recommendations. To ensure that the guideline is easily accessible and approachable, it is chosen to combine each recommendation on one page. It should be possible to read the guideline in a short period of time to make it attractive for design team members. Moreover, it is chosen to support the recommendations with icons in order to improve the readability and comprehensibility of the guideline. The guideline is displayed in figure 5.1.

As displayed, the guideline is divided into two sections, recommendations related to interpersonal and inter-organizational trust. The benefits of each trust type for the design teams are briefly described at the top of each section. The description is confined to three bullet points of information in order to assure that the guideline stays compact. The benefits of each trust type originate from the literature review in chapter 2.

The recommendations relating to ties and meetings are displayed at the bottom of the guideline. Each recommendation is supported by an icon and a short explanation. The numbers of the recommendations relate to the descriptions provided in section 5.2.

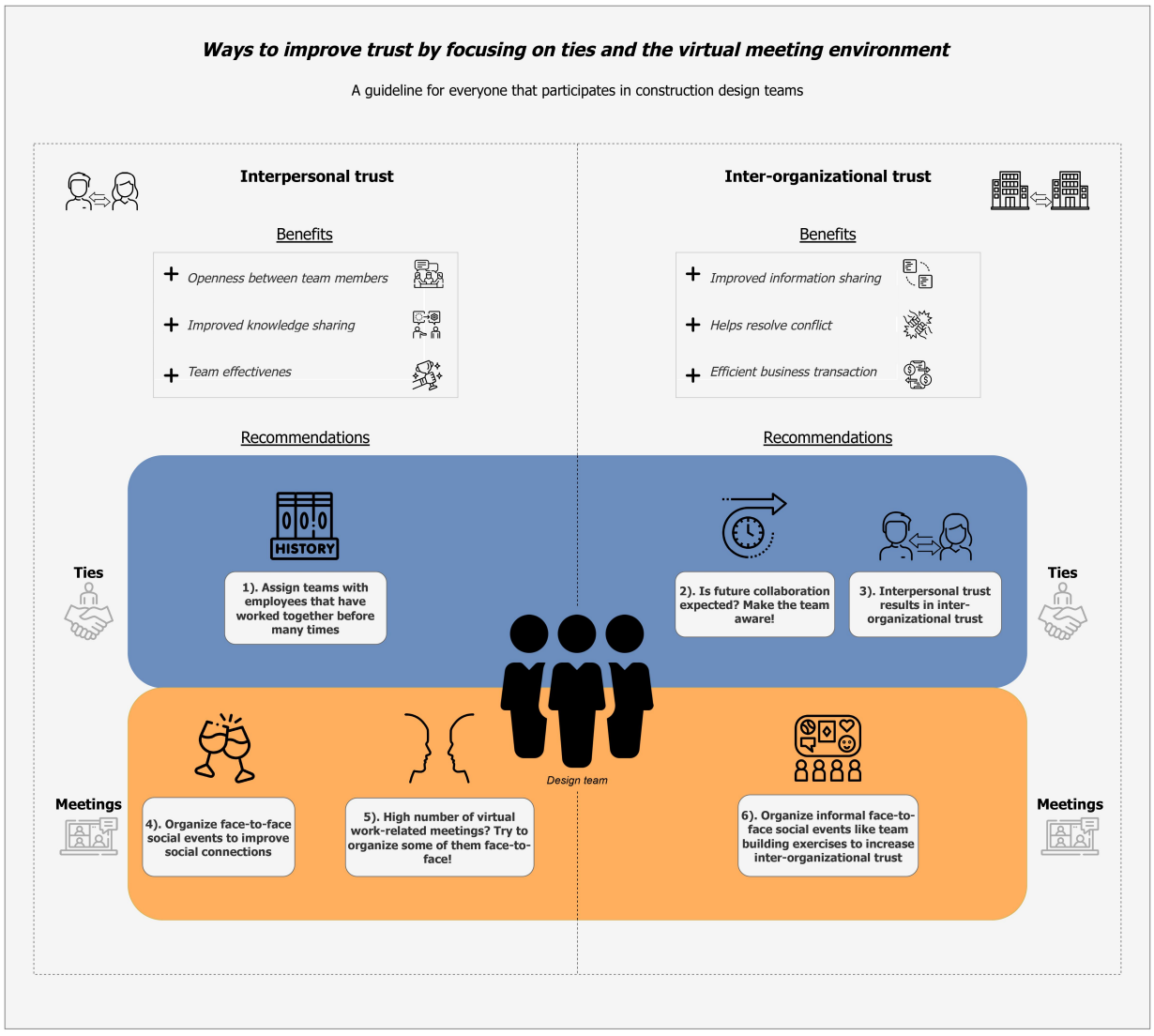

Figure 5.1: Trust guideline

5.4. Expert evaluation

The guideline is evaluated with the use of an expert interview. The interview predominantly focuses on the practicality and feasibility of the guideline as these experts have knowledge and experience regard-

ing the use of certain recommendations in practice. The interview questions and provided answers by the experts can be found in appendix C section C.2.

The expert interview is performed with two employees of Drees & Sommer which are part of the senior management of the organization. Both of the employees have multiple years of experience as project managers in construction design teams. As both experts participate in senior management of Drees & Sommer, they have knowledge regarding the practicability and feasibility of the guideline. The experts can provide insights regarding the implementability of the guideline in the organization. It is decided to interview the experts in the same session to allow for discussion between the experts.

During the interview, the experts evaluate the practical relevance and the feasibility of the proposed recommendations of the guideline which can be found in figure 5.1. Also, potential expected boundaries when implementing the guideline are evaluated. Lastly, the experts are asked if they have additions to the guideline.

5.4.1. Recommendations

The recommendations related to ties and meetings are evaluated separately.

Ties

1. The experts are asked if they have experienced the positive effect of prior interactions on the amount of trust design teams. Both experts state that they have seen many situations in which having a prior relationship with the design team members helped to improve trust within the design team. According to the experts, the prior ties resulted in trust between the team members and helped the team processes. The experts were also asked if prior ties can also have a negative effect on trust in design teams. Their response was that it is expected that having prior ties could have a negative impact on trust when preexisting expectations regarding competence which are related to prior collaboration may not be met when someone has a different role in the project. Also, when new design teams start working together, expectations are elaborately expressed to enable efficient collaboration. When prior ties are present this may result in a kind of laxity, which results in little expression of expectations, which may lead to conflicts later in the project. But in most cases the prior ties will have a beneficial effect on the trust levels in design teams. When considering the practicability of recommendation 1). the experts stated that assigning teams with prior ties is possible, but as the composition of teams vary a lot it may be hard to find teams in which prior ties are present.

2. During the expert interview, the experts are asked if they think that an effect between future ties and interpersonal trust is present in the context of design teams. The experts answer that they believe that future ties do not have an effect on the level of interpersonal trust between design team members. According to them, do the team members focus on the current project without thinking about projects or collaborations in the future. According to the experts, trust that develops between design team members comes from how they

manage to get their work done on the current project. Inter-organizational trust on the other hand could be increased according to the experts. Organizations can be triggered to improve trustworthy behaviour as they are more likely to be approached to work together in the future. This in return results in more perceived inter-organizational trust by the design team members. Thus by making team members aware that future collaboration is expected, inter-organizational trust may be increased. But regarding the practicability, similar to prior ties it does not often occur that future collaboration is already expected when the current project is still unfinished.

3. Regarding the transformation of interpersonal trust in inter-organizational trust, the experts both mention that this transformation comes from the idea that people represent their organizations, thus if you trust an individual working for an organization, you are likely to trust the organization as well. Thus focusing on the development of interpersonal trust can result in more inter-organizational trust as well.

Meetings

4. When considering the recommendations related to meetings, both experts agree that organizing face-to-face or social meetings with the design teams can be easily implemented and beneficial for trust development. During the interview, the experts provided examples in which they experienced the benefits of social meetings on the levels of trust in their design teams. Especially when the frequency of virtual work-related meetings was high.

5. During the interview, the experts are asked if they think that virtual work-related meetings have a negative effect on trust. Both experts mention that they think that virtual work-related meetings do not necessarily cause a negative effect on the amount of trust. May it be interpersonal or inter-organizational. It will, however, not help to improve trust. The trust within the team is more likely to minimally stay the same according to the experts. This effect might occur when the participating organizations in the design team are not adequately equipped to participate in virtual meetings. According to the experts, can inadequate virtual capabilities reflect on the organization, making the inter-organizational trust decrease or at least stay at a minimum level. Next to that, do virtual work-related meetings make communication less efficient which is not beneficial for trust development in the design team. Thus, organizing some meetings face-to-face would be beneficial for trust development.

6. The experts both mention that the relationship between the positive effect of social face-to-face meetings on inter-organizational trust comes from the transformation of interpersonal trust into inter-organizational trust. Thus organizing face-to-face events could help to increase inter-organizational trust.

5.4.2. Potential boundaries and additions for the final guideline

Finally, the experts are asked if there are specific boundaries expected when implementing the guideline and if they have any additions to the guideline. Both experts agree that no specific boundaries regarding the implementation are expected. An addition to the guideline is their notion on hybrid meetings. According to the experts are hybrid meetings not beneficial to team trust and should be avoided. Hybrid meetings are meetings where team members participate either online or face-to-face. When collaborating through hybrid meetings, communication with the virtual participants is negatively affected which results in inefficient meetings. It is more helpful to find a balance between virtual and face-to-face meetings than to provide the option to meet either virtual or face-to-face in one meeting. This notion by the experts is neither supported by the literature review or the survey analysis. Also, hybrid meetings are not in the scope of this research. Therefore the proposed addition to the guideline is not added and solely mentioned as an advice for further research. Thus no changes are made to the guideline.

6

Discussion

6.1. Interpretation of the research results

This research aims to determine the effect of prior and future ties on interpersonal and inter-organizational trust in inter-organizational construction design teams. The impact that virtual meetings might have on this relationship is also considered. The research is performed by a mixed research method containing a literature review and a survey. The results of the literature review and the survey analysis are compared and evaluated in this section.

The results of the survey analysis show that both the existence and the amount of prior ties have a significant positive effect on the amount of interpersonal trust in design teams. This is in line with the findings in the literature (Wang et al., 2017, Guo et al., 2021, Maurer, 2010, Buvik and Rolfsen, 2015). However, it should be noted that the literature also mentions that prior ties do not always have a positive effect on trust in teams (Jap, 2005, Sorenson and Waguespack, 2006). Preexisting expectations regarding competence may not be met which could result in a negative effect on trust. When considering the effect of prior ties on inter-organizational trust, the survey showed no significant relationship. When comparing this result to the literature review, it is found that inter-organizational trust does develop when prior ties exist. This is due to the fact that interpersonal trust gradually leads to inter-organizational trust as the trustee conveys the trust throughout the organization (Guo et al., 2021, Lee and Chong, 2021, Poppo et al., 2008). There could be several reasons for the non-significant relationship found in the survey analysis. However, when considering the trust measures used in the survey, they originate from research by Guo et al. (2021). Guo et al. (2021) had a sample size of 319 respondents as opposed to 49 samples in this research. To exclude this potential reason for the non-significant relationship, a larger sample size has to be examined in future research. However, other factors could also contribute to the non-significance. It could be caused by a too large or too little variance in the data or there might be simply no relationship between the measured variables. All in all, the findings of the literature review indicate that there is a relationship between prior ties and inter-organizational trust, but the survey analysis shows no significance. It is therefore not proven that a positive effect between prior ties and inter-organizational trust is present in inter-organizational construction de-

sign teams. On the contrary, the positive effect of prior ties on interpersonal trust is considered to be present. Nonetheless, design teams should consider a potential negative effect of prior ties originating from preexisting expectations or laxity.

Expected future collaboration between design team members has a significant positive effect on inter-organizational trust according to the survey analysis. On the contrary, the effect that the expectancy of future collaboration has on interpersonal trust is not significant. When relating these results with the findings in the literature review, they are not that surprising. Poppo et al. (2008) and Chen et al. (2018) researched the effect of future ties on inter-organizational trust. They found that the expectations of continuity positively affect the levels of inter-organizational trust as the expected future payoff from honest cooperation outweighs the gain from short-term self-interested behaviour. The research by Poppo et al. (2008) and Chen et al. (2018) only looked at inter-organizational relations. It therefore seems that future ties in interpersonal relations also affect the inter-organizational trust levels. As mentioned, expectations of future collaboration do not have a significant influence on interpersonal trust according to the survey analysis. Also, no literature is found on this effect. Thus, only the positive effect of future ties on inter-organizational trust is considered to be present in inter-organizational construction design teams. The effect of future ties on interpersonal trust, however, is not believed to be existing. This is due to the non-significant relationship found in the survey analysis. It should be noted that the non-significance of the relationship might be caused by other factors, like the small sample size. It is therefore also not proven that no relationship exists at all between future ties and interpersonal trust.

The potential impact that virtual meetings have on the direct effect of ties on trust is considered in this research. It is found in the literature review that virtual work-related meetings and social meetings can affect the levels of trust in teams. The focus therefore lies on these meetings. After analyzing the survey data, it is concluded to only consider social face-to-face and virtual work-related meetings. This is due to the lack of responses that indicated that virtual social meetings are present in the surveyed design teams. This result of the survey came as a surprise. As has been mentioned, the design teams that participated in the survey were subjected to the restrictions related to the pandemic which resulted in a higher frequency of virtual meetings. The lack of virtual social meetings in the survey answers indicate that the design teams do not think of social interactions as a fundamental factor resulting in team success and efficient collaboration. On the contrary this effect has been mentioned widely in literature. Thus it seems that the design teams are not initially aware of a potential beneficial effect of social interactions.

When considering the moderating effect of virtual work-related meetings, a significant moderating effect is found in the relationship between the existence of prior ties and interpersonal trust. A high frequency of virtual work-related meetings reduces the positive effect of these prior ties on the levels of interpersonal trust. The findings in the literature review state that virtual work-related meetings make trust development difficult as it prohibits the creation of interpersonal connections between team members (Choi and Cho, 2019, Hacker et al., 2019, Aissa et al., 2022). It, therefore, seems reasonable that this results in a reduction of the positive effect of prior ties on the interpersonal trust levels

in the design teams. The moderating effect of virtual meetings on the relationship between future ties and inter-organizational trust, on the other hand, shows no significance. The negative effect of virtual meetings, according to the literature, is related to the reduction of interpersonal connections between team members, which is less relevant for inter-organizational trust. These statements, however, are not supported by the survey analysis as the non-significant relationship might be caused by other factors.

When looking at the direct effect of the frequency of virtual work-related meetings on interpersonal and inter-organizational trust, the virtual work-related meetings show a significant negative correlation with interpersonal trust. On the contrary, the direct effect of virtual work-related meetings on inter-organizational trust shows no significance and is also not found in the literature review. As mentioned, this may be due to the irrelevance of the lack of social interaction to the amount of trust one has for the organization.

Social face-to-face meetings show no significant effect on the relationship between future ties and inter-organizational trust. Thus, based on the findings of this research, no moderating effect is found on the effect of social face-to-face meetings on any of the direct relationships. However, when looking at the direct effect that social face-to-face meetings have on interpersonal and inter-organizational trust, it is found that both show a positive significant effect. This means that when the number of organized face-to-face social meetings increases, this results in more interpersonal and inter-organizational trust in the design teams. This is in line with the view of the experts and the literature review, which mentions that face-to-face social meetings develop a shared understanding and interpersonal connections resulting in interpersonal trust (Aissa et al., 2022, Hacker et al., 2019). When considering the diffusion process of interpersonal trust, one can argue that the interpersonal trust originating from these social face-to-face meetings might subsequently be conveyed in inter-organizational trust (McDermott et al., 2005, Noordin et al., 2012, Guo et al., 2021).

The findings of the literature review and the survey analysis show quite similar results. Each analysis shows that prior ties affect interpersonal trust. The effect of prior ties on inter-organizational trust is non-significant according to the survey analysis, but the literature does agree that an effect is present due to the transformation of interpersonal trust into inter-organizational trust. The relationship between future ties and both types of trust showed the same results in both the literature review and the survey analysis. Future ties have a positive effect on inter-organizational trust. On the contrary, an effect on interpersonal trust is not found. When considering the moderation effects of virtual work-related meetings and social face-to-face meetings, the moderating effect of virtual work-related meetings on the relationship between prior ties and interpersonal trust only showed significance. It stands out that in many of the perceived effects, the process of interpersonal to inter-organizational trust transformation applies. According to the results of this research, it is the main factor contributing to inter-organizational trust in design teams. It should be noted, however, that there are certain factors that may have influenced the results of these analyses. Especially when considering the survey analysis. The survey sample population is not evenly dispersed and is represented predominantly by individuals in the project manager role with short or long professional work experience. It should therefore be considered that when interpreting the results of this research, the survey response is coloured by

the role of the project manager as team roles influence trust development (Guo et al., 2021).

6.2. Added value of the research

6.2.1. Scientific contribution

This research has added value to literature related to ties and trust in multiple ways. Firstly, the currently available literature only has a limited contextual focus and did not yet consider inter-organizational construction design teams. Besides, the relationship between ties and trust in the context of the construction industry as a whole is only little represented in actual literature. In addition, current literature has not yet focused on the effect that future ties have on interpersonal trust. This potential effect is only considered for inter-organizational trust. Moreover, the effect that interpersonal future ties have on both interpersonal and inter-organizational trust is new knowledge for the scientific field. Current literature only looked at the effect of inter-organizational ties and did not consider the future ties between individuals. Also, this research looks at the effect of both prior and future ties on interpersonal and inter-organizational trust.

When considering the effect that virtual meetings have on trust, this research also fills a gap in literature. The effect that virtual work-related and social meetings have on trust in teams is not yet explored in the context of inter-organizational construction design teams. Moreover, the effect that these meetings have on the construction industry, in general, is not found in the literature review on this topic. The effect that both types of meetings have on interpersonal trust is considered in the current available literature. However, the effect on inter-organizational trust, on the other hand, is still lacking.

The explored effects of ties and virtual meetings on trust in construction design teams are brought together in order to enable trust development. The overview of trust development factors facilitates further research on this topic in the construction industry. Still, a lot can be learned about which exact processes lead to trust and how to increase it in teams. Also, the contextual factors of design teams that influence trust development are not yet all discovered. Nevertheless, this research allowed new insights regarding the topic of ties and trust in inter-organizational construction design teams. Thus, adding a contribution to the scientific field.

6.2.2. Practical contribution

The findings of the literature review and the survey analysis provide insights into the utilization of the effects of prior and future ties on interpersonal and inter-organizational trust. These effects are used to develop recommendations that may be used in practice to improve the levels of trust in the teams. Moreover, as the potential impact of virtual and social meetings is also considered, it provides design teams knowledge to better handle the effect that the virtual meeting environment has.

Trust is seen as one of the most important factors to develop effective working relationships in construction design teams. Enabling design teams to actively improve their levels of trust, therefore contributes to practice. All in all, the research explores the use of prior ties, future ties, and virtual and

social meetings to develop the amount of interpersonal and inter-organizational trust in design teams. This exploration resulted in the development of a guideline which contributes to practice, while at the same time being new to the currently available literature.

6.3. Limitations

When interpreting the results and the conclusions of this research it is important to take some limitations into account. The limitations that this research is subjected to are elaborated upon below.

- **Sample size:** A considerable limitation to this research is the low sample size. Only 49 usable responses to the survey are gathered. As mentioned before, the measures for interpersonal and inter-organizational trust are derived from the research by Guo et al. (2021). The research by Guo et al. (2021) had 319 responses to the survey and predominantly significant results of the survey analysis. The small sample size of this research could have led to some non-significant relationships. A larger sample size may have led to more significance in the result, but it would certainly have resulted in a better representation of the target population.

- **Personal and organizational role:** Inter-organizational construction design teams can have multiple varying compositions with individuals performing different roles. To provide a broad view of the effect that ties have on trust in these teams, it is important to represent each of these roles in the sample. However, the distribution of roles in the sample population is highly centred. The largest group of team roles is that of project managers with 71.4% of the total sample size. This results in a considerable limitation when interpreting the results and the conclusions of this research. This research did not succeed in representing each role in the design teams evenly. This might influence the results regarding the relationships between ties and trust. Role differences can influence the perceived amount of trust development (Guo et al., 2021).

- **Work experience:** The sample population is represented by predominantly individuals with a relatively low (< 10 years) and relatively high (>20 years). Individuals with work experience between 10 and 20 years are not that well represented. As experience and background matter when determining whether to trust someone, this might have an effect on the results of the survey analysis (Mayer et al., 1995).

- **Survey and expert interview translation:** The survey is developed in English with the use of the literature review. As the target population mainly consists of Dutch-speaking individuals, it is chosen to translate the survey into Dutch. The translated survey is checked by fellow students and employees from Drees & Sommer. However, interpretation issues might have arisen. Moreover, the expert interview is conducted in Dutch as this is the native language of the experts and the researcher. The translated results of the expert interview, which are needed for the analysis, are checked by the experts to determine if they agree with the translation and the contents. However, some interpretation issues might still have arisen.

- **Respondents nationality:** The scope of this research considers building construction projects in the Dutch construction industry. This means that the target population are design team mem-

bers that predominantly have Dutch nationality. Cultural aspects might influence the development of trust in design teams. This limits the generalisability of the results of this research to design teams that consist of other nationalities.

7

Conclusion and recommendations

7.1. Conclusion

The conclusion of the research is formulated in this section. The conclusion is based on the findings of the research. First, each sub-question is answered by elaborately describing the relevant results of the research. This is followed by answering the main research question and thus achieving the goal of the research.

7.1.1. Answering the sub-questions

1. What does trust in the construction industry entail and which factors contribute to this?

The literature review of this research enables the determination of what trust exactly entails in the construction industry and which factors contribute to the development of trust. According to many researchers is trust one of the most important concepts in the construction industry as it helps to develop effective working relationships. Trust has varying definitions in current literature due to extensive research on this topic in several contexts. In this research, trust is defined as "A trustor's willingness to become vulnerable to a trustee whose behaviour is beyond his control." This definition originates from research by Mayer et al. (1995) and represents the idea that trust is affected by both the trustor and the trustee. Namely, the trustor's personal characteristics which may lead to a certain amount of vulnerability, and on the other hand the trustworthy behaviour of the trustee.

The concept of trust is divided into interpersonal and inter-organizational trust. Interpersonal trust is the level of trust between individuals, while inter-organizational trust considers the level of trust between two or more different organizations. Interpersonal trust can be further decomposed into two categories, namely cognitive trust and affective trust. Inter-organizational trust on the other hand can be divided into three categories; Integrity trust, competence trust and intuitive trust.

All the factors that contribute to interpersonal and inter-organizational trust found in the literature review can be seen in table 2.2 and table 2.3 respectively. The factors contributing to interpersonal and inter-organizational trust show similarities. Prior ties, a common philosophy, transparency and open

communication contribute to each trust type. Moreover, according to the literature does interpersonal trust result in inter-organizational trust. This is due to a diffusion process between the different contextual layers. All in all, can the trust developing factors be related to the three main concepts, namely communication, actions and outcomes.

2. What is the effect of prior and future ties on trust in inter-organizational teams according to literature?

Teams in this research are defined as "a group of people sharing a common mission or reason for working together, interdependent in effectively achieving the shared goals, and sharing a commitment to working together toward identifying and solving problems." (Albanese and Haggard, 1993). Inter-organizational teams specifically refer to "a team which is made up of representatives from the owner, designer, and/or contractor organizations that are involved together in producing the results" (Albanese and Haggard, 1993). This research focuses on the effect of interpersonal prior and future ties on the amount of trust in inter-organizational teams. Prior ties are defined as interactions that have occurred before the current collaboration took place, while future ties are expectations of collaboration in the future. Both types of investigated ties only consider the ties between individuals. The definition for interpersonal ties that is used in this research is: "Interpersonal ties refer to the subjective perception of interpersonal social interaction due to inter-organizational cooperation in construction projects." (Huang et al., 2016).

The effect that the interpersonal prior and future ties have on interpersonal and inter-organizational trust is investigated by performing a literature review. When considering prior ties, it is found that prior interactions breed interpersonal trust as the interactions between individuals are influenced by the developed social content, open communication and mutual behavioural expectations. The effect of prior ties on inter-organizational trust mainly comes from the diffusion of interpersonal trust into inter-organizational trust according to literature. Next to that, do prior ties ensure higher adaptability to deal with collaboration issues or miss-alignment resulting in inter-organizational trust development. However, it has to be mentioned that prior ties do not always improve trust, it is argued in the literature that due to the prior interactions, potential overestimates regarding team members' or organizations' competencies could result in disappointments and trust reduction. The research on the effect of future ties on trust only looked at inter-organizational ties and the effect on inter-organizational trust. It is found that expectations of future collaboration result in more inter-organizational trust. This effect originates from the idea that short-term opportunistic acts reduce the achieved future value. Employees of both organizations are therefore more likely to trust each other as they do not expect untrustworthy behaviour.

3. What is the proportionate effect of prior and future ties on interpersonal and inter-organizational trust in inter-organizational construction design teams?

Research by Poppo et al. (2008) considered the effect that both prior and future ties have on inter-organizational trust. They found that prior ties did not have a direct effect on the amount of inter-organizational trust. According to them, it only increased the positive effect that the expectations of continuity have on the amount of trust. However, as mentioned before, Poppo et al. (2008) only looked

at inter-organizational ties and inter-organizational trust.

The analysis of the survey considered the effect that both prior and future ties have on interpersonal and inter-organizational trust. However, the only significant relationships are found between prior ties and interpersonal trust, and between future ties and inter-organizational trust. When considering the significant relationship between prior ties and interpersonal trust, the survey analysis shows that both the existence and amount of prior ties result in an increase in interpersonal trust. This is in line with the literature findings. The significant relationships between future ties and inter-organizational trust on the other, similarly show that future ties increase the inter-organizational trust in design teams. The literature review is also in line with this notion. Nevertheless, it is not possible to exactly determine the proportionate effect that both prior and future ties have on trust with the survey analysis due to the non-significance of the other relationships. However, a large contributor to inter-organizational trust is the presence of interpersonal trust. This notion is argued in literature. It is thought that interpersonal trust is conveyed into inter-organizational trust through a diffusion process. As said before, prior ties are proven to increase interpersonal trust in design teams with the survey analysis and the literature review. This increased interpersonal trust will subsequently result in an increase in inter-organizational trust. One could therefore argue that prior ties have a proportionately larger effect on the amount of trust as it is beneficial for both interpersonal and inter-organizational trust. Future ties, on the other hand, are only considered to improve the amount of inter-organizational trust by both the survey analysis and the literature review. However, these statements are not substantiated by the empirical analysis and therefore it can not be concluded that the effect of prior ties is more significant than the effect of future ties. Moreover, more research should be performed on this proportionate effect as the non-significance in the survey analysis might be the result of other factors like the small sample size of the survey.

4. How do virtual meetings, during the course of a project, influence the effect of ties on trust in inter-organizational construction design teams?

The construction design teams that are the focus of this research could have experienced a certain amount of virtual meetings during their projects due to the COVID-19 pandemic. The potential effect of virtual meetings on these teams is therefore investigated. The focus of this investigation lies on the potential effect of virtual work-related meetings and social face-to-face meetings. The effect that both virtual work-related and social face-to-face meetings have on interpersonal and inter-organizational trust is investigated by using a moderation analysis. The moderation analyses showed predominantly non-significant results. A significant moderating effect is only found for the impact of virtual work-related meetings on the effect of the existence of prior ties on interpersonal trust. The moderation effect showed that a high frequency of virtual work-related meetings reduces the positive effect that prior ties have on the levels of interpersonal trust in the teams. Findings in the literature review are in line with this result, as it is stated that virtual work-related meetings make trust development difficult as it prohibits the creation of interpersonal connections (Aissa et al., 2022, Hacker et al., 2019). The direct effect between the frequency of virtual work-related meetings and interpersonal trust also shows a negative correlation. The effect on inter-organizational trust, however, shows no significance and is also not found in the literature review. This difference in the effect of virtual work-related meetings

on interpersonal and inter-organizational trust is expected to be due to the irrelevance of the lack of social interaction to the amount of trust one has for an organization. However, this argument is not supported by the survey analysis as the non-significant relationship might be caused by other factors.

Social face-to-face meetings show no significant moderating effect on any of the relationships between ties and trust. However, when considering the direct effect, it is found that the amount of social face-to-face meetings have a significant positive effect on both trust types. This means that when the number of organized face-to-face social meetings increases, this results in more interpersonal and inter-organizational trust in the design teams. This is in line with the findings in the literature review which mention that face-to-face meetings develop a shared understanding and interpersonal connections between the design team members which are beneficial for the development of interpersonal trust (Rogers et al., 2021). This interpersonal trust could subsequently be conveyed in inter-organizational trust.

5. How can design team members enhance the amount of trust present in inter-organizational construction design teams?

As argued in the literature, trust increases the willingness to share information, aligns the interest of stakeholders and improves team performance. Thus, improving trust could reinforce team processes and subsequently project success. Influencing the amount of trust in teams would therefore be beneficial for design teams and the projects that they participate in. The potential utilization of ties and virtual and social meetings to improve trust in inter-organizational construction design teams is investigated by evaluating the results of the literature review and the survey analysis. The findings of this evaluation are used to develop recommendations, which are combined into a guideline for design team members. The recommendations are evaluated by performing an expert interview. The experts provide a professional experience which is needed to assess the practical relevance and the feasibility of the guideline.

To influence interpersonal trust, it is recommended to focus on the development of a design team composition in which prior ties are present between the design team members. Besides, when considering the effect of virtual and social meetings on trust development in teams, it is recommended to organize online or face-to-face social events for the design team members to develop interpersonal ties and a shared understanding between the team members. Also, as virtual work-related meetings have a non-beneficial effect on the amount of interpersonal trust, it is recommended to try to organize as many face-to-face work-related meetings with the design team as possible.

Influencing inter-organizational trust, on the other hand, can be realised by making design team members aware of expected future collaboration when this expectation is present. Another recommendation to improve inter-organizational trust is related to the transformation of interpersonal trust into inter-organizational trust. Design teams are recommended to focus on interpersonal trust development as the trust between individuals portrays onto the trust for organizations. Moreover, the survey analysis showed that virtual work-related meetings do not directly affect the amount of inter-organizational trust in teams. On the contrary, social face-to-face meetings do positively affect inter-

organizational trust. It is therefore recommended to organize face-to-face social events for the design team.

All in all, there are multiple ways for design team members to influence trust in design teams by focusing on the effects of ties and meetings. The finalized trust guideline can be found in figure 7.1.

7.1.2. Answering the main research question

The answers to the research sub-questions are used to provide an answer to the main question of this research. The main research question is formulated as follows:

"What is the effect of ties on trust in inter-organizational construction design teams?"

This research focuses on the effect of interpersonal prior and future ties on the amount of trust in inter-organizational design teams in the Dutch construction industry. The research combines the results of a literature review and a survey analysis. The results of the research enabled the development of a trust guideline which can be used by design team members to improve the levels of trust within their team. The design team trust guideline is displayed in figure 7.1.

As the Dutch construction design teams in the scope of this research are subjected to COVID-19 restrictions, it is necessary to take the impact of the virtual work environment into account. To find the true effects of ties on trust, and to ensure the relevance of this research, the impact that virtual meetings have on the relationship between ties and trust has to be discovered.

The investigated ties in this research are interpersonal prior and future ties. Prior ties consider interactions that have occurred before the current collaboration took place. Future ties are defined as expectations of future collaboration. Trust is similarly divided into two categories. Namely, interpersonal and inter-organizational trust. As displayed in the trust guideline (figure 7.1), both trust types are beneficial for the design teams. To obtain these benefits one should utilize the effects of ties. It has been found that there are multiple varying effects of ties on trust. Prior ties, or prior interactions between individuals, directly affect the amount of interpersonal trust in design teams. Team members that have prior experience with each other tend to have a common philosophy and experience open communication. The positive effect of prior ties on inter-organizational trust, on the other hand, is predominantly caused by the transformation of interpersonal trust into inter-organizational trust. Thus, as can be seen in figure 7.1, these findings can be utilized to improve the levels of trust in the design team. When considering future ties, or the expectations of future collaboration between individuals. These ties have a direct positive effect on the amount of inter-organizational trust in design teams. This is due to the idea that the expected future payoff of trustworthy collaboration outweighs the gain from short-term self-interested behaviour. The effect of future ties on interpersonal trust on the other hand is not present. Again, as can be seen in 7.1, can these known effects be used to the advantage of design teams.

The transformation of interpersonal into inter-organizational trust is a reoccurring process in the results of this research. This process is identified as the main contributor to inter-organizational trust. When comparing both the effects of ties on trust in design teams. It is suggested that prior ties have

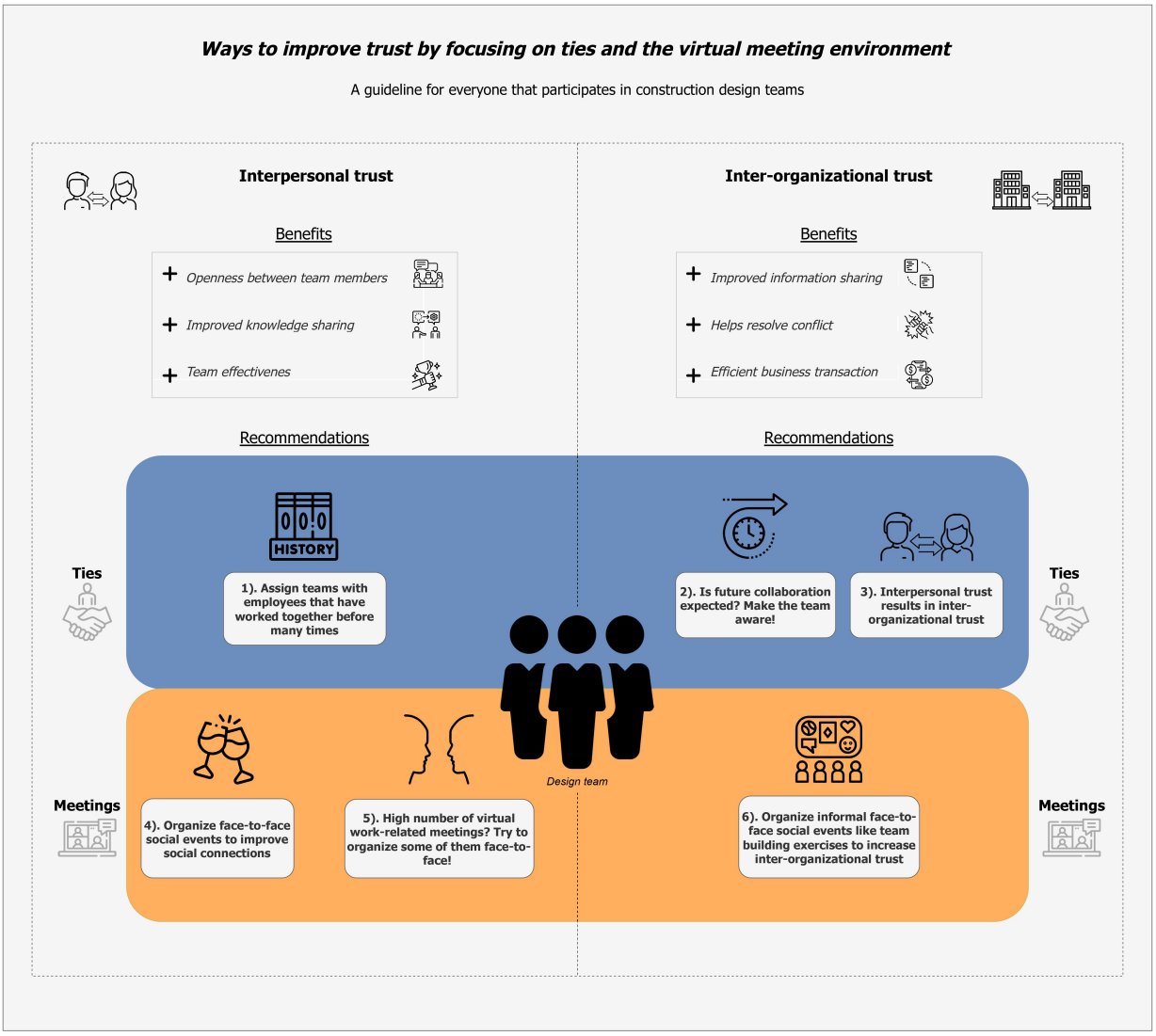

Figure 7.1: Design team trust guideline

a more significant impact on the levels of trust. Prior ties are proven to increase interpersonal trust. This increased interpersonal trust subsequently results in an increase in inter-organizational trust due to the diffusion process. Future ties on the other hand only contribute to inter-organizational trust. Nevertheless, it should be noted that due to multiple non-significant relationships in the empirical analysis, this suggestion can not be concluded.

As displayed in the trust guideline (figure 7.1), there are also meetings that affect the levels of trust in design teams. As mentioned, the design teams are impacted by the virtual meeting environment. In order to cope with these impacts, the effects of virtual work-related and social face-to-face can be used. Research has shown that virtual work-related meetings have a negative moderating impact on the positive effect of prior ties on interpersonal trust. Moreover, virtual work-related meetings directly affect the levels of interpersonal trust in teams. On the contrary, virtual work-related meetings do not affect inter-organizational trust. This may be due to the irrelevance of the lack of social interactions to the amount of trust an individual has for organizations. However, again, due to non-significance in

the survey analysis, this argument can not be substantiated by empirical evidence.

Social face-to-face meetings, on the other hand, show significant positive effects for both trust types. Thus, to improve trust, design teams are recommended to organize these meetings. The results of the survey analysis however, surprisingly show that design teams did yet not implement social meetings to improve trust and team processes. The lack of responses related to the presence of virtual social meetings in the sample population indicate that this positive effect of social meetings, and the development of interpersonal connections related to it, are not yet widely known and utilized by design teams.

It has to be mentioned that the findings of this research are subjected to several limitations which have to be considered when interpreting the conclusions. First and foremost, during the research, it proved to be very difficult to gather respondents for the survey. This has resulted in a small sample size. Due to this considerable limitation, many other limitations have originated like an unequal representation of personal and organizational roles taking part in the surveyed design teams. Especially the view from a project manager role may have influenced the results of the research. Nevertheless, this research elaborates further on existing literature and broadens our understanding of trust development in construction design teams.

Thus, to conclude, ties are an important factor in the development of trust in design teams. By utilizing the individual aspects of prior and future ties, design team members can improve the levels of trust in their team. It is suggested that prior ties are more important for trust development than future ties. However, it should be noted that prior ties are no silver bullet. Prior experiences may induce unmet preexisting expectations and laxity. In addition, the potential non-beneficial effects of virtual meetings on trust in the design team should be considered. To deal with these effects it is advised to organize social and face-to-face meetings. Lastly, it is important to emphasize the development of interpersonal connections through social interactions because the results of this research indicate that this awareness is not yet widely present in inter-organizational construction design teams.

7.2. Recommendations for practice

For inter-organizational design teams in the construction industry it is recommended to consider the importance of prior ties for trust development. It is believed that trust is one of the key factors contributing to team and eventually project success. Therefore, design teams are advised to focus on combining design team members that have personal acquaintances. Moreover, in order to further benefit from trust in teams it is important to take into account the potentially negative effect that virtual meetings may haves. Especially when considering the change in the way of working after the pandemic. People work more from home and therefore virtual meetings are inevitable. In order to cope with the potential negative effect of virtual meetings, design teams are recommended to focus on developing interpersonal connection by organizing some meetings face-to-face or to organize social events. The trust guideline developed in this research may be used by the design teams as it provides an overview of the recommendations that can be used to improve trust.

7.3. Recommendations for further research

Based on the existing research, recommendations for further research are developed. These recommendations consider topics that fell outside of the scope of this research or relate to the experienced limitations of this research. The recommendations are described below and can provide insights into areas fit for future research.

- **Role differences:** The current research did not differentiate between roles in the design team. However, as researched by Guo et al., 2021, the effect of interpersonal ties on inter-organizational trust differs between team members and project leaders. Further research on the different effects of prior and future ties on trust related to roles in the design team could considered. The specific effect of trust development for the client or contractor for example, may have contrasting mechanisms related to it.

- **Hybrid meetings:** During the expert evaluation of the trust guideline, the experts mentioned the use of hybrid meetings in design teams. Their notion on these meetings was that they should be avoided at all cost as it results in inefficient meetings. This is because communication with individuals that participate virtually in the hybrid meeting is negatively affected. Further research may investigate this topic and find out what the exact effect of these meetings on the trust development in design teams and how to overcome these potential negative effects.

- **Development of trust throughout projects:** The current research considered trust in the whole lifetime of the design team. Taking into account each different phase of the design process. However, the levels of trust are measured at singular points. A recommendation for further research is to look into how trust develops throughout a project or design process. Specifically, how the influence of ties changes the levels of trust in a team from the beginning till the end of the design process. Moreover, this effect could also be researched when considering the effects of virtual meetings. Thus, investigating how trust changes throughout a project when influenced by a certain frequency of virtual meetings.

- **Diffusion process of interpersonal into inter-organizational trust:** A recurring process in this research is the diffusion process of interpersonal trust into organizational trust. Interpersonal trust related to the individuals is portrayed in the organizations that they work for. But the exact amount of this trust diffusion is not yet investigated. Moreover, the precise mechanisms generating this diffusion process can be considered for future research.

- **Cultural differences:** The current research focuses on design teams in the Dutch construction industry. The effect of ties on trust might be affected by the Dutch culture. As mentioned by Guo et al. (2021) and Wang et al. (2017), culture influences the perception of trust. The generalizability of this research is therefore limited. The effect of ties on trust in the Dutch culture may be different than in other cultures. A recommendation for future research is to investigate the effect that cultural differences have on this relationship. Moreover, teams consisting of multiple nationalities may also experience different trust-building processes. These international design teams could also be considered for future research.

- **Execution phase:** The design phase is the focus of the current research. This phase has specific characteristics related to it. As it exists in the front-end phase of construction projects no previous collaboration took place that could affect the trust between individuals or organizations. This is different for the execution phase of the project. The effects of prior and future ties on trust development in the execution phase of a project could be considered for future research.

- **Contract types:** The contract type sample characteristics of this research did not provide a valid representation of the contract types used by the design teams. This is due to misinterpretation. Some respondents provided answers which relate to model agreements or certain terms and conditions. It is recommended to include the effect that contract types may have on the relationship between ties and trust in further research.

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A

Literature review plan

In order to search for relevant literature and lay the foundation of the current research, a step-for-step literature review plan is composed. This literature review plan ensures the completeness of the literature review and maintains the quality and repeatability of the research. The plan helps to structure the literature review and prevent unnecessary repetitions of certain search queries. It has to be mentioned that not all used literature is found with the use of this literature review plan. Some of the literature is provided by the graduation supervisors or are found in the bibliography of relevant articles. The desired outcome of this literature review plan is to gather a large enough set of articles and papers to substantiate the research and help answer the research questions. In this section the literature review plan is described.

A.1. Defining the search queries

The research concepts relevant for this literature review originate from the main and sub-questions of this research:

"What is the effect of ties on trust in inter-organizational construction design teams?"

1. What does trust in the construction industry entail and which factors contribute to this?
2. What is the effect of prior and future ties on trust in teams according to literature?
3. What is the proportionate effect of prior and future ties on interpersonal and inter-organizational trust in inter-organizational construction design teams?
4. How do virtual meetings, during the course of a project, influence the effect of ties on trust in inter-organizational construction design teams?
5. How can design teams members influence the amount of trust present in inter-organizational construction design teams?

The main and sub-questions are decomposed in a set of concepts. These concepts are summarized in table A.1. In order to maintain a broad view of these concepts and ensure that no relevant literature is lost, the synonyms and alternatives of these concepts are listed. These alternatives and synonyms are merged with Boolean operators in order to find each potentially relevant article or paper. “TU Delft” (2021) provided information on how to use Boolean operators to formulate the search queries. The concepts, their synonyms and alternatives are merged using the "OR" operator to find as much information as possible. These search queries are then combined using the "AND" operator which makes the search more relevant. The "*" Boolean operator replaces zero or more characters to provide a wider range of possibilities. Each possible combination is executed in search engines to find a wide range of literature. These articles are briefly scanned in order to determine the relevancy. If the literature is determined as relevant for the research, it is added to the Mendeley library which helps organizing the vast amount of literature.

Table A.1: Literature review concepts

	Combine concepts with AND						
Combine synonyms with OR	**Ties**	**Trust**	**Inter-organizational**	**Design teams**	**Construction industry**	**Virtual**	**Meetings**
	Tie*	Trust*	Inter* organizational	Design team*	Construction industry	Virtual*	Meeting*
	Relationship*		Inter* organisational	Design phase	Construction environment	Digital*	Communicate*
	Partner*				Built* industry	Online	Interact*
	Partnership*				Built* environment	Connect*	Work* together
	Connection*					Electronical*	Teamwork*
	Link					Wired	Collaborat*

A.2. Relevant scientific search engines

There exists a wide variety of scientific literature research engines. For the initial exploration of potentially relevant literature, the search engine Scopus is used. When certain search queries did not provide enough hits or relevant articles and papers, literature was retrieved from Google Scholar or Web of Science. As has been mentioned, it often occurred that a relevant paper or article provided citations for literature that seemed useful for the current research. Moreover, some of the literature is provided by the graduation supervisors during the course of the research. Therefore not all utilized literature originated from the search engines. An oversight of the used search engines is provided below.

- Search engines:
  - Scopus
  - Web of Science
  - Google Scholar

B

Results of the survey

B.1. Independent variables

The overviews of the response frequencies of the independent variables are displayed in this section.

B.1.1. Prior ties

Table B.1: Presence of prior ties (PT0or1)

Presence of ties	Frequency	Percent	Cumulative percent
No prior ties present	31	63.3%	63.3%
Prior ties present	18	36.7%	100.0%
Total	49	100.0%	100.0%

B.2. Correlation overview

The correlation overview, displayed in figure B.1, shows the correlation between the items of the dependent variables, the independent and the moderating variables. The numbers in red show relationships that are significant on the p = 0.05 level.

Correlations

		PT1	PTOor1	FT1	FT2	VMW#2	VMS#1	VMS#2	IPTA1	IPTA2	IPTA3	IPTC1	IPTC2	IPTC3	IPTC4	IOTC1	IOTC2	IOTC3	IOTIV1	IOTIV2	IOTIV3	IOTI1	IOTI2	IOTI3	IPT_full	IOT_full
Spearman's rho	PT1	Correlation Coefficient	1,000	,974**	0,085	0,235	-,365*	0,236	-0,025	0,127	,386*	0,203	-0,120	0,224	0,191	0,101	-0,014	0,095	0,247	,341*	0,032	0,005	0,123	0,114	0,139	,308*	0,115
		Sig. (2-tailed)		0,000	0,563	0,104	0,010	0,103	0,885	0,383	0,005	0,162	0,410	0,122	0,189	0,488	0,922	0,515	0,088	0,017	0,828	0,971	0,399	0,436	0,342	0,031	0,431
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	PTOor1	Correlation Coefficient	,974**	1,000	0,010	0,225	-,384*	0,220	-0,054	0,137	,416*	0,211	-0,115	0,287	0,188	0,118	0,010	0,103	0,259	,327*	-0,031	0,002	0,088	0,086	0,147	,337*	0,096
		Sig. (2-tailed)	0,000		0,948	0,120	0,007	0,128	0,714	0,348	0,003	0,146	0,431	0,064	0,196	0,419	0,946	0,481	0,073	0,022	0,833	0,981	0,548	0,556	0,314	0,018	0,510
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	FT1	Correlation Coefficient	0,085	0,010	1,000	,342*	-,347*	,326*	-0,073	0,221	0,147	0,208	0,175	0,092	0,151	0,038	0,218	,316*	0,140	0,135	,476**	0,216	,421**	,433**	0,159	0,202	,430**
		Sig. (2-tailed)	0,563	0,948		0,016	0,015	0,022	0,619	0,127	0,313	0,153	0,228	0,530	0,299	0,798	0,133	0,027	0,339	0,356	0,001	0,136	0,003	0,002	0,274	0,163	0,002
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	FT2	Correlation Coefficient	0,235	0,225	,342*	1,000	-0,249	0,200	0,136	,301*	0,145	0,040	,551**	,460**	0,299	0,455**	,808**	,629**	,422**	0,403**	0,251	0,161	0,197	0,248	,414**	,491**	,541**
		Sig. (2-tailed)	0,104	0,120	0,016		0,085	0,169	0,351	0,035	0,320	0,788	0,000	0,001	0,001	0,001	0,000	0,000	0,002	0,004	0,082	0,289	0,174	0,086	0,003	0,000	0,000
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	VMW#2	Correlation Coefficient	-,365*	-,384*	-,347*	-0,249	1,000	-,432**	-0,140	-,285*	-0,251	-,581**	0,024	-0,129	-0,242	-0,279	-0,150	-,383**	-0,280	-0,099	-0,012	-0,060	-0,193	-0,115	-0,169	-,428**	-0,226
		Sig. (2-tailed)	0,010	0,007	0,015	0,085		0,002	0,337	0,047	0,081	0,000	0,872	0,376	0,094	0,052	0,303	0,010	0,052	0,499	0,936	0,682	0,185	0,433	0,246	0,002	0,119
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	VMS#1	Correlation Coefficient	0,236	0,220	,326*	0,200	-,432**	1,000	0,275	,487**	0,204	0,253	0,156	,296*	0,079	0,142	0,083	0,210	0,091	0,135	0,164	0,210	0,163	,309*	0,183	,354*	,283*
		Sig. (2-tailed)	0,103	0,128	0,022	0,169	0,002		0,055	0,000	0,160	0,080	0,285	0,039	0,592	0,331	0,570	0,147	0,532	0,354	0,260	0,148	0,283	0,031	0,209	0,013	0,049
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
	VMS#2	Correlation Coefficient	-0,025	-0,054	-0,073	0,136	-0,140	0,275	1,000	0,125	-0,018	,294*	-0,014	0,017	-0,023	0,047	-0,115	-0,026	-0,087	0,174	0,004	0,021	-0,096	-0,021	0,104	0,016	0,013
		Sig. (2-tailed)	0,865	0,714	0,619	0,351	0,337	0,055		0,392	0,901	0,041	0,923	0,909	0,876	0,751	0,432	0,857	0,553	0,232	0,980	0,885	0,512	0,887	0,914	0,479	0,928
		N	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49

Figure B.1: Correlation overview

B.3. Sample characteristics

The overviews of the response frequencies of the control variables are displayed in this section.

B.3.1. Project

Table B.2: Project overview

Project number	Frequency	Percent	Cumulative perc
1	1	2.0%	2.0%
10	2	4.1%	6.1%
11	1	2.0%	8.2%
12	3	6.1%	14.3%
13	4	8.2%	22.4%
14	1	2.0%	24.5%
15	2	4.1%	28.6%
16	2	4.1%	32.7%
17	1	2.0%	34.7%
18	1	2.0%	36.7%
19	1	2.0%	38.8%
2	1	2.0%	40.8%
20	2	4.1%	44.9%
21	2	4.1%	49.0%
22	1	2.0%	51.0%
23	1	2.0%	53.1%
24	1	2.0%	55.1%
25	1	2.0%	57.1%
26	1	2.0%	59.2%
27	1	2.0%	61.2%
28	1	2.0%	63.3%
29	2	4.1%	67.3%
3	1	2.0%	69.4%
30	1	2.0%	71.4%
31	1	2.0%	73.5%
32	1	2.0%	75.5%
33	1	2.0%	77.6%
34	2	4.1%	81.6%
4	4	8.2%	89.8%
5	1	2.0%	91.8%
6	1	2.0%	93.9%
7	1	2.0%	95.9%
8	1	2.0%	98.0%
9	1	2.0%	100.0%
Total	49	100.0%	100.0%

B.3.2. Project phase

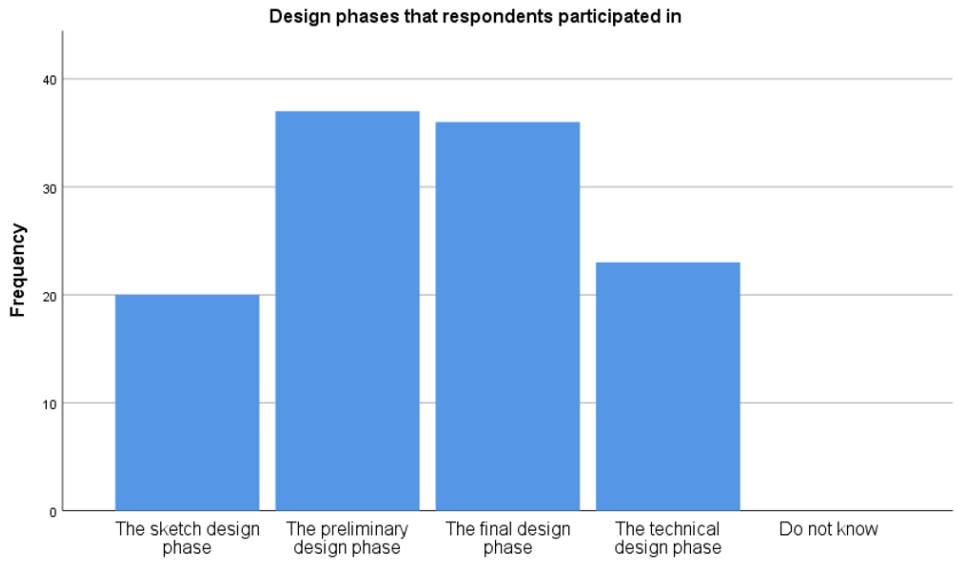

Figure B.2: Project phase frequencies

B.3.3. Organizational role in design team

Table B.3: Overview of organizational roles in design teams

Role type	Frequency	Percent	Cumulative percent
Designer/Architect	4	8.2%	8.2%
Contractor	1	2.0%	10.2%
Project/Process manager	33	62.3%	77.6%
Consultant	5	10.2%	87.8%
Client	4	8.2%	95.9%
Other	2	4.1%	100%
Total	49	100%	100%

B.3.4. Work experience

Table B.4: Work experience overview

Experience	Frequency	Percent	Cumulative percent
0 - 5 years	13	26.5%	26.5%
5 - 10 years	13	26.5%	53.1%
10 - 15 years	8	16.3%	69.4%
15 - 20 years	3	6.1%	75.5%
More than 20 years	12	24.5%	100%
Total	49	100%	100%

B.4. Moderating effects

The results of the moderation analysis using PROCESS in SPSS are displayed in this section.

B.4.1. Virtual work-related meetings

Moderating effect virtual work-related meetings on PT1 → IPT_full

Figure B.3 shows the PROCESS output of the moderating effect of the frequency of virtual work-related meetings on the relationship between the amount of prior ties and interpersonal trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : IPT_full
    X  : PT1
    W  : VMW#2

Sample
Size:  49

**************************************************************************
OUTCOME VARIABLE:
 IPT_full

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,3932      ,1546      ,2886     2,7434     3,0000    45,0000      ,0541

Model
              coeff         se          t          p       LLCI       ULCI
constant     4,1083      ,5688     7,2226      ,0000     2,9627     5,2540
PT1           ,2630      ,3086      ,8521      ,3987     -,3586      ,8846
VMW#2        -,0692      ,1361     -,5082      ,6138     -,3434      ,2050
Int_1        -,0329      ,0800     -,4115      ,6826     -,1941      ,1282

Product terms key:
 Int_1    :        PT1      x        VMW#2

Test(s) of highest order unconditional interaction(s):
       R2-chng           F        df1        df2          p
X*W      ,0032      ,1693     1,0000    45,0000      ,6826
----------
    Focal predict: PT1      (X)
          Mod var: VMW#2    (W)

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   PT1        VMW#2      IPT_full    .
BEGIN DATA.
     1,0000     2,0000     4,1671
     1,0000     2,0000     4,1671
     2,0000     2,0000     4,3642
     1,0000     4,0000     3,9628
     1,0000     4,0000     3,9628
     2,0000     4,0000     4,0941
     1,0000     5,0000     3,8607
     1,0000     5,0000     3,8607
     2,0000     5,0000     3,9590
END DATA.
GRAPH/SCATTERPLOT=
 PT1      WITH     IPT_full BY       VMW#2    .

********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

------ END MATRIX -----
```

Figure B.3: PROCESS moderation output effect of VMW#2 on PT1 → IPT_full

Moderating effect virtual work-related meetings on PT0or1 → IPT_full

Figure B.4 shows the PROCESS output of the moderating effect of the frequency of virtual work-related meetings on the relationship between the existence of prior ties and interpersonal trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : IPT_full
    X  : PT0or1
    W  : VMW#2

Sample
Size:  49049

**************************************************************************
OUTCOME VARIABLE:
 IPT_full

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,4172      ,1740      ,2590  3444,7863     3,0000 49045,0000      ,0000

Model
             coeff         se          t          p       LLCI       ULCI
constant    3,5772      ,0240   148,8240      ,0000     3,5301     3,6243
PT0or1       ,6371      ,0152    41,9347      ,0000      ,6073      ,6669
VMW#2        ,0214      ,0056     3,7899      ,0002      ,0103      ,0324
Int_1       -,0928      ,0038   -24,5185      ,0000     -,1002     -,0854

Product terms key:
 Int_1    :       PT0or1    x       VMW#2

Test(s) of highest order unconditional interaction(s):
       R2-chng           F        df1        df2          p
X*W      ,0101   601,1585     1,0000 49045,0000      ,0000
----------
    Focal predict: PT0or1    (X)
          Mod var: VMW#2     (W)

Conditional effects of the focal predictor at values of the moderator(s):

      VMW#2     Effect         se          t          p       LLCI       ULCI
     2,0000      ,4515      ,0084    53,5750      ,0000      ,4350      ,4680
     4,0000      ,2659      ,0051    52,3154      ,0000      ,2559      ,2759
     5,0000      ,1731      ,0068    25,4614      ,0000      ,1598      ,1864

Data for visualising the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   PT0or1     VMW#2      IPT_full    .
BEGIN DATA.
     1,0000     2,0000     4,0714
     2,0000     2,0000     4,5229
     1,0000     4,0000     3,9286
     2,0000     4,0000     4,1945
     1,0000     5,0000     3,8571
     2,0000     5,0000     4,0302
END DATA.
GRAPH/SCATTERPLOT=
 VMW#2     WITH      IPT_full BY       PT0or1    .

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

W values in conditional tables are the 16th, 50th, and 84th percentiles.

------ END MATRIX -----
```

Figure B.4: PROCESS moderation output effect of VMW#2 on PT0or1 → IPT_full

Moderating effect virtual work-related meetings on FT1 → IOT_full

Figure B.5 shows the PROCESS output of the moderating effect of the frequency of virtual work-related meetings on the relationship between the expectancy of future collaboration and inter-organizational trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : FT1
    X  : IOT_full
    W  : VMW#2

Sample
Size:  49

**************************************************************************
OUTCOME VARIABLE:
 FT1

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,3588       ,1288      ,8377     2,2167     3,0000    45,0000      ,0992

Model
              coeff         se          t          p       LLCI       ULCI
constant     2,0984     3,5893      ,5846      ,5617    -5,1308     9,3277
IOT_full      ,6145      ,8474      ,7251      ,4721    -1,0923     2,3213
VMW#2         ,0283      ,8032      ,0352      ,9721    -1,5894     1,6460
Int_1        -,0383      ,1917     -,2000      ,8424     -,4244      ,3477

Product terms key:
 Int_1    :        IOT_full x        VMW#2

Test(s) of highest order unconditional interaction(s):
       R2-chng           F        df1        df2          p
X*W      ,0008       ,0400     1,0000    45,0000      ,8424
----------
    Focal predict: IOT_full (X)
          Mod var: VMW#2    (W)

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   IOT_full    VMW#2       FT1         .
BEGIN DATA.
     3,4444     2,0000     4,0074
     4,2222     2,0000     4,4257
     4,6667     2,0000     4,6647
     3,4444     4,0000     3,7999
     4,2222     4,0000     4,1585
     4,6667     4,0000     4,3635
     3,4444     5,0000     3,6961
     4,2222     5,0000     4,0249
     4,6667     5,0000     4,2128
END DATA.
GRAPH/SCATTERPLOT=
 IOT_full WITH      FT1       BY        VMW#2     .

********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

------ END MATRIX -----
```

Figure B.5: PROCESS moderation output effect of VMW#2 on FT1 → IOT_full

B.4.2. Social face-to-face meetings

Moderating effect social face-to-face meetings on PT1 → IPT_full

Figure B.6 shows the PROCESS output of the moderating effect of the frequency of social face-to-face meetings on the relationship between the amount of prior ties and interpersonal trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : IPT full
    X  : PT1
    W  : VMS#1

Sample
Size:  49

**************************************************************************
OUTCOME VARIABLE:
 IPT_full

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,3903       ,1523      ,2894     2,6949     3,0000    45,0000      ,0572

Model
              coeff         se          t          p       LLCI       ULCI
constant     3,3852      ,3458     9,7909      ,0000     2,6888     4,0816
PT1           ,2584      ,2054     1,2582      ,2148     -,1553      ,6721
VMS#1         ,2256      ,1586     1,4228      ,1617     -,0938      ,5450
Int_1        -,0511      ,0821     -,6223      ,5369     -,2164      ,1142

Product terms key:
 Int 1    :        PT1      x        VMS#1

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      ,0073      ,3873     1,0000    45,0000      ,5369
----------
    Focal predict: PT1       (X)
          Mod var: VMS#1     (W)

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   PT1        VMS#1       IPT_full    .
BEGIN DATA.
     1,0000     1,0000     3,8182
     1,5510     1,0000     3,9325
     2,3942     1,0000     4,1073
     1,0000     1,8571     3,9678
     1,5510     1,8571     4,0580
     2,3942     1,8571     4,1959
     1,0000     2,9373     4,1564
     1,5510     2,9373     4,2161
     2,3942     2,9373     4,3075
END DATA.
GRAPH/SCATTERPLOT=
 PT1       WITH      IPT_full BY       VMS#1     .

********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

NOTE: One SD below the mean is below the minimum observed in the data for W,
      so the minimum measurement on W is used for conditioning instead.

------ END MATRIX -----
```

Figure B.6: PROCESS moderation output effect of VMS#1 on PT1 → IPT_full

Moderating effect social face-to-face meetings on PT0or1 → IPT_full

Figure B.7 shows the PROCESS output of the moderating effect of the frequency of social face-to-face meetings on the relationship between the existence of prior ties and interpersonal trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : IPT full
    X  : PT0or1
    W  : VMS#1

Sample
Size:  49

**************************************************************************
OUTCOME VARIABLE:
 IPT_full

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,4197      ,1762      ,2812     3,2078     3,0000    45,0000      ,0318

Model
              coeff         se          t          p       LLCI       ULCI
constant     3,1280      ,4690     6,6694      ,0000     2,1834     4,0726
PT0or1        ,4796      ,3226     1,4866      ,1441     -,1702     1,1294
VMS#1         ,2664      ,2294     1,1610      ,2517     -,1957      ,7284
Int 1        -,0874      ,1453     -,6011      ,5508     -,3800      ,2053

Product terms key:
 Int_1    :        PT0or1    x        VMS#1

Test(s) of highest order unconditional interaction(s):
       R2-chng           F        df1        df2          p
X*W      ,0066      ,3614     1,0000    45,0000      ,5508
----------
    Focal predict: PT0or1    (X)
          Mod var: VMS#1     (W)

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   PT0or1     VMS#1      IPT_full    .
BEGIN DATA.
     1,0000     1,0000     3,7866
     2,0000     1,0000     4,1788
     1,0000     2,0000     3,9656
     2,0000     2,0000     4,2704
     1,0000     3,0000     4,1446
     2,0000     3,0000     4,3621
END DATA.
GRAPH/SCATTERPLOT=
 VMS#1    WITH     IPT_full BY       PT0or1    .

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

------ END MATRIX -----
```

Figure B.7: PROCESS moderation output effect of VMS#1 on PT0or1 → IPT_full

Moderating effect social face-to-face meetings on FT1 → IOT_full

Figure B.8 shows the PROCESS output of the moderating effect of the frequency of social face-to-face meetings on the relationship between the expectancy of future collaboration and inter-organizational trust.

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 4.1 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2022). www.guilford.com/p/hayes3

**************************************************************************
Model  : 1
    Y  : IOT full
    X  : FT1
    W  : VMS#1

Sample
Size:  49

**************************************************************************
OUTCOME VARIABLE:
 IOT full

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      ,3447      ,1188      ,3196     2,0223     3,0000    45,0000      ,1242

Model
              coeff         se          t          p       LLCI       ULCI
constant     2,8313      ,7021     4,0326      ,0002     1,4172     4,2454
FT1           ,2884      ,1703     1,6936      ,0973     -,0546      ,6313
VMS#1         ,3932      ,4273      ,9203      ,3623     -,4674     1,2538
Int 1        -,0785      ,0980     -,8016      ,4270     -,2758      ,1188

Product terms key:
 Int 1    :        FT1      x        VMS#1

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      ,0126      ,6426     1,0000    45,0000      ,4270
----------
    Focal predict: FT1      (X)
          Mod var: VMS#1    (W)

Data for visualizing the conditional effect of the focal predictor:
Paste text below into a SPSS syntax window and execute to produce plot.

DATA LIST FREE/
   FT1        VMS#1      IOT full    .
BEGIN DATA.
     3,1730     1,0000     3,8904
     4,1224     1,0000     4,0896
     5,0000     1,0000     4,2738
     3,1730     1,8571     4,0139
     4,1224     1,8571     4,1492
     5,0000     1,8571     4,2743
     3,1730     2,9373     4,1695
     4,1224     2,9373     4,2243
     5,0000     2,9373     4,2749
END DATA.
GRAPH/SCATTERPLOT=
 FT1      WITH     IOT_full BY       VMS#1    .

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95,0000

NOTE: One SD below the mean is below the minimum observed in the data for W,
      so the minimum measurement on W is used for conditioning instead.

------ END MATRIX -----
```

Figure B.8: PROCESS moderation output effect of VMS#1 on FT1 → IOT_full

C

Expert interview

In this appendix, the expert interview of section 5.4 is described in detail. The structure of the interview is explained and the questions related to each part of the interview are stated. Finally, the results of the interview are displayed.

C.1. Interview structure

The structure of the interview is divided into two parts. The interview is started by confirming if the concepts of the received are perceived similarly by the experts and the researcher. After that the guideline is evaluated. In this section, each part is briefly explained and the questions related to the content of the parts are stated.

C.1.1. Definitions

To make sure that the concepts are perceived similarly by the experts and the researcher, the definitions of the main concepts are stated. If both parties fully understand the proposed definitions, the interview is continued.

- Do you fully understand the proposed definitions?

C.1.2. Guideline evaluation

The recommendations that are combined in the concept guideline are evaluated with the help of the experts. This testing of the guideline predominantly focuses on the practicality and feasibility of the guideline as these experts have knowledge and experience regarding the use of certain recommendations in practice. The feedback from the experts is used to improve and finalize the guideline. The questions below evaluate the recommendations related to ties and meetings separately. Lastly, the overall usefulness of the guideline is evaluated.

Ties

- Do you think that the expectancy of future collaboration between individuals increases trust on a personal level? Do you have examples that substantiate your opinion?

- Do you think that ties could have a negative effect as well?
- Do you have examples of situations where the effects of ties on trust were clearly present?
- Do you agree with the notion that interpersonal trust results in inter-organizational trust? Do you have examples that support your opinion?

Meetings

- Do you think that a high frequency of virtual work-related meetings can affect the trust between organizations or do you think it will solely affect trust between individuals? Do you have examples that support your opinion?
- Do you think that an effect is present between social face-to-face meetings and inter-organizational trust? If yes, how do these meetings affect inter-organizational trust?

Overall usefulness

- Do you think the recommendations of the guideline can be used in practice?
- Do you expect boundaries when implementing these recommendations?
- Do you have additions to the guideline in terms of recommendations or the layout of the content?

C.2. Results of the interview

The results of the expert interview are summarized in this section. The answers provided by the experts are combined and stated under each question. In order to ensure that the experts agree with the summarizing of their answers and support the results provided in this section, the summarizing is shared with them before adding it to the research. The experts have reviewed the summarizing of their answers and agreed with the contents.

C.2.1. Definitions

- Do you fully understand the proposed definitions?

The experts both stated that they fully understood the proposed definitions regarding the concepts of this research.

C.2.2. Guideline evaluation

Ties

- Do you think that the expectancy of future collaboration between individuals increases trust on a personal level? Do you have examples that substantiate your opinion?

The experts agreed that they do not think that future ties between design team members affect the levels of interpersonal trust. When participating in a design team, the focus is on the current project without taking future projects into account. The trust developed between design team participants comes from how they manage to do their work in the current project. Besides, you look at people that are the best fit for the job. To know this fit, you look at proven experience like resumés and completed projects. Moreover, it does barely happen that you know that you will collaborate again in future projects as design teams are not continuous by nature.

- Do you think that prior ties could have a negative effect as well?

The experts mention that they think that prior ties may have a negative effect on trust within design teams. Especially when the individual, that experienced the prior tie, had a different role in the design team during the previous collaboration. Some kind of expectation may be related to the prior interaction that is not met during the new collaboration. This could result in a negative effect on the amount of trust in the team. Also, laxity may be present when many prior ties are present as expectations could not be elaborately expressed between the team members.

- Do you have examples of situations where the effects of ties on trust were clearly present?

Both experts mentioned that they have experienced many situations in which prior ties were beneficial for the amount of trust in the design teams. Due to prior ties, the design team members came in sync with each other. They knew how to approach one another and how they preferred to work and communicate. This resulted in trust between the team members and helped the team processes.

- Do you agree with the notion that interpersonal trust results in inter-organizational trust? Do you have examples that support your opinion?

The experts agree on the notion that interpersonal trust results in inter-organizational trust as people represent their organizations. If you trust an individual working for an organization, you are likely to trust the organization as well. This also works the other way around. You trust employees coming from a trustworthy organization as you trust the organization to take care when hiring and training their employees.

Meetings

- Do you think that a high frequency of virtual work-related meetings can affect the trust between organizations or do you think it will solely affect trust between individuals? Do you have examples that support your opinion?

First of all, the experts mentioned that virtual work-related meetings do not directly have a negative effect on the amount of trust. Instead, it just does not have a positive effect. So the amount of trust would be more likely to stay the same and not increase. According to the experts, does the negative, or at least not positive, effect that virtual work-related meetings have on inter-organizational trust arise when the other organization is not adequately equipped to participate in virtual meetings. These inadequate virtual capabilities reflect on the organization, making the inter-organizational trust decrease. Apart from that, virtual work-related meetings prohibit efficient communication when comparing it to face-to-face meetings. This makes working together more difficult and does not help to improve trust, but it does not necessarily have a negative effect on trust. An addition to this is the notion of the experts on hybrid meetings. According to the experts are hybrid meetings inefficient and should be avoided.

- Do you think that an effect is present between social face-to-face meetings and inter-organizational trust? If yes, how do these meetings affect inter-organizational trust?

When considering the effect that social meetings have on inter-organizational trust, the experts agree on the notion that social meetings have a positive effect on interpersonal trust. This interpersonal trust results in inter-organizational trust as people represent their organizations.

Overall usefulness

- Do you think the recommendations of the guideline can be used in practice?

The experts both say that the recommendations can be used in practice. Especially organizing face-to-face or social meetings with the design teams can be very helpful and practical. When speaking from experience, one of the experts mentioned that after a long virtual meeting period due to COVID-19 restrictions, the design team organized its first face-to-face social meeting. This event resulted in a shared personal understanding between the team members which contributed to the trust within the team. About the prior ties, it is possible to staff employees on projects when you know that they have prior ties with one another. However, this is not common as teams and projects vary a lot.

Regarding future ties, as mentioned before, the experts do not think that these ties influence the levels of interpersonal trust. Inter-organizational trust on the other hand could be increased as organizations can be triggered to improve trustworthy behaviour as they are more likely to be approached to work together in the future. So the recommendation can be beneficial.

- Do you expect boundaries when implementing these recommendations?

No specific boundaries are expected by the experts.

- Do you have additions to the guideline in terms of recommendations or the layout of the content?

As mentioned before, the experts want to add to the guideline that it is recommended that hybrid meetings should not be organized as it is very difficult to communicate with both online and offline individuals. A balance should be found between a mix of virtual and face-to-face meetings.

D

Research survey

This appendix shows the survey that was sent out under the participants. This version shows the survey logic that was used. The survey is created with Qualtrics which is a accessed with a paid license from the TU Delft.

Thesis Robert de Nie

Start of Block: Introduction

Introduction
Thank you for taking the time to participate in this survey, which will take around **15** minutes of your time.

The main goal of this survey is to identify in which design team prior or future ties are present and how this potentially affects the trust within the team. Also, due to the COVID-19 pandemic, many team meetings have switched from a face-to-face setting to a virtual environment. This may have an impact on the relationship between ties and trust and will therefore also be taken into account in this research. The results of the survey will be used in quantitative analysis to provide answers to these questions.

Your participation in this survey is of great value and will contribute to a strong data set that enables analyses on trust, which is an important concept in the construction industry.

When participating in this survey you will be asked to fill in the name of the specific project design team that you were working in and you will be asked to provide information about your role in that specific design team. Moreover, you will be asked to evaluate the amount of trust that was present in the team. If you have participated in multiple design teams, it would be appreciated if you could complete the survey for each of these design teams seperately.

All of the personal information that you provide in this survey will be kept confidential and is only accessible by the researcher. Neither Drees & Sommer nor the TU Delft will have insight into individual responses. Data is handled anonymously and can not be traced back to you or your company. Only aggregated data will be used for any publication based on the result of the research.

The survey consists of four sections:

- Project characteristics
- Prior and future ties
- Virtual and face-to-face interactions
- Interpersonal and inter-organizational trust

If you are interested in the findings of this research please provide your email address at the end of the survey.

Kind regards,

Robert de Nie

Delft University of Technology
MSc Construction Management and Engineering
robert.de-nie@dreso.com or robertdenie@hotmail.com

End of Block: Introduction

Start of Block: Characteristics of the project

Section 1: Project characteristics

Q1.1 Which project design team did you participate in?

_____

Q1.2 In which phase did you participate in the design process?

- ☐ The sketch design phase (1)
- ☐ The preliminary design phase (2)
- ☐ The final design phase (3)
- ☐ The technical design phase (4)
- ☐ Do not know (5)

Q1.3 Which contract type was used between you and the client in the project?

_____

End of Block: Characteristics of the project

Start of Block: Personal and organizational information

Q1.4 What was your role in the design team? (Client, designer, project manager, technical advisor, financial advisor, etc.)

_____

Q1.5 What was the role of your organization?

- Designer/architect (1)
- Contractor (2)
- Project/process manager (3)
- Consultant (4)
- Client (5)
- Other (6)

Q1.6 How many years of work experience do you have?

- 0 - 5 years (1)
- 5 - 10 years (2)
- 10 - 15 years (3)
- 15 - 20 years (4)
- More than 20 years (5)

End of Block: Personal and organizational information

Start of Block: Prior ties

Section 2: Prior and future ties

In the following section, questions will be asked regarding prior and future ties in the design

team that you participated in. The 'design team members' in these questions **represent all the people that participated in the design team <u>except</u> colleagues that work within your own organization.**

Page Break

Q2.1 Have you worked together before with one or more of the design team members?

- ○ No (1)
- ○ Yes (2)

Display This Question:

If Have you worked together before with one or more of the design team members? = Yes

Q2.2 How many times have you worked before with these design team members?

- ○ 1 - 2 times (1)
- ○ 3 - 5 times (2)
- ○ More than 5 times (3)

End of Block: Prior ties

Start of Block: Future ties

Q2.3 I expect future cooperation between the design team members and me.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q2.4 I would like to cooperate with the design team members in the future.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Future ties

Start of Block: Quantity of virtual or face-to-face interaction

Section 3: Virtual and face-to-face interactions

Q3.1 We often had face-to-face work-related meetings with the design team.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q3.2 We often had online work-related meetings with the design team.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q3.3 We had more online work-related meetings than face-to-face work-related meetings with the design team.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Page Break

Q3.4 We often had face-to-face social meetings, such as coffee breaks, lunches, teambuilding activities, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q3.5 We often had online social meetings, such as digital coffee breaks, online pubquizzes, etc.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q3.6 We had more online social meetings than face-to-face social meetings with the design team.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Quantity of virtual or face-to-face interaction

Start of Block: Quality of virtual or face-to-face interaction

Q3.7 In general, I experienced the face-to-face work-related meetings with the design team positively.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q3.9 In general, I experienced the face-to-face work-related meetings with the design team as effective.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

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Q3.10 In general, I experienced the online work-related meetings with the design team positively.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q3.11 In general, I experienced the online work-related meetings with the design team as effective.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Page Break

Q3.12 In general, I experienced the face-to-face social meetings with the design team positively.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q3.13 In general, I experienced the face-to-face social meetings as effective in creating social relationships with the design team members.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

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Q3.14 In general, I experienced the online social related meetings with the design team positively.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q3.15 In general, I experienced the online social meetings as effective in creating social relationships with the design team members.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Quality of virtual or face-to-face interaction

Start of Block: Interpersonal trust: Affective

Section 4a: Interpersonal trust

In the following section, the statements relate to the members of the design team that you participated in.

Q4.1 Within the design team we had a sharing relationship. We could all freely share our ideas, feelings, and hopes.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.2 I could talk freely to my design team members about the difficulties I had at work and know that they wanted to listen.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.3 I would have to say that my design team members and I, have all made considerable emotional investments in our working relationship.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Interpersonal trust: Affective

Start of Block: Interpersonal trust: Cognitive

Q4.4 My design team members approached their job with professionalism and dedication.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.5 My design team members were very capable of performing their job.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q4.6 I could rely on my design team members not to make my job more difficult by careless work.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q4.7 Given my design team members track records, I saw no reason to doubt their competence and preparation for the job.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Interpersonal trust: Cognitive

Start of Block: Inter-organizational trust: Competence

Section 4b: Inter-organizational trust

In the following section, the statements relate to the organizations participating in the design team. So these statement are about your feelings or opinions regardings the other organizations and not individual design team members.

Q4.8 During the project, the other participating organizations were professional and dedicated.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.9 The staff of the other participating organizations were competent.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.10 The results the other organizations have achieved in the project were within its sphere of competence.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Inter-organizational trust: Competence

Start of Block: Inter-organizational trust: Integrity

Q4.11 The other participating organizations were credible and integrate throughout the project.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q4.12 The other participating organizations strictly adhered to ethical standards during the project.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q4.13 The other participating organizations always cared about our interests and will not easily cause our interests to suffer losses.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

End of Block: Inter-organizational trust: Integrity

Start of Block: Inter-organizational trust: Intuitive

Q4.14 During the project, my “intuition” told me that we could deal with the other participating organizations with ease.

- Strongly disagree (1)
- Somewhat disagree (2)
- Neutral (3)
- Somewhat agree (4)
- Strongly agree (5)
- Do not know (6)

Q4.15 During the project, I was able to foresee that our cooperation with the other participating organizations would achieve good results.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

Q4.16 During the project, I felt I could trust the other participating organizations employees.

- ○ Strongly disagree (1)
- ○ Somewhat disagree (2)
- ○ Neutral (3)
- ○ Somewhat agree (4)
- ○ Strongly agree (5)
- ○ Do not know (6)

End of Block: Inter-organizational trust: Intuitive

Start of Block: E-mail address

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E-mail address If you are interested in the findings of this research please fill in your email address.

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End of Block: E-mail address