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MASTER OF SCIENCE THESIS

CONSTRUCTION MANAGEMENT AND ENGINEERING

**Improvement opportunities in the
collaboration between general contractor and
subcontractor.**

*Assessing inter-organizational teamwork to improve project performance and
relationship continuity.*

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Executive Summary

'What can be improved in the collaboration between general contractor and subcontractor to attain higher project performance and relationship continuity?'

This was the central question in this research.

It is found that the design of the contract is basically abandoned. The contract is designed to have few inter-organizational relations, issues should be solved between counterparts which can each call upon their own organization. In practice there is a network of relations between Fluor and IREM. The organization has been divided into 5 clusters, based on which employees are expected to be most interrelated according to the contract's design. These people (from the same clusters) are in practice, however, not most interrelated which underpins the conclusion, based on the number of ties, that a network structure is in place and that the design mentioned above is abandoned.

An other conclusion is that the open communication factors (responsiveness, effectiveness and energy) could be improved between the construction- and office-cluster, within the construction-cluster (3 persons in particular) and one person in the preparation-cluster. After analyzing the perceptions about the collaboration between Fluor and IREM at these improvement areas, several trends have been identified. It has been found that people who consider collaborative practices and relational attitudes to be few or low, often respond slower when issues arise, have a lower conversation effectiveness and drain energy from their interlocutor. A trend has also been observed between their perception of teamworking quality and their responsiveness and effectiveness. The direction of this trend can however not be determined based on this research's data, it could be self-enforcing.

Based on the above mentioned conclusions, recommendations can be made on how to improve the collaboration between the general contractor and subcontractor. The above mentioned result have been gathered by conducting a valued social network analysis (SNA) and executing (and thereby testing) the relational capability (RECAP) tool of Suprpto (2016) in a setting between general contractor and subcontractor. Based on the results of the RECAP tool, it couldn't be concluded that there are no significant differences between the clusters' perceptions on collaboration. This, and the conclusion that the cluster structure is abandoned, lead to the conclusion that effort to increase collaboration, project performance and likelihood of relationship continuity, should be directed on company level.

This research question can, in short, be answered as follows: The collaboration between general contractor and subcontractor can be improved by improving the collaborative practices, relational attitudes and teamworking quality between and within both parties on company-level. Specific to this research, the team integration should be prioritized when looking for ways to strengthen collaborative practices. Regarding the improvement of the relational attitudes, the establishment of relational norms (like honesty, transparency and 'no-blame'-attitude) should be focused on. In order to increase the teamworking quality between Fluor and IREM, the Fluor management should direct their efforts to balancing the contribution, increasing the coordination and mutual support among employees of the two companies.

Efforts directed on these criteria for good collaboration can both attain short-term benefits (improved responsiveness, effectiveness and energy in the organization) and long-term benefits (improved project performance and relationship continuity). This research might even have found how improved collaboration actually, through these short-term gains, achieves better project performance and eventually relationship continuity.

More specific recommendations are:

- Short-term actions
 - Address identified specific improvement opportunities by providing feedback, looking for root causes and potentially looking for other responsibilities in the organization.
 - Improving team integration by organizing frequent alignment and goal setting meetings.
 - Stronger establishment of relational norms by hiring a facilitator to create an environment of trust, commitment, 'no-blame' and to organize team-building activities, clarify the short- and long-term objectives of this person's activities to both parties.
 - Take away uncertainty at IREM about the desired new way of collaborating with each other by being transparent the risks and proven opportunities. Jointly think about mitigating potential risks or concerns brought forward from within both organizations.
- Long-term actions
 - Improve team integration by eliminating distance between Fluor and IREM, co-locate.
 - Incentives for good teamwork for individual Fluor and IREM employees to teach new behaviour.
 - Ask freelancer or employee within the organization to carry out a valued SNA in future projects to identify inefficiencies.

By combining the RECAP tool with a social network analysis, a new methodology is introduced that both identifies inefficiencies during individual communication between employees, and assesses the quality of collaboration between companies in general. This methodology has proven itself useful for making recommendations about the level on which efforts should be directed, the more specific improvement opportunity areas, and what criteria of good collaboration should be improved. Future scientific efforts should go to the development of a RECAP tool to assess the collaboration between general contractor and subcontractor, and to construct a generalizable RECAP model that explains project performance and relationship continuity.

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1 Introduction

'Delivering the best project ever' has been a quote that one will come across a lot in the first few days when being introduced to the Rotterdam Hydrocracker (RAHC) project. This goal is not only expressed in personal contact with the project director and during the safety induction, but also in the internal RAHC Update #5, where project executive R. Garcia stresses the importance of this goal too (ExxonMobil, 2017). The RAHC-project is an initiative of ESSO which has requested ExxonMobil Research and Engineering (EMRE) to execute this project at their Botlek facilities in the Port of Rotterdam. EMRE at its turn has outsourced the engineering, design, procurement and construction of the expansion of the current refinery with a hydrocracker ('the project') to Fluor B.V. (Fluor) and has given it a budget of approximately 1.5 billion USD.



Figure 1: Mission statement at the RAHC-project site (own picture)

To execute a project like this, Fluor relies on multiple subcontractors during the construction stage of the RAHC-project. In order to deliver the best project ever, Fluor started collaborating with the Delft University of Technology (TU Delft), to expand their knowledge about the concept of organizational effectiveness. Previous research by the TU Delft on this subject has been conducted by Wang (2015), who studied the collaboration in the front-end engineering design (FEED) phase, and Patil (2016), who studied the impact of concurrent engineering on organizational effectiveness in the phases towards the construction phase, which were the detailed engineering phase and the procurement phase. This research is part of this longitudinal series of researches. For projects to be a success, an effective organization is required, primarily in the way people organize themselves, and in the way they collaborate (Bakker & De Kleijn, 2014). Fluor, carrying main responsibility of this project's success is therefore more than interested in ways to improve the collaboration in the construction stage of this project and all projects thereafter.

1.1 Problem statement Fluor B.V.

The problem is that the Fluor management, although putting good effort in improvement of the collaboration in general by organizing alignment meetings with inspiring guest speakers and activities,

currently doesn't know where to direct their efforts to in order to further optimize collaboration. This is important for the leaders of this project because they firmly believe good collaboration influences a project's success, which is at the end of the day the goal of the Fluor management involved in the RAHC-project. The Fluor management is convinced of, and operates under, the belief that working together with subcontractors in good rapport is more beneficial for project performance than working with a more traditional system of command and control, often found in traditional contracts. Next to the fact that excellent project performance is important for the credibility and continuity of Fluor as a private company, it is also believed to serve Fluor's interests to have good collaboration because it holds better prospects for potential future projects together with its subcontractor. Fluor's project director of the RAHC-project wants to create an environment in which it has good rapport with its subcontractors. Their philosophy is that both companies shouldn't feel reluctant to contact each other about little inconveniences and that they should trust each other to work towards a common goal which is beneficial for all parties instead of emphasizing each other's differences. However, as mentioned at the start of this section, it is not clear yet how Fluor can pinpoint specific improvement opportunities, if there are any, and what could be the reason for possible inefficiencies or ineffectiveness during collaboration with subcontractors. Therefore more scientifically sound research needs to be done on how to optimize Fluor's collaboration strategy.

Currently, Fluor and its subcontractors are working together but their motivations, goals and interests are not yet aligned. Fluor's management wants to know if there are collaboration models in the scientific literature that explain how good collaboration, project performance and relationship continuity can be achieved. Specific to this research, they want to know in the first place how they can make the RAHC-project a success for Fluor, its client and its subcontractors through better collaboration, and secondly how to attain a long-term relationship with its subcontractors.

1.2 Scope of research

Geography and time. The research has a time constraint of six months and focuses on the piping construction and installation of the RAHC-project in the Botlek-area of the Port of Rotterdam. The geographical scope of this research is thus the RAHC-project site (installation of piping), and the prefabrication site in Italy (construction of piping).

Project's phase. The research will focus on the collaboration in the construction phase. Previous project phases like engineering and procurement are completed, which means that contracts are already in place. This research's scope won't entail an active pursuit to identify which contract forms should be used and what should be included. It will describe how Fluor can improve its collaboration with the means it still has.

Participating organizations. Because of the time constraints of this research, a selection has been made from the subcontractors that are involved in the RAHC-project. The selected subcontractor is IREM S.p.A (IREM), an Italian construction company that is responsible for the prefabrication and installation of the piping at the project. IREM has been selected because they just commenced their activities at the start of this research, which makes it possible to implement the recommendations of this research immediately in the RAHC-project to improve the collaboration between Fluor and IREM. IREM also is an important player in the field of piping, with which Fluor has had some difficulties in their collaboration in past projects. These are two of the reasons for the selection of IREM. The last reason is the potential cultural difference, IREM is a predominantly Italian company which might enable making some culture-related conclusions.

Next to IREM, Fluor is of course one of the participation organizations since the research is initiated by Fluor.

At last, ExxonMobil as the client of this project is included in this research. The Fluor management has stated that ExxonMobil and Fluor have such a good relation in this project, that there are no apparent boundaries in goals and interests and that they practically act as one in relation with the subcontractor. Because of this, the client and general contractor are represented in the analyses as one (i.e. under the denominator 'Fluor').

Respondents. The research will look at the relations between key persons of the two parties (Fluor and IREM). These key persons have been selected after studying the contract and the communication matrix, followed by an interview with one of the contract engineers. The resulting key persons and their mutual interrelations were then verified by Fluor's project director, Fluor's project engineer, an other contract engineer of Fluor (responsible for the contract between Fluor and IREM) and the project manager of IREM. By doing this, the group of research participants of the organizations is clearly demarcated and is believed to comprise all relevant actors that are responsible for the performance and continuity of the piping installation on a day-to-day basis and the inter-organizational communication and collaboration associated with this.

1.3 Scientific context

Fluor has appointed multiple subcontractors for their specialized construction skill sets and resources, thereby surrounding itself with other parties which should perform better and deliver a better quality product than when all activities were done by only one party (Quinn, 1999). It is often even seen that the role of the general contractor is practically limited to the management of activities and how they affect each other (Humphrey, Matthews, & Kumaraswamy, 2003). As mentioned, the research focuses on the interactions and relations between general contractor and subcontractor. This means that this research will specify the role of the general contractor more specifically to relations management.

Ward, Curtis and Chapman already concluded in 1991 that next to a good performance regarding quality, costs and time, contractors also deem it important to finish the project while looking back at good collaboration and a good relationship with each other. Ward et al. (1991) state that contractors feel this way because negative connotations with another party are not easily forgotten and affect the likelihood of working together in the future.

One of the reasons why the relationship between general contractors and subcontractors is often adversarial (Eom, Yun & Peak, 2008) in the construction industry is because the interests of these parties are different (Love, 1997). The focus on their own interests, resulting in objective differences, is explained by Lee, Seo, Park, Ryu and Kwon in 2009, who found its causes in the uncertainties due to fluctuating demands, economic fluctuations, rapid technological innovations and governmental policies. By trying to shift the risks that come with these uncertainties to the other party, they try to shield themselves from the possible consequences.

A strategy that tries to better the relations between general contractor and subcontractors can be found in partnering with each other, sometimes referred to as making relational agreements. Successful partnering reduces clashes and determines the success of good long-term relationships (Schaufelberger, 2000). Partnering knows a variety of different definitions in the scientific literature; therefore the definition of partnering used in this research will be given below. The second component of the definition is added to the first one because it complements it by adding a goal to the definition.

Partnering is defined as:

"Putting the handshake back into business and involving a return to the old way of doing business based on trust, respect and good faith rather than suspicion, contempt and scepticism and when a person's word was their bond and people accepted responsibility"
(Macdonald, 2005, p.3)

"to achieve specific primary objectives by maximizing the effectiveness of each participant's resources and expertise."
(Maturana, Alarcón, Gazmuri, & Vrsalovic, 2007, p.68)

The problem the Fluor management has expressed is that they have insufficient insights on how and where they can implement more specific collaboration measures to improve project performance, while secondly also establishing a good long-term relationship with IREM.

It is believed that Fluor is helped most by identifying the areas where collaboration improvement is possible and most viable, what the reason of possible current ineffectiveness could be, and thus to provide the Fluor management with directions for further efforts. In this research a social network analysis (SNA) investigates the possible improvement opportunities and the relational capability (RECAP) tool will be used to investigate the potential reasons.

Since Suprpto's RECAP tool is solely designed to assess the collaboration between project owner and general contractor, one of the scientific aims of this research is to test the applicability of the RECAP tool in a general contractor and subcontractor setting. By testing the applicability of this tool, a first step is set toward the development of a generalizable RECAP model for the collaboration between general contractor and subcontractor. An other scientific aim is to introduce a new methodology (combination of SNA and RECAP) to assess and improve collaboration between these parties.

1.4 Research objectives

The theoretical aim. Part of the scientific contribution will be the combination of a SNA with the RECAP tool as a new collaboration assessment and improvement methodology. It is expected that this combination enables to give the output of the SNA more meaning. Testing the applicability of the RECAP tool in a general contractor and subcontractor context is also one of the scientific aims of this research, since Suprpto's RECAP model and tool are specifically designed for the collaboration between project owner and general contractor. By testing this applicability, the first step is set toward the development of a RECAP model for the collaboration between general contractor and subcontractor. An other scientific aim is to introduce a new methodology (combination of SNA and RECAP) to assess and improve collaboration between these parties. This new methodology might also bring forward new scientific insights.

The practical aim. By performing a SNA improvement opportunities between and within (groups of) the organizations are identified. This is useful information for Fluor since it can take targeted collaboration improvement measures. The RECAP results will help to make clear what kind of collaboration directed measures should be taken and prioritized when pursuing an optimized collaboration strategy, resulting in better project performance. In the end, this research's aim is to provide Fluor with recommendations about where and what efforts should be directed to. These results could be used to revisit the collaboration strategy in future projects with IREM but insights might also be taken into consideration in other projects with other companies when certain symptoms occur.

1.5 Research question and constructive questions

The research question that will be answered at the end of this report is:

What can be improved in the collaboration between general contractor and subcontractor in order to attain higher project performance and relationship continuity?

To answer this research question, several other questions are raised and will have to be answered in order to build up to answering the research question. In this research they will be called constructive questions.

Constructive question 1 What model and factors can be used to explain project performance and relational continuity?

Constructive question 2 What is the difference in the contractual and current collaboration structure between Fluor and IREM?

Constructive question 3 What current relations could be interesting improvement opportunities?

Constructive question 4 What elements of collaboration can be improved, and which groups should be targeted?

Constructive question 5 Is the RECAP model and tool applicable for the relationship between general contractor and subcontractor?

Constructive question 6 Is there a trend recognizable in the RECAP results at the improvement opportunity areas?

1.6 Reading guide

- **Chapter 1 - Introduction.** In this chapter Fluor's problem and desires are identified, the corresponding scientific lack of knowledge has been described and the research questions have been formulated.
- **Chapter 2 - Literature study.** In this chapter, the first constructive question will be answered. The best project performance model found in literature will be described and the factors that influence collaboration will be identified.
- **Chapter 3 - Research approach.** This chapter, describes the methodology of the RECAP and SNA surveys and analyses.
- **Chapter 4 - Analysis SNA.** In this chapter the contractual and IST-state of collaboration are presented and the difference described, thereby answering constructive question 2. The first analysis regarding the valued SNA will identify where interesting improvement opportunities can be found (i.e. answering constructive question 3).
- **Chapter 5 - Analysis RECAP.** Chapter 5 serves two purposes. Firstly, it answers constructive question 4 by describing the differences in the perceptions of the companies, clusters and some nationalities. Secondly, the applicability of the RECAP survey is described, thereby answering constructive question 5.
- **Chapter 6 - Analysis Combination.** In this chapter, constructive question 6 is answered, about trends in the results of the RECAP analysis and SNA.
- **Chapter 7 - Discussion.** This chapter discusses the research' limitations, practical and scientific contributions.
- **Chapter 8 - Conclusion & Recommendation.** In this last chapter, a summary of the research's answers to the constructive questions is given and recommendations are made.

2 Literature study

This chapter will lay the foundations for this research on improving the inter-teamworking quality between and within the general contractor (Fluor) and the piping subcontractor (IREM). To do this, this chapter will encompass a literature study which will first explain the emphasis on collaboration in an attempt to improve project performance, after which several models or theories are described related to teamworking and project performance.

For convenience the report will contain some abbreviations: PO-GC collaboration for the collaboration between project owner and general contractor, and GC-SC collaboration for the collaboration between the general contractor and subcontractor.

2.1 Importance of teamworking

The Fluor management has proclaimed that it wants to shift from the traditional collaboration approach of command and control to a state in which it collaborates with a trusted group of subcontractors. These are then expected to act in a common interest, thereby deserving a goodwill factor which might open doors to potential future cooperation on other projects. When this state would be reached, this would imply advantages for both parties since they know and trust each other on basis of good collaboration and performance at previous projects, and they would eliminate the need to start at the bottom of the learning curve. They would already know the capabilities, resources and procedures of the other party, and would thus be able to perform their activities more effectively immediately after commencement of their collaboration, which results in less process waste and thus more profit. This would imply a competitive advantage for the general contractor because it can realize economies of scale and have an execution advantage due to improved organizational effectiveness. For the subcontractor it is beneficial because he will have an improved prospect of future work, feels less pressured (less monitoring would be necessary because of less principal-agent suspicion) and might also benefit from economies of scale when he is working on multiple projects with the contractor or is going to in the nearby future (Lee et al., 2009).

In the past decades the theory around project performance has been extensively explored. This has everything to do with the enormous budget and schedule overruns in the construction industry due to the complexity and scale of construction projects (De Ridder & Vrijhoef, 2007). Due to these reasons, it is practically impossible to have complete information about a project, let alone to have all the skills and knowledge to execute a project (Son & Rojas, 2011). They also stated that good collaboration with other parties is of great importance for this reason. Other authors agree with this statement, in recent literature more and more attention is spend on the people aspect of project performance.

The Fluor management has made notice that they would like to see a more relational approach to managing their projects. The partnering approach is used here because this doesn't necessarily refer to contract, but rather a certain state of mind as defined in section 1.3. In 2016, Wang, Tang, Du, Duffield and Wei concluded in their literature study that partnering factors can be divided in two categories. The first one being attitudinal factors (e.g. commitment, equity, trust and mutual goals) and the second being open communication factors (e.g. problem resolution, timely responsiveness, openness and effective communications).

Black, Akintoye and Fitzgerald (2000) compared whether there is a difference between the opinions towards partnering of people that have been involved in partnering-projects and those who have not. It is striking to see that for each benefit, 'the involved' have given a higher rating (2nd column, table 1).

On the other hand, apparently also 'the not involved' are positive (3rd column, table 1) towards the potential benefits of partnering, since only a few benefits have a significant difference between 'the involved' and 'the not involved' (see table 1). This means that people are open to the idea of partnering and can see the benefits it could bring to a project, both in advance as when looking back at a partnering project.

Table 1: Benefits attributable to partnering (Modified) (Black et al. (2000, p.427))

	Involved	No involvement	Significance level
Less adversarial relationship	4.49	4.12	0.12
Increased customer satisfaction	4.38	3.80	0.02
Increased understanding of parties	4.15	3.64	0.03
Improved time-scales	4.13	3.48	0.02
Reduced risk exposure	4.02	3.68	0.21
Reduced cost	3.96	3.48	0.09
Improved administration	3.81	3.56	0.31
Quality improvements	3.74	3.60	0.63
Improved design	3.68	3.28	0.12
Risk shared	3.57	3.20	0.13
Improved return on resources	3.62	3.04	0.02
Design cycle reductions	3.47	3.20	0.27
Increased market share	3.38	2.88	0.06

In table 1, the top-5 of benefits that both 'the involved' as 'the not involved' believe to come with partnering, are highlighted. It is interesting to see that two out of the three classical project success factors (cost, schedule and quality) are represented in this top-5 (i.e. quality and costs), next to risk exposure and less adversarial relationships. It is a positive sign that these potential benefits are broadly recognized because this might also mean that people are more eager to adopt partnering practices in their work and organization than when only 'the involved' are convinced that partnering holds benefits.

Principal-agent problems general contractor vs. subcontractor. The principal-agent theory is ought to have some attention in this research because of the general contractor's dependence on its subcontractors.

Dependence is inevitable when one party (the principal) approaches another party (the agent) to perform a certain task in his name. Müller and Turner (2005) attributed the following problems to this dependence:

Firstly they state that general contractor and subcontractor are unlikely to have aligned interests and objectives. Both companies are in first instance trying to maximize their profits. Where subcontractors are hired solely to construct a certain aspect or to provide a service, general contractors are also bound to other goals/objectives of the client they are serving. The second problem is that it is not possible for the general contractor to control or to monitor the activities of the subcontractors. This being said, Müller and Turner (2005) add to this that this is in any case not possible without making an investment to acquire perfect information about the activities of the subcontractor. The same goes for acquiring non-activity information (e.g. status quo of project or possible deficiencies).

It is thus difficult for the general contractor to know whether the subcontractor is acting in its own interests or, as agreed upon, on the interests of the general contractor. This is called the adverse selection problem. This may look like the moral hazard problem, in which the subcontractor actually does act in its own interests.

The world of construction is full of specialized companies and can thus be said to be fragmented (Alashwal & Fong, 2015). This fragmentation causes the above described problems. Because of different interests between principal and agent (De Ridder & Vrijhoef, 2007), there is a low level of trust because both parties suspect each other to act in its own interest at cost of the other. The idea of partnering is not of recent years. Already in 1994, Saunders provided six ingredients of which he stressed that these are the determinants of a partnership's success:

1. Frequent formal or informal communication
2. Cooperative attitudes
3. Win-win approach
4. Trust
5. Open information sharing
6. Multi-disciplinary involvement

The principal-agent related problems affect at least four of Saunders' partnership success factors: Adversarial interest clearly exclude a win-win approach, agents can benefit by withholding information (open information sharing), principals don't completely trust the agents and this all implies a not very cooperative attitude towards each other.

On top of this, Black et al. (2000) have stated that in order to reduce these principal-agent problems, the principals are often inclined to develop strict communication protocols, thereby limiting the possibilities of Saunders first success factor, frequent formal and informal communication.

In order to improve partnering not only the attitudinal and open communication partnering factors of Wang et al. (2016) should be improved, but fragmentation (and thus principal-agent related problems) should also be reduced (i.e. a network structure of frequent formal and informal communication should be in place). It might therefore be interesting to see whether there is a network structure in place or whether Fluor and IREM are yet clearly fragmented. It will also be investigated to what extent the effect of Fluor's and IREM's roles as principal and agent are recognizable in the results of the analyzes. The expectation is, that these roles will be mostly be reflected in their general responses and their RECAP factor scores, like trust.

2.2 Teamworking quality models

In this section, some older (1971 to 1989) and some more recent (2011 to 2016) models and theories will be mentioned and discussed on similarities or differences.

2.2.1 Older literature

If one looks at older literature about project performance and their critical success factors (see table 2), one can see that there is little attention for collaboration related factors, while their importance has been made clear in section 2.1.

In 1996 Belassi & Tukel performed research on the critical success factors of projects. Their opinion was that although there was already much research done on the subject, project managers still weren't presented with an unambiguous list of factors as can also be seen in table 2. In the context of this research it has appeared that this is also the case for a model concerning inter-teamworking quality between general contractor and subcontractor.

After conducting a literature study, it should in theory be possible to give an unambiguous and more recent answer to the first constructive question (*What model and factors can be used to explain project performance and relationship continuity?*). The following subsections will try to find the answer to this question. There is, however, little research done specifically towards identifying the factors

Martin ¹⁶ (1976)	Locke ¹⁴ (1984)	Cleland and King ²⁵ (1983)	Sayles and Chandler ²⁶ (1971)	Baker, Murphy and Fisher ⁹ (1983)	Pinto and Slevin ⁷ (1989)	Morris and Hough ¹¹ (1987)
Define goals	Make project commitments known	Project summary	Project manager's competence	Clear goals	Top management support	Project objectives
Select project organizational philosophy	Project authority from the top	Operational concept	Scheduling	Goal commitment of project team	Client consultation	Technical uncertainty innovation
General management support	Appoint competent project manager	Top management support	Control systems and responsibilities	On-site project manager	Personnel recruitment	Politics
Organize and delegate authority	Set up communications and procedures	Financial support	Monitoring and feedback	Adequate funding to completion	Technical tasks	Community involvement
Select project team	Set up control mechanisms (schedules, etc.)	Logistic requirements	Continuing involvement in the project	Adequate project team capability	Client acceptance	Schedule duration urgency
Allocate sufficient resources	Progress meetings	Facility support		Accurate initial cost estimates	Monitoring and feedback	Financial contract legal problems
Provide for control and information mechanisms		Market intelligence (who is the client)		Minimum start-up difficulties	Communication	Implement problems
Require planning and review		Project schedule		Planning and control techniques	Trouble-shooting	
		Executive development and training		Task (vs. social orientation)	Characteristics of the project team leader	
		Manpower and organization		Absence of bureaucracy	Power and politics	
		Acquisition			Environment events	
		Information and communication channels			Urgency	
		Project review				

Table 2: 'Old' lists of critical success factors (Belassi & Tukel, 1996, p. 143)

that determine the extend of collaboration between general contractors and subcontractors, therefore extrapolation from the collaboration between project owner and general contractor might be necessary.

2.2.2 Teamwork quality model

Hoegl's and Gemuenden's (2011) hypothesis was that there is a positive and significant coefficient of correlation between teamwork quality and project success. They attributed effectiveness and efficiency as constructs to team performance, and attributed six other constructs to teamwork quality. These six factors are:

1. **Communication.** Hoegl and Gemuenden (2011) speak of communication in terms of two-way communication in general and of information flows. They found that this construct had a significant correlation with teamwork quality of $r = 0.16$ ($p \leq .01$).
2. **Coordination.** The researchers state that coordination is a necessity in order to become an efficient organization. The correlation coefficient of this construct with teamwork quality found in their research is $r = 0.22$ ($p \leq .01$).
3. **Balance of member contribution.** What the researchers mean with this construct is that each team member should contribute more or less an equal share during discussions. They reason that dominant members are a threat to this construct, and thus also the success of a project. It's correlation coefficient is $r = 0.19$ ($p \leq .01$), and is thus significant.

4. **Mutual support.** In order to perform effectively and efficient as a team, support is considered to be important. Having common goals is an important facilitator for supporting each other according to Hoegl and Gemuenden. With significance level of $p \leq .01$, this construct's correlation with teamwork quality ($r = 0.20$) is significant.
5. **Effort.** The researchers simply define this construct as the amount of effort people know that is sufficient and put in their work. The correlation with teamwork quality is significant ($r = 0.22$, $p \leq .01$).
6. **Cohesion.** Hoegl and Gemuenden (2011) use the definition of Cartwright (1968) for this construct: 'the degree to which team members desire to remain on the team' (Hoegl & Gemuenden, 2011, p.438). In order to remain a team, and to motivate team members to work as a team, it is important that people feel part of a team and have a sense of belonging. This sixth construct is also a significant construct of teamwork with a correlation coefficient of $r = 0.20$ ($p \leq .01$).

In the same research they concluded that these six constructs could explain 71.51% of the variation in teamwork quality (this is called the coefficient of determination, R^2).

Concerning their hypothesis about the correlation between teamwork quality and project success, Hoegl & Gemuenden (2011, p. 445) concluded that 'TWQ (teamwork quality) shows a relationship with the success of innovative projects as measured by team performance (effectiveness and efficiency) and by the personal success of team members (satisfaction and learning)'.

2.2.3 Exemplary 'Mother Nature'

Ever since mankind, men have tried to imitate certain qualities of animals to ease their lives or even to survive. As simple as it might seem, already in prehistoric times mankind learned to make clothes from their woolly or furry animal companions in order to survive the cold. More recent examples are flying, the development of porcupine-inspired needles and the invention of Velcro based on plants sticking to animal hairs (Machalek, 2013). These are all examples of 'hard' technological inventions. However, the realm of the animals also shows a lot of behaviour that comes natural for them but seems to be troublesome for men. Most of this behaviour shows while hunting (e.g. killer whales, hyenas, penguins and wolves) but bees and ants show behaviour that goes beyond collaboration while hunting. An ant is a little creature that is as good as powerless on its own, but in a group can manage to overcome almost all obstacles through teamwork. This section does not present a model, it does however, present a theory of how Mother Nature might show an example and relates this to the model of Hoegl and Gemuenden. Low (2011) described in the 'Business journal for entrepreneurs' what he has observed in the behaviour of ants and how these observations might serve humans in their attempt to collaborate effectively.

1. **"Cooperate, collaborate and have organized cooperation"** (Low, 2011, p.104)

It is believed that the key word in this first factor is 'organized'. This is because the Cambridge Dictionary defines cooperation, collaboration and teamwork similarly:

Cooperation: 'the process of working with another company, organization, or country in order to achieve something'.

Collaboration: 'the act of working together with other people or organizations to create or achieve something'.

Teamwork: 'the activity of working together as a team, or the skills needed to do this'.

The point being made is that it is considered to be self-explanatory that cooperation leads to good collaboration when they are very similar by definition. However, cooperation can be organized or unorganized. People can cooperate together in a very unstructured and chaotic fashion, which can negatively influence the performance of the group or organization. This statement is made

by Hoegl and Gemuenden (2001) who, as described in subsection 2.2.2, identified coordination as one of their teamwork quality factors. Hoegl and Gemuenden defined coordination as a state in which the activities of persons are structured and put in sync in the organization. Ants are very organized in their roles, each ant has its own tasks in life (e.g. defending the nest, mating with the queen or working on the nest). This first success factor for teamwork, thus, shares characteristics of Hoegl's definition of coordination.

2. **"Be united, unity is strength!"** (Low, 2011, p.106)

As said above, although they are relatively strong compared to their size, ants are at the same time very vulnerable. This seems to be apparent for the ants as can be seen at their behaviour. When ants defend their nest against predators, they attack as one. This can only happen when they align their efforts and give it their best, which is also a factor Hoegl and Gemuenden identified (effort).

3. **"Connect, communicate and have good communications"** (Low, 2011, p.106)

In performing tasks, ants depend on their communication. While gathering food, ants signal other ants by leaving a trail of pheromones. Low (2011) mentions the research of Yahya (2000), who has concluded from her study that ants leave stronger trails when they have found a bigger source by assigning multiple ants to lead the way. This signal is picked up by the ants in the nest, which will follow in bigger numbers. Communication is thus important to perform a task efficiently and effectively in the life of ants (Low, 2011). Communication is another success factor according to Hoegl and Gemuenden (2011).

4. **"Build and grow a family-like situation"** (Low, 2011, p.107)

When running into danger, ants signal the other ants in the surroundings by spreading a scent in the air. By doing this, ants show that they want to maintain the group. Although literally every ant in the group is part of one big family, this is most often the case for most human organizations. Nevertheless, feeling part of a family-like group awakens a sense of responsibility for the existence and performance of the group. Hoegl and Gemuenden (2001) have identified this feeling as 'cohesion' between members of an organization.

5. **"Reduce ego and have patience - they make for better teamspirit"** (Low, 2011, p.109)

Low (2011) states that there are, basically, two sorts of leaders, the dominant one and the one that lays back while its subordinates do their jobs. Low (2011) concludes that ants only know the latter ones, the ones which are able to not put all attention on themselves. This factor could be explained as good leadership, which is not identified as a success factor by the model of Hoegl and Gemuenden (2001). Castka, Bamber and Sharp (2003) have identified this factor to be an organizational enabler of teamwork culture. Castka et al. (2003, p.161) have defined good leadership as leaders that 'develop the teamwork culture within the organization', 'are personally involved in ensuring that teamwork culture is developed, implemented and continuously improved', 'are involved with team leaders and team member' and finally as leaders that 'motivate, support and recognize the teams'.

6. **"Be industrious and work hard together"** (Low, 2011, p.110)

What Low (2011) means with this is that ants can't afford to be idle. Being idle would mean that they make themselves vulnerable, not only for short-term hazards but also on the long-term. This means that every ant is contributing equally to their project's success, be it gathering enough food, nursing off-spring, defending or cleaning the nest. As stated above, every ant has its own role in the colony and puts maximum effort in it. When looking at the success factors of Hoegl and Gemuenden (2011), this most resembles the factor 'balance of member contribution'.

7. **”Care for one another”** (Low, 2011, p.111)

In the paragraphs above, it has become apparent that ants support each other in their tasks, for example by reducing their ego and forming a bridge to let the group cross a gap or by helping to guide ants to carry a big food source successfully to its destination. Whether this is purely instinct or not, ants seem to care for one another by supporting each other. This is a very important factor for ants to survive as a group and according to the research of Hoegl and Gemuenden (2011), mutual support is also critical for project success of human endeavors.

8. **”Be self-motivated and self-directed”** (Low, 2011, p.113)

Being self-motivated in human activities is not expected to be a success factor. In the context of this research for example, general contractor and subcontractor can be self-motivated but their goals and interests are different. Ants don’t have other motivations than the existence of the nest. Therefore, this factor Low (2011) has identified is interpreted as the importance of common goals in the context of human activities. Alderman and Ivory, (2007) have stated this to be important in relational agreements like partnering.

2.2.4 Relational capability model

In 2016 Suprpto performed extensive research on the collaboration between project owner and general contractor. He successfully managed to develop a structural model depicting the significant relations between multiple collaboration and project performance factors (see figure 2).

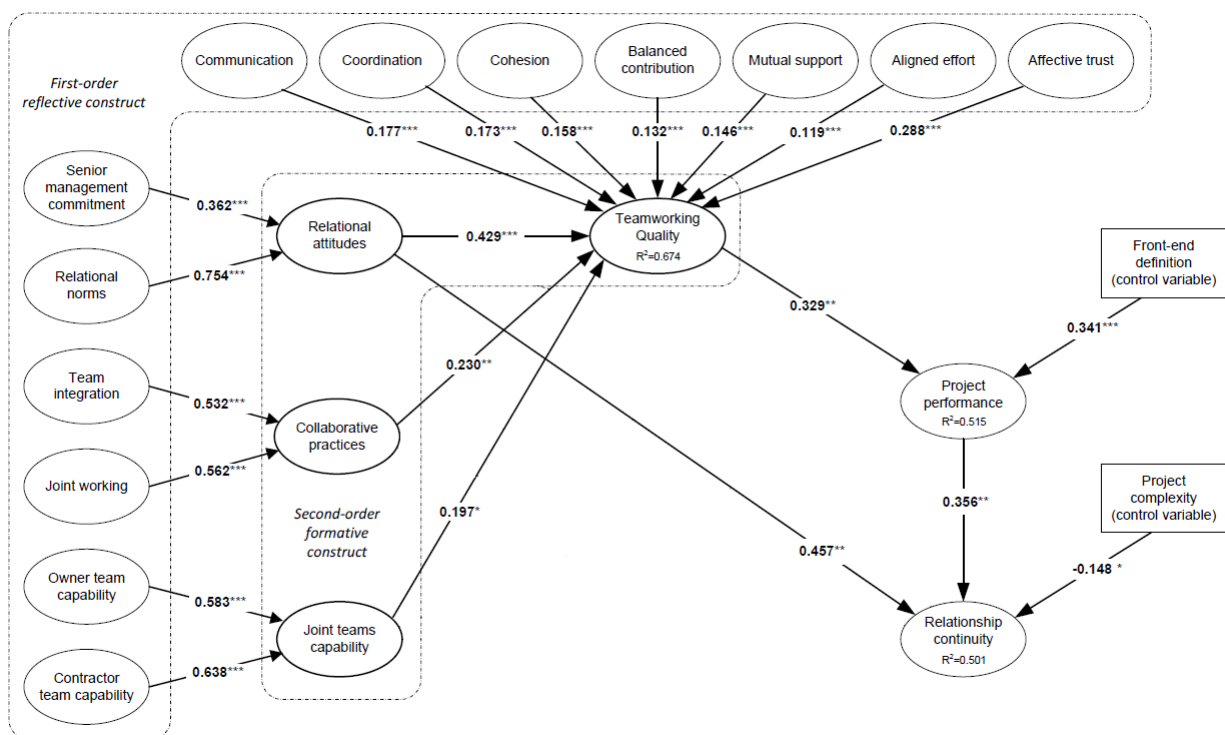


Figure 2: Simplified RECAP collaboration model (Suprpto, 2016 (modified))

Figure 2 shows the relations between collaboration related factors/criteria, project performance and relational continuity. Section 2.2.3 states that collaboration and teamwork are synonyms of each other, the RECAP model thus affirms the importance of collaboration on project performance (or success).

Figure 2 might need some clarification. One can observe three sorts of correlations between what Suprpto calls 'criteria/indicators'; with one, two and three asterisks. For convenience, the non-significant correlations are eliminated from figure 2.

Table 3: Explanation asterisks

*	**	***
p<0.05 In at least 95% of the cases in a random sample, this correlation is expected to be found.	p<0.01 In at least 99% of the cases in a random sample, this correlation is expected to be found.	p<0.001 In at least 99.9% of the cases in a random sample, this correlation is expected to be found.

In table 3 the explanations of the number of asterisks are given, the more asterisks, the more likely it is to observe the same relation between criteria/indicators in the real world.

Another piece of information, in the relations themselves (depicted by arrows) are the correlation coefficients, which have already been mentioned before in section 2.2.2. The correlation coefficient is in literature often depicted by the symbol 'r'. This coefficient can vary between -1 and 1, respectively indicating a perfect negative correlation and a perfect positive correlation. The middle, '0', thus means that there is no correlation at all and that there is, thus, no effect from one criteria/indicator on the other. The further the correlations coefficient differs from '0', the stronger the relation between the two criteria/indicators.

Next to the correlation coefficient (r) which is shown *in the arrows*, the determination coefficient (R^2) can be found *in some of the ovals*.

The determination coefficient indicates how well the incoming criteria determine the target criterion/indicator. For example: Teamworking quality has a R^2 of 0.674. This means that 67.4% of the total variance that can be observed in the quality of teamwork, can be attributed to the criteria that have a significant correlation with teamworking quality.

Although the correlation coefficient of the seven subcriteria on top in figure 2 are relatively low, the significance is really high, these relations are expected to be found in 99.9% of the real world samples in case when the survey is conducted again. It can also be observed that the criterion 'relational attitudes' has an indirect and a direct link with relationship continuity. This means that the attitude people in collaborating companies have towards each other, not only determines the chance of future cooperation, but also influences the project performance indirectly. Suprpto has, as one of the few researchers, developed a quantitative model that shows that project performance has a fairly strong correlation ($r = 0.356, p \leq .01$) with relationship continuity.

All in all, the RECAP model that Suprpto (2016) developed for the collaboration between project owner and general contractor, can be stated to be well-founded and well-explanatory in terms of correlations between the criteria and subcriteria, and their coefficients of determination which are relatively high.

Suprpto has uttered that the coefficients of determination might be improved by including cultural factors in the RECAP survey, some attention will be given to culture in section 2.3.1.

Table 4 shows the factors that have been identified by the three models/theories concerning inter-teamworking quality and project performance. When the first six factors of each column are compared, it can be seen that these are very similar or have been argued to be similar in the case of the

Table 4: Short list of the factors of models

Hoegl & Gemuenden (2011)	Low (2011)	Suprpto (2016)
Communication	Good communication	Communication
Coordination	Organized cooperation	Coordination
Balance	Be industrious	Balanced contribution
Support	Care for one another	Mutual support
Effort	Unity	Aligned effort
Cohesion	Family-like situation	Cohesion
	Reduce ego	Senior management commitment
	Self-motivation	Affective trust
		Established relational norms
		Team integration
		Joint working processes
		Senior management trust
		Owner team capability
		Contractor team capability

ant collaboration theory. The model of Suprpto (2016) is, however, believed to be the most complete one because it encompasses all those factors of the other models and more. The factors concerning capabilities are not investigated in this research because both Fluor as IREM are considered experts in their field of expertise. Another reason for this is that the RECAP tool (Suprpto, 2016) doesn't provide for these criteria and the aim of this research is to remain as close to the original design to look whether it can be applied in its current form in an other context. The factors that Suprpto has identified are also very well supported by literature study and strict selection of elements of these factors. Because of this, the RECAP tool Suprpto designed is a reliable tool to assess the collaboration status between project owner and general contractor, which is now also tested in an other setting.

The RECAP model's and tool's focus on project owner and general contractor collaboration entails an opportunity in the context of this research but also difficulties. Testing the applicability of the tool, creates a scientific opportunity because insights whether statements, criteria or subcriteria can be considered applicable can be used by future researchers to further develop the theory surrounding the RECAP model for general contractor and subcontractor collaboration. Difficulties concern the substantiation to use the original RECAP model, its factors, and the RECAP tool in a GC-SC context. The RECAP model and tool are designed specifically for PO-GC collaboration. In order to construct a RECAP model for GC-SC collaboration, it is therefore necessary that the RECAP survey is transmuted to fit this type of collaboration. Specifics on how this is done, can be found in section 3.3.3.

The RECAP model for PO-GC collaboration of Suprpto is also selected to be the guiding model in the remainder of this research because it includes relationship continuity. Fluor has stated that this is a desired side-effect of improved project performance. Section 2.1 has already shown the importance of teamwork on project performance. Sections 2.2.2 and 2.2.3 have shown that more or less the same factors are applicable on GC-SC collaboration. Although it is proven that factors from the RECAP model for PO-GC collaboration could in theory also apply to explain project performance and collaboration in a GC-SC setting, the correlation between project performance and relationship continuity in the context of a general contractor and subcontractor has yet to be substantiated by literature.

In 2001 Kale and Arditi have conducted a research on the relationship between general contractor and subcontractor. Most of their research variables are unfortunately not of interest for this research (for example, the size and age of the contractors). In section 1.2 it is stated that contracts aren't part of the scope because these are already in place and aren't meant to be changed at this phase of the project. The same goes for age and size, these factors (especially age) can't be changed, thus can't be used to potentially improve the collaboration quality between Fluor and IREM, which is in the end the goal of this research.

Three variables are, however, interesting to make the above mentioned substantiation; relationships with subcontractors, overall performance and growth in contract awards. The latter will be elaborated upon in the next subsection. The conclusions of Kale & Arditi (2001) fill in the missing link between project performance and relationship continuity. Their results show a significant correlation coefficient ($r = 0.43, p \leq .01$) between overall performance and relationships. Although the latter seems to differ from relationship continuity, there was a strong emphasis on the 'longevity' of relations in their survey, leading to a score on 'relationships with subcontractors' (Kale & Arditi, 2001). The awareness of the importance and benefits of relationship continuity also shows from their conclusions: "Furthermore, these research findings provide empirical support to the research studies that promote the concept of 'partnering', where adversarial relationships are avoided by establishing and maintaining long term collaborative relationships in order to meet the challenges presented by competitive conditions" (Kale & Arditi, 2001, p.546-547).

The theories of Hoegl & Gemuenden (2011), Low (2011) and Kale & Arditi (2001), which focus on GC-SC collaboration, also account for most part of the RECAP model for PO-GC collaboration. It is therefore expected that the same factors of the RECAP tool can be applied to assess GC-SC collaboration (after minor statement modifications). Whether this is the case, is the answer to constructive question 5.

2.3 Additional factors

Suprpto (2016) states in his conclusions that literature has shown that cultural differences might also explain part of the variance in project performance. Culture will therefore get some attention in the following subsection. Besides that, incentives resulting from contract type may also be of (indirect) interest, this will be elaborated upon in the second subsection.

2.3.1 Culture

During his research's discussion Suprpto acknowledges that there might be more factors of interest. One of which is a potential cultural difference between parties. This research will strive to look whether cultural differences might explain differences in the way the surveys have been completed.

In 2005, Shore and Cross investigated the impact of some cultural dimensions. They concluded that national culture has an impact on behaviour, but that it is very difficult to test how this works through behaviour to project performance.

Hofstede et al. (2010) have identified the following 6 cultural dimensions:

1. Power distance.
2. Individualism vs. Collectivism.
3. Masculinity vs. Femininity.
4. Uncertainty avoidance.
5. Short-term orientation vs. Long-term orientation.
6. Restraint vs. Indulgence.

Power distance. This dimension is considered to measure the degree of inequality. The definition (Hofstede et al., 2010, p.61): *'The extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally'*.

This means in practice that nationalities with a high score on this dimension don't easily approach their bosses and aren't likely to contradict their bosses opinion or decision on the work-floor. This also means that nationalities with high power distance scores are not expecting to receive this attitude from their employees, or to consult their decision-making.

Individualism vs. Collectivism. The definition of individualism (Hofstede et al., 2010, p.92): *'Societies in which the ties between individuals are loose: everyone is expected to look after him- or herself and his or her immediate family'*. The definition of collectivism (Hofstede et al., 2010, p.92): *'Societies in which people from birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty'*.

What is very interesting in the context of this research, and what is actually more appropriate in the next subsection, is what Hofstede et al. (2010) state about the use of incentives. The researchers conclude that clashes on the workplace often occur because individualistic managers do not handle their incentive strategy right. They state that management strategies in the existing literature are most of the time based on the opinions of relatively individualistic countries. The problem here is that employees might not be that individualistic, which creates a difference between what the managers think are good incentives (i.e. incentives based on individual performance) and what the employees think that should be rewarded (i.e. good team performance).

Masculinity vs. Femininity. The definition (Hofstede et al., 2010, p.140): *'Society (Masculine) where emotional gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success, whereas women are supposed to be more modest, tender, and concerned with the quality of life'*. It is called feminine (Hofstede et al., 2010, p.140) *'when emotional gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life'*.

Differences concerning this dimension might show on the workplace when conflicts (of interests) arise. In a masculine culture, as the definition might suggest, there is little to no room for compromise. Conflicts are to be solved in 'a fight' and only one can be considered to be the winner. In contrast, in feminine cultures there is more room for compromise and concessions.

Uncertainty avoidance. The definition (Hofstede et al., 2010, p.191): *'The extent to which the members of a culture feel threatened by ambiguous or unknown situations'*.

It has to be said that this doesn't mean that people from countries with high uncertainty avoidance are also risk averse. Risk implies that something concrete has a chance of happening, while in uncertainty one has no idea of what might happen (neither what the 'something concrete' is, nor what the probability of this is). The difference between countries with low and high uncertainty avoidance, is that the latter prefers to structure everything that can be structured within reason, while the first thinks that rules and regulations should only be applied when it is absolutely necessary.

Short-term orientation vs. Long-term orientation. Hofstede et al. (2010, p.239) define long-term orientation as follows: *'The fostering of virtues oriented toward future rewards –in particular, perseverance and thrift'*, and short-term orientation as follows: *'The fostering of virtues related to the past and present –in particular, respect for tradition, preservation of 'face', and fulfilling social obligations'*.

The definitions of both orientations already give some understanding of one's behaviour at the workplace. In short it can be said that nationalities with a low score on the long-term orientation dimension, mostly aim for small and quick successes on the short-term (Hofstede et al., 2010), and honor the tradition within the company (e.g. their position or the position of their supervisors). In long-term orientated societies one looks at the big picture on the long-term, they often have larger networks which they would not want to damage for small and quick successes on the short-term.

Restraint vs. Indulgence. The definition of indulgence (Hofstede et al., 2010, p.281): *'A tendency to allow relatively free gratification of basic and natural human desires related to enjoying life and having fun'*. On the contrast, they define restraint as: *'A conviction that such gratification needs to be curbed and regulated by strict social norms'*.

According to Hofstede et al. (2010) people from indulgent societies (high score) have more need, and make more room, for a laugh on the workfloor than those from restrained societies.

2.3.2 Incentives

In 2011, Merrow published his book *'Industrial mega-projects – Concepts, strategies, and practices for success'*. Merrow's research has a good fit with the RAHC-project and one of his most striking conclusions was that using different contract types doesn't show in the overall project performance of major industrial projects.

Merrow (2011) compared EPC-Lump Sum, EPC/EPCm Reimbursable, Alliances and Mixed Contracting projects while coming to this conclusion.

Shortly explained, lump sum projects are often procured to the lowest bidder which has to perform within a given budget without extra fees unless agreed upon by the general contractor in the form of for example change orders. Reimbursable projects exist in many different subforms which have in common that the subcontractor is reimbursed based on its used materials, working hours and other costs, often accompanied with incentives to perform within a set budget or schedule. An alliance is a project organization form in which both the general contractor and subcontractor share responsibilities and accountability (and thus profits and losses) equally or other ratio. Mixed contracting projects have a reimbursable engineering and procurement phase but a lump sum construction phase (Merrow, 2011). Mixed contracting will have less attention since the scope of this research specifies the construction phase, lump sum projects and mixed contracting project are thus both lump sum in this phase.

Reimbursing. The reimbursable and lump sum (more traditional) approaches don't show a significant difference in project performance. If there would be a significant difference, reimbursable projects would likely have scored worse than lump sum projects. The reason for this is that reimbursed contractors are inclined to speed up construction when the deadline is approaching. By doing this, they attempt to gain the additional incentive for meeting the schedule deadline. An accompanying danger with this is, according to Merrow, that contractors deliver sub-quality, thereby affecting the overall project performance.

As said, general contractors outsource tasks to subcontractors because of their construction skill-set and know-how; this means that there is almost always information asymmetry between these two parties. A reason why schedule incentives are not effectively reducing the schedule is partly attributable to this phenomenon (Merrow, 2011). While negotiating on the initial schedule for the job, the subcontractor can use his task specific knowledge to his advantage (Merrow, 2011). By negotiating a more lengthy schedule than they know is necessary, they can 'secure' themselves of an award for meeting the initial schedule. In practice, however, this means that the subcontractor is the main beneficiary of this approach, while the general contractor doesn't have an optimal schedule reduction.

Lump sum. On the other side of the spectrum, lump sum projects tend to perform averagely (Merrow, 2011), subcontractors are driven by cost minimization in order to achieve maximum profit on their part. Quality is often a point of concern during lump sum projects, reports state that contractors will underperform on this aspect by working with less quality materials.

This point of concern remains, but Merrow compared the overall performance of projects, of which quality is part. This means that when concluding that reimbursable and lump sum projects don't significantly differ from each other while comparing project performance, this is accounted for. However, research has proven that for industrial megaprojects, cost performance is positively correlated to schedule performance (Merrow, 2011). This means that contractors in a lump sum project perform reasonably within budget and within schedule. It is of course not possible to conclude that contractors in a lump sum project always perform within budget and schedule but it can, however, be concluded that schedule and cost overruns in these projects don't significantly differ from reimbursable projects.

Alliance. According to Merrow, alliances are worst. The main reason for this is the element of risk, responsibility and accountability sharing in this project form. In practice this has often turned out to be translated in 'nobody is responsible'. One can imagine that when issues arise, which is likely to happen in complex industrial megaprojects, this creates an additional issue. Often it is seen that parties in alliances fall back on the contract.

The conclusions of Merrow (2011) seem to contradict collaborative researches that state that incentives are a necessity to good relations by creating a win-win environment and to be a means to align their objectives and interests. It must however not be forgotten that good collaboration is not the ultimate goal of projects, neither is it to Fluor. Good inter-teamworking quality is a determinant for the real goal, i.e. project performance which is, according to the selected model in section 2.2, at its turn is expected to affect the relationship continuity of parties involved in a project.

In a nutshell, Merrow thus concludes that incentivizing contractors by contract type either makes no difference (lump sum and reimbursable) or is worse (alliances) concerning the overall project performance. This seems to be contradicting section 2.2.4 because alliances are instinctively associated with collaboration, which according to the RECAP model of Suprpto (2016) positively influences project performance.

Good collaboration is, however, not exclusively reserved for alliances, but can 'appear' in all sorts of settings where people set their minds towards a common goal.

Suprpto (2016) shares the opinion of Merrow that contract type in itself is not one of the direct factors influencing project performance or even teamworking quality. Suprpto, Bakker, Mooi & Hertogh (2015) looked into the correlation between contract types and contractual incentives with project performance. They underpinned the conclusion of Merrow that there is no significant difference between lump sum and reimbursable projects when looking at their positive correlation with project performance ($r=0.004$, $p = .973$), teamworking quality ($r=0.144$, $p = .084$) and their negative correlation with relational attitudes ($r=-0.026$, $p = .827$).

Their conclusion is that collaboration is the main ingredient for good project performance, not the setting (i.e. contract type).

The findings of Merrow (2011) would thus indicate that good collaboration is not self-evident.

Suprpto (2016) also states that contractual incentives have an indirect correlation with project performance via its correlation with relational attitudes ($r=0.225$, $p \leq .05$). The latter is significantly correlated with teamwork quality ($r=0.573$, $p = .000$), which at its turn is significantly correlated with project performance ($r=0.465$, $p = .009$). The point that Suprpto (2016, p.146) is making: *'A partnering/alliance contract and incentive contracts do not necessarily result directly into better project performance but through relational attitudes and how they play out into actual teamworking behavior'*. The same goes for partnering according to Suprpto.

Day (1995) also linked benefits to alliances, enhanced capabilities, realization of economies of scale, leverage of resource depth or compensation for a lack of resources.

2.4 Conclusion literature study

This chapter has clarified the importance of partnering before the collaboration models have been discussed. The top-5 of partnering benefits that are recognized by both people that have been involved in partnering projects as well as by people that have not been involved are: 1) Less adversarial relationship, 2) Reduced risk exposure, 3) Reduced Cost, 4) Improved administration and, 5) Quality improvements. The perception that partnering has a positive impact on projects is thus widely spread. Partnering is, however, often obstructed by the principal-agent problem. It is often the case that principals have strict rules concerning communication lines to limit opportunistic behaviour. Feedback will be given whether the principal and agent roles are recognizable in the way how the participants responded to the surveys, whether the general contractor has adopted strict communication procedures, and whether these procedures are adopted in practice.

Furthermore, there are multiple theories discussed concerning project performance models. This paragraph will answer **constructive question 1**. The RECAP model of Suprpto (2016) is the most complete and elaborate model that has been found in the scientific literature. It also not only includes collaboration related factors and project performance, but also the second goal of Fluor: Relationship continuity. The factors Suprpto has identified to construct his RECAP model for project owner and general contractor collaboration, are compared to factors from other models or theories concerning (general contractor and subcontractor) collaboration. This model has factors similar to those mentioned in the other theories, and more. Suprpto (2016) has concluded that it is not the type of contract (lump sum, reimbursable, alliance) that has no significant effect on project performance, but rather the level of collaboration in the contract types. Suprpto has acknowledged that cultural differences might also play a role in the success of collaboration and project performance. This is not tested quantitatively in this research due to time constraints. However, this research will try to provide feedback where possible to explain certain behaviour.

3 Research approach and strategy

In this chapter it will become clear how the RECAP tool is modified to fit the assessment of collaboration between general contractor and subcontractor, while staying as close as possible to the original survey. Next to this, it will describe the methodology of this research, the SNA and the RECAP tool.

3.1 Research framework

In figure 3 the chapters are shown with accompanying end products and an indication of which constructive questions are answered. The research question is answered in chapter 8. Each product contributes to and brings forth insights to be used in the rest of the research, but in order to retain order in the research framework, only the intermediate products that are used at a specific step or are used to provide feedback, are accompanied with an arrow (see figure 3).

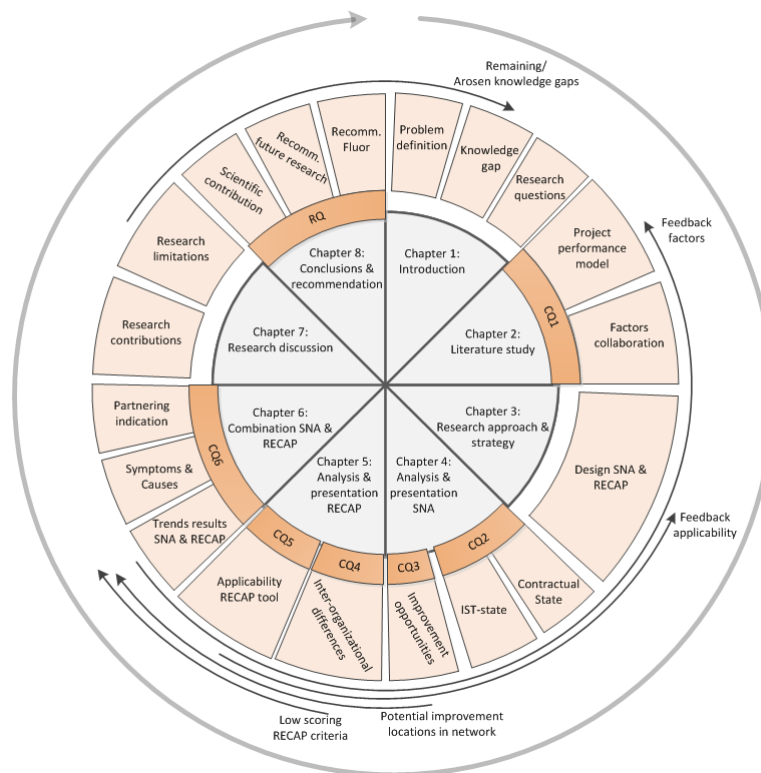


Figure 3: Research approach/framework

3.2 Methodology Social Network Analysis (SNA)

In this section, SNA will be explained and methodological choices will be motivated.

In order to be able to come to the conclusions, a Social Network Analysis (SNA) ought to be conducted in order to identify the formal and informal ties between the participants. The SNA will provide multiple graphical valued representations of the interactions between the participants based on four elements, i.e. frequency, responsiveness, effectiveness and energy, derived from 'The organizational network fieldbook' (Cross, Singer, Colella, Thomas & Silverstone, 2010). The results are also used to construct the IST-state of interactions among the participants, and to compare this to the contractual state of interactions.

3.2.1 Value of SNA

The aim of this report is to make recommendations about how Fluor can optimize the collaboration with IREM in order to increase the project performance in the first place, and in second place to increase the likelihood of relationship continuity after the installation of the piping by IREM in the RAHC project is completed. In a major project, like the RAHC-project, it is important that the management of the general contractor and the subcontractor have a good relation with each other (Kale and Arditi, 2001). Working together implies interaction between parties in any way (vocal or in writing). When this happens on a regular basis, a so-called social network emerges (Haythornthwaite, 1996). De Nooy, Mrvar, and Batagelj (2011, p.5) defined the main goal of SNA as 'detecting and interpreting patterns of social ties among actors'. In section 2.1 the theory of Wang et al. (2016) has been used to gain some understanding of what partnering is. Wang et al. (2016) stated that partnering consists of attitudinal factors and open communication factors. The first one puts emphasis among others on mutual goals, trust and commitment, the second one puts it on factors like effective communication, timely responsiveness, openness and problem resolution.

Cross et al. (2010) described a SNA method where they used four elements to assess the state of collaboration in a network; frequency, responsiveness, effectiveness and energy. If one compares these elements to the open communication factors above, it can be said that this set-up for the SNA can be used to approach the current status of the open communication factors. The same can be said for the set-up of the RECAP tool (and its factors) and the attitudinal factors of partnering.

Not only does this combination give valuable information in itself, like identifying improvement opportunities and potential root causes, the RECAP-factors show similarities to those Wang et al. (2016) described as being attitudinal factors. Together it can thus be said that the SNA provides insights in the open communication part of partnering, and the RECAP in the attitudinal part of partnering. It has to be said that there has been no indication of the existence of a 'desired level of partnering', nor of its factors. It is thus not possible to compare Fluor's and IREM's results to a SOLL-state. It will be checked whether there is reason to believe that the SNA-scores (comparable with open communication factors of partnering) are correlated with the RECAP-scores (comparable with attitudinal factors of partnering).

At least three of the four elements of the SNA might be seen as symptoms of poor collaboration (responsiveness, effectiveness and energy), leaving frequency to be an element that could be either a sign of poor or good collaboration. One could imagine that low frequency of interactions between participants can indicate a high level of trust, and thus lesser need to frequently engage communication. But it can also indicate a reluctance to engage in interactions with a participant's counter-party. By combining the results of the SNA with those of the RECAP, valuable lessons can be extracted from them as it will identify which ties are weak and whether these are weak due to good or bad collaboration. The SNA thus pinpoints potential improvement areas, after which these areas are investigated to deeper extent by analyzing the RECAP results.

3.2.2 Participants of SNA

Because the two parties that are under investigation in this research (IREM and Fluor) have very clear organizational charts, the positional approach (Scott, 2000) is used to identify the participants of the SNA. The key persons will be identified in subsection 4.1.

This target group will not be extended as is the case with the snowball approach in SNA. The snowball approach has different 'rounds' of SNA surveys. Each time a SNA survey is sent, the participants are asked to name a 'X' number of people they have social relations with most. When a significant number of previously unidentified names are filled in, these persons are contacted and asked to fill in the SNA survey in the next 'round'. By doing this repeatedly an almost complete view of the entire involved organization can be made. The snowball approach has been successfully applied by a predecessor in this longitudinal research on organizational effectiveness of the RAHC-project. This predecessor, Wang (2015), aimed to identify the network concerned with tasks in the Front-End Engineering & Design (FEED) phase of the project. It was her goal to identify the network, for which the snowball approach is a logical approach. However, in the context of this research the identification of the network itself is not, nor should it be, the focus in the construction phase as will be explained in section 3.2.3.

The big difference is that other than in the FEED-phase in which activities are distributed all over the world, the construction phase has a relatively small organization with clearly demarcated roles and responsibilities of the people involved. It is, thus, believed that in order to make sensible recommendations on the collaboration in the construction phase, focus should lie on the relations and not necessarily on identifying the network. This is also the reason why a valued positional approach is preferred over a binary snowball approach.

3.2.3 Data collection for SNA

Social network analysis requires that the type of communication is specified narrowly. Wang (2015) successfully identified the workflow between the participants in the FEED phase. Visualization of these workflows is very useful in the FEED-phase where design is done at different Fluor facilities, between which documents need to be passed around and eventually need various approvals. This is believed to be less important in the construction phase because the focus lies more on in-budget, in-schedule, qualitative and safe construction. It is, thus, important that issues are resolved quickly and potential change requests have a fast turnaround.

Appendix B encompasses the SNA survey hand-outs. In order to safeguard an unbiased response from the respondents, they are asked to complete the SNA survey table (see appendix B, table 11) privately. Also, additional measures have been taken by anonymisation of the included participants, already in the survey. By using numbers instead of names in the survey's table, with corresponding names elsewhere, the participants will be more likely to give unbiased responses.

Wang (2015) used a binary snowball approach, which is very appropriate to use while identifying a network. This research is focused on identifying improvement opportunities within a demarcated network, for this purpose a valued positional approach is better suited. In a binary approach there is either a relation or not (0: no relation, 1: relation), in a valued approach (1 to 5) the scores say something about the quality of the relation. Each participant is asked to rate the other participants on the basis of the four above mentioned elements on a Likert-scale (scores ranging from 0 to 5). An explanation of the scores per element can be found in appendix B, tables 12, 13, 14, and 15.

In order to prevent overlooking lower quality relations, the scores/weights of the relations have been reversed when imported into the software-program. This meant the following transmutations: 1-score \Rightarrow 5-weight, 2 \Rightarrow 4, 3 remained the same, 4 \Rightarrow 2 and 5 \Rightarrow 1. By reversing the scores of the surveys into the above mentioned weights, the lower quality relations became better visible for analysis. The 0-scores are not imported in the software-program because this means that the participants don't have a relation to each other (in case of frequency) or that the relation is not applicable (in case of responsiveness, effectiveness and energy, when they have mentioned not to have a relation).

3.3 Methodology Relational Capability (RECAP)

In the following subsections, the methodology of the RECAP tool will be explained and motivated.

3.3.1 Value of RECAP tool

After the SNA has identified the improvement opportunities, the results of the RECAP tool will be used to identify trends in the results of the RECAP results at these areas. These new insights will create an opportunity to suggest a strategy to direct their efforts to improve collaboration and project performance through better collaboration.

RECAP in short, adds value by giving more meaning to the results of the SNA. Instead of 'just' a graph with the quality of relationships between the key persons, by combining SNA with RECAP it can be tried to explain why certain relations are of low quality. As stated before, the RECAP results can also be seen to represent the attitudinal factors of partnering which Wang et al. have identified in 2016. Some feedback is expected to be given about potential indications to believe whether partnering is successfully established in the RAHC-organization concerning piping or not, based on combination of SNA, RECAP and Wang et al. (2016).

At last, the results of RECAP can be used to compare the overall assessment of collaboration between Fluor and IREM on company-level, and among different nationalities and functions within the organization. If there is a significant difference between the two companies, this might also indicate a potential opportunity for Fluor to take directed actions to improve collaboration at the areas at which the differences are identified in order to increase the prospect of relational continuity. It also identifies which (sub)criteria of good collaboration are most viable to improve in order to pursue optimized collaboration, enhanced project performance, and a better likelihood of relationship continuity.

3.3.2 Participants of RECAP tool

For reasons mentioned in section 4.1, all 29 SNA participants are asked to participate in the RECAP test.

3.3.3 Data collection for RECAP tool

The model of Suprpto is accompanied with a RECAP tool to be used to assess the collaboration between project owner and general contractor. One of the aims of this research is to assess the collaboration between general contractor and subcontractor. Before the general contractor and subcontractor were asked to complete the RECAP survey, first some of the statements had to be transmuted. Appendix C contains the entire RECAP survey containing the statements as they are sent to the participants, table 5 solely shows the RECAP survey statements that have been transmuted into suitable statements in the context of this research. Most of the transmuted statements of the survey (table 5) entail a transmutation from '(project) owner' to 'general contractor' and from 'contractor' to 'subcontractor', this is to remain as close to the design of the initial RECAP tool as possible.

The RECAP survey consists of 72 statements (see appendix C) that ought to be evaluated by the participants on a Likert-scale (ranging from 1 to 5) in which 1=very poor, 2=poor, 3=moderate, 4=good, 5=very good. Participants will also be able to evaluate the statements as 'not applicable' or 'do not know'. The subcriteria scores are composed by averaging the corresponding statements of that subcriteria. The criteria scores by averaging the corresponding subcriteria scores, and the overall RECAP score by averaging the criteria scores. By doing this, Suprpto's method is followed.

Table 5: Modifications to the RECAP tool's statements

Original RECAP statements (project owner & general contractor)	Modified RECAP statements (general contractor & subcontractor)
Front-End definition	
The project goals, objectives, and scope are understood by the contractor team	The project goals, objectives, and scope are understood by the subcontractor team
The project goals, objectives, and scope are understood by the project owner team	The project goals, objectives, and scope are understood by the general contractor team
Collaborative practices	
We form an integrated project team (IPT) where the owner and the contractor teams are structured and integrated as a single team with no apparent boundaries	We form an integrated project team (IPT) where the general contractor and the subcontractor teams are structured and integrated as a single team with no apparent boundaries
We perform goal setting and alignment meetings with the owner's business and operation representatives	Subcontractor's team performs goal setting and alignment meetings with the general contractor's business and operation representatives
Project performance	
Both owner and contractor are satisfied with the project results and outcomes so far	Both general contractor and subcontractor are satisfied with the project results and outcomes so far
So far, this project will make a positive impact on the owner's business	So far, this project will be a (commercial) success to the general contractor
So far, this project will be a (commercial) success to the contractor	So far, this project will be a (commercial) success to the subcontractor
Relational attitudes	
Senior management of the owner commits to provide necessary resources and support to the project teams	Senior management of the general contractor commits to provide necessary resources and support to the project teams
Senior management of the contractor commits to provide necessary resources and support to the project teams	Senior management of the subcontractor commits to provide necessary resources and support to the project teams
Senior management of the owner shows consistent and passionate leadership	Senior management of the general contractor shows consistent and passionate leadership
Senior management of the contractor shows consistent and passionate leadership	Senior management of the subcontractor shows consistent and passionate leadership
The owner intentionally adopts 'no blame culture' when problems arise	The general contractor intentionally adopts 'no blame culture' when problems arise
The contractor intentionally adopts 'no blame culture' when problems arise	The subcontractor intentionally adopts 'no blame culture' when problems arise
The owner is intentionally open and honest in any interactions with no hidden agendas	The general contractor is intentionally open and honest in any interactions with no hidden agendas
The contractor is intentionally open and honest in any interactions with no hidden agendas	The subcontractor is intentionally open and honest in any interactions with no hidden agendas
The owner strives for business outcomes whereby both parties either win or both parties lose	The general contractor strives for business outcomes whereby both parties either win or both parties lose
The contractor strives for business outcomes whereby both parties either win or both parties lose	The subcontractor strives for business outcomes whereby both parties either win or both parties lose
Inter-teamworking quality	
The work done in the teams is closely synchronized between the teams	The work needed to be done in cooperation with the both teams is closely synchronized between the teams

4 Analyses and presentation of SNA results

After identifying the most important persons concerned with solving issues during the construction and placement of the piping, these were asked to complete the SNA survey. The results of this survey will also be presented in this chapter.

4.1 Contractual state of interactions

Identification participants of research. Although this research is focused on the collaboration between general contractor and subcontractor, it is considered to be interesting to also include some key persons from ExxonMobil's construction team. This is because these are also heavily involved with issues coming up during construction and installation of the piping, and the decision-making about these issues. Fluor's management has stated that the relation between Fluor and ExxonMobil in this project is of such a good level that there are no apparent boundaries when it comes to their goals and interests regarding their relation with the subcontractor.

After a contract study and expert consultation made clear what functions are important concerning the communication about scope change and issues coming up during construction and placement, the corresponding names could be found relatively easy. This resulted in a participants pool of 29 key people.

These are divided in five clusters that correspond with their working activities:

- Organizational management - Sponsors and other connecting employees
- Preparation - Employees concerned with the preparation of activities
- Construction - Employees involved with the placement of piping at the RAHC-project site
- Office - Several office-related functions, like planning, contract management and control
- Prefab - Employees involved with the prefabrication of piping at the Italian building site

The division of the 29 key people in these clusters is checked and confirmed by Fluor's project director.

Construction of contractual state. After the important functions and key persons were identified, the contractual state could be constructed (see figure 4). In figure 4 the ExxonMobil key persons are linked to their Fluor counterparts, because they practically act as one.

To properly execute a valued positional approach of SNA, it is important to ensure that all relevant persons are targeted. For this purpose, Fluor's project engineer, contract engineer and project director were asked to verify whether or not all relevant functions/persons are included. This has been done after the contractual state was constructed so that potential differences could be identified between how Fluor and IREM see the contractual inter-organizational ties. The three above mentioned persons of Fluor were satisfied with the presented key persons and the inter-organizational ties were viewed the same among these persons. The view on the contractual inter-organizational ties of IREM's project manager has also been asked. The project manager of IREM also agreed on the identified key persons when the contractual state was shown for verification. IREM's project manager, however, made additional remarks about the qualifications of IREM's project manager and construction manager. According to IREM's project manager, the contract enables these two managers to contact all of Fluor's employees. That is why these two managers have an asterisk behind their names in figure 4.

According to the contract (see figure 4), participants with similar functions are free to solve minor issues and changes with each other. The ties between the participants in the contractual state are designed in this way. For major issues and changes the companies have agreed to a more formal

way of communications between the contract engineer of Fluor and the project manager of IREM. If ExxonMobil as a client has any issues or desired changes, their communications should contractually follow the same reasoning (minor, in collaboration with their functional counterpart of Fluor; major, via the contract engineer of Fluor who will pick it up). The sponsors only jump in when disputes arise and escalate. Figure 4 includes the 29 key persons concerning work-related issues and decision-making during the construction and placement of the piping at the RAHC-project.

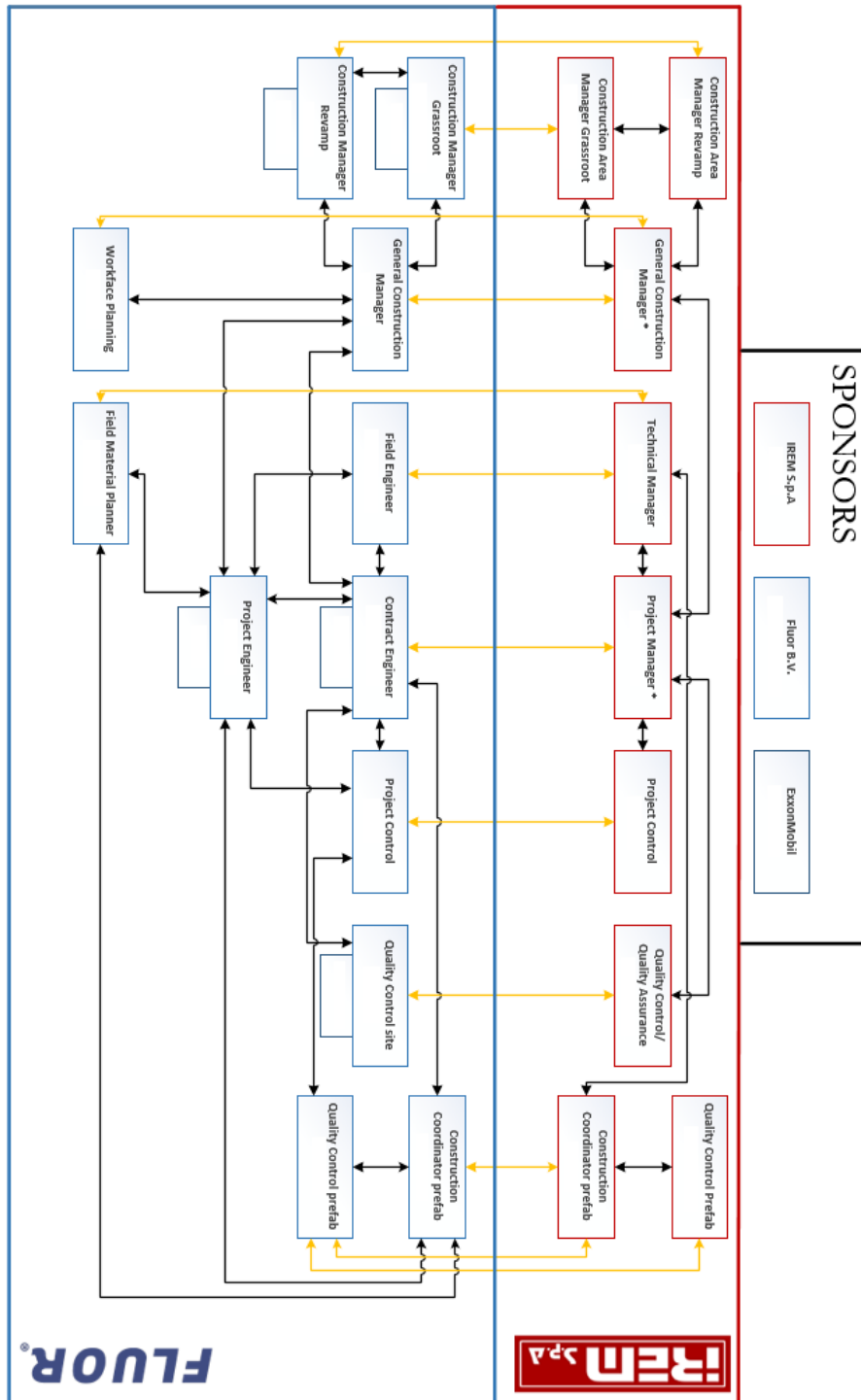


Figure 4: Contractual state of inter-team interactions

4.2 Data gathering

In section 4.1 the 29 participants that play a key role in decision-making and issue-resolving during the construction phase have been identified. These 29 participants have been asked to submit a set of two surveys, a RECAP survey and a SNA survey. The surveys have been sent via e-mail because the schedules of the participants didn't allow for oral communication and/or they were not situated in the Netherlands. In appendices B and C the surveys can be found. The respondents have been given 2.5 weeks to respond to the request to submit their surveys. In these 2.5 weeks, several personalized reminders have been specifically addressed to non-respondents to ensure an as big as possible pool of participants.

This research investigates the collaboration between an American company operating in The Netherlands which has at least 11 nationalities only in the pool of (29) research participants, and an Italian company, with a number of nationalities. Participating nationalities are: Dutch, American, Italian, Greek, Spanish, Canadian, English, Brazilian, French, Portuguese and Belgian. This big pool of different nationalities makes a straight forward comparison between the Fluor's and IREM's culture rather cumbersome. For this reason, organizations will not be compared with each other in general. It is important to state that, with an eye on promised anonymity to ensure truthful answers to the surveys, this feedback regarding the differences between nationalities doesn't include nationalities of which there is only one in the pool of participants because the identity of this person can easily be derived.

The participating nationalities that are represented by multiple people are the Dutch, American and Italian nationalities. Their overall scores on the 6 cultural dimensions of Hofstede, Hofstede and Minkov (2010) can be reviewed in appendix A.

Response rates. Originally 29 respondents were called upon in this research, 22 of them have completed the RECAP survey. This means that the response rate is 76%. One participant only submitted the RECAP survey but didn't submit his SNA survey.

The response rate of the SNA survey was the same. 22 Out of the original 29 targeted participants submitted their SNA survey, this implies a response rate of 76%. One participant only submitted the SNA survey but didn't submit his RECAP survey.

As one can see, however, the tables in chapter 5 count up to 23 respondents. This is due to an additional participant of the RECAP survey. This participant became interesting because of an internal shift in activities. Notion of this shift was too late to include this person in the SNA survey. Although this substitute is not represented in the SNA diagrams, its perceptions on the general collaboration, can however still be of interest. Therefore the RECAP results are based on 23 people, while the SNA results are based on 22 people.

Data computation.

1. After the data was collected, some transformations have been made to create a database on which the analysis could be based. The scores of the SNA survey (0 to 5) have been reversed ($1 \Rightarrow 5$, $2 \Rightarrow 4$, 3 remained the same, $4 \Rightarrow 2$ and $5 \Rightarrow 1$). This is done so that the lower scores, indicating low quality relations, were given a bigger weight when imported in the software and became better visible for analysis. The '0'-score has not been transformed since this score indicates a non-relation and is thus not imported in the software at all.
2. The results of the RECAP survey have been transformed according to Suprpto's design (2016). This means that the statements average up to the subcriteria scores, that the subcriteria scores average up to the criteria scores and that the criteria scores average up to the overall RECAP score.

4.3 Comparison contractual and IST-state

A distinction has to be made between IST-state, and the contractual state and SOLL-state in particular.

Although one could state that the contract provides the SOLL-state because apparently both companies have agreed upon this, which (with reasoning of people as a homo economicus) they would not do if the contract were to provide something different than the SOLL-state. This line of reasoning, however, heavily depends on a (relatively outdated) model of how humans behave and make choices. The homo economicus model is one of the oldest, and numerous other models have been described. These models will not get much attention in this research because these models are often very theoretic. It is however argued that the homo economicus model doesn't cover or explain all behaviour that can be observed in practice. People are often making concessions, a good example being the 'Poldermodel' in Dutch politics that is based on negotiation and compromise. It can therefore not simply be argued that the contract provides the SOLL-state.

A SOLL-state of an inter-organizational interaction structure has not been found in the existing literature. Therefore the existing, current state of interactions (IST-state) is compared to the contractual state.

The contractual state has been presented in figure 4, section 4.1. In the contractual state, there are only a few inter-organizational ties (12, depicted by the yellow arrows) between Fluor's and IREM's employees, whereas in practices there are a lot more (see figure 5). The design of the contract is that minor issues are to be solved directly with one's counterpart, and major issues via the entitled figures, who then start an intra-organizational discussion (depicted by black arrows in the contractual state). Figures 5 and 6 show a completely different picture, these figures are split for clarity purposes. Figure 5 in particular implies that this design is heavily abandoned, because it shows that there are in total 77 inter-organizational ties between Fluor and IREM, in contrast to the above mentioned 12 ties as specified in the contract.

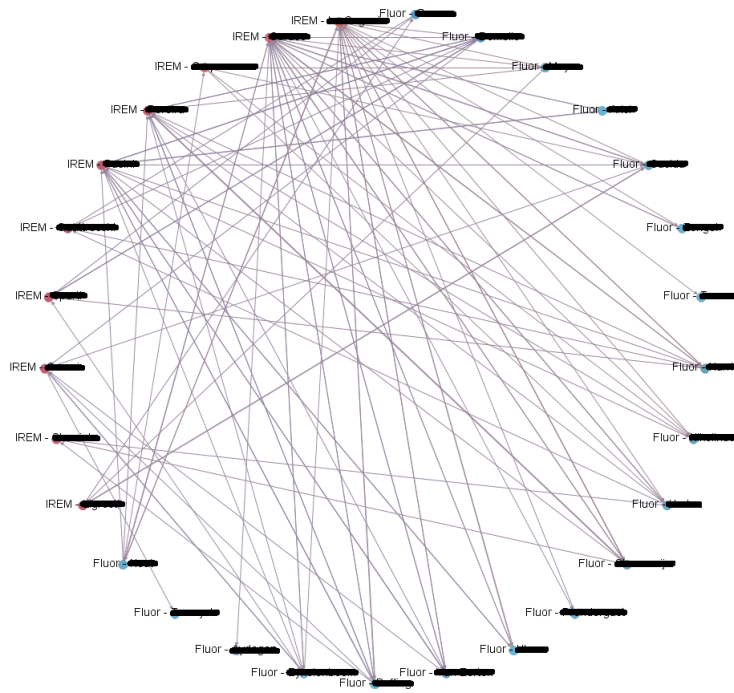


Figure 5: IST-state of inter-organizational communication

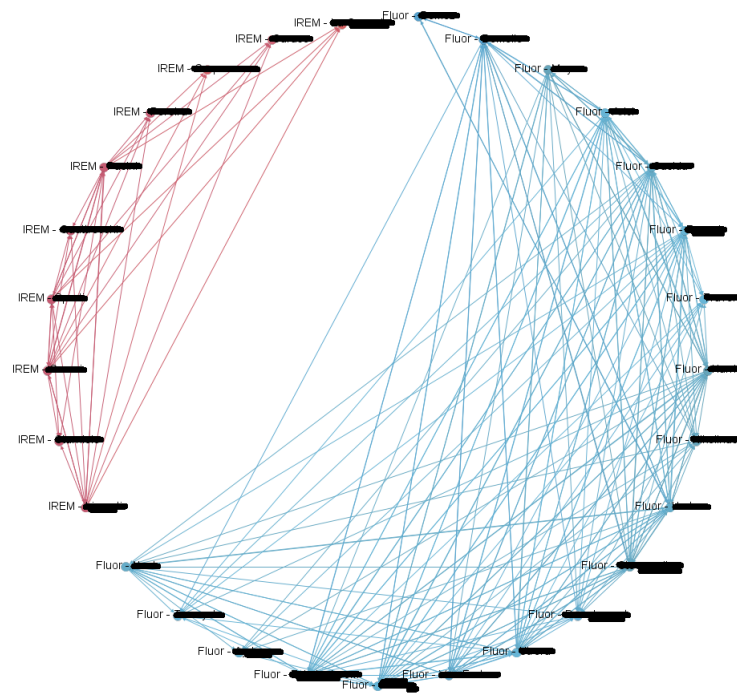


Figure 6: IST-state of intra-organizational communication

Both the contractual as the IST-state contain names, this is not considered to be an infringement of the promised anonymity because there lies no value within the ties, as they do have when discussing frequency, responsiveness, effectiveness and energy in section 4.4. In figures 5 and 6, red 'nodes' indicate that this person is an employee at IREM, the blue nodes that it is an employee at Fluor. In practice the communication between Fluor and IREM is a network of communications.

Communication Matrix. Table 6 puts the ties in the IST-state next to those of the contractual state. Where figures 4, 5 and 6 show the gravity of the differences better, table 6 enables better comparison of the contractual and IST-state.

- **'I'** = Tie in IST-state, **'C'** = Tie in contractual state.
- **Dark green** = Tie is existent in both states and both participants state that they communicate with the other.
- **Light green** = Tie likely to be existent in both states because one of two has indicated to have communications with the other. The other didn't participate in the SNA or part of it. Four participants of IREM for example haven't submitted SNA results for communications concerning changes within IREM. Perhaps instructions were not clear on this part and this, thus, underpins the importance of clarity in the instructions.
- **Dark orange** = Tie should be existent according to the contractual state, both parties have indicated however not to have communication with the other when issues occur during construction.
- **Light orange** = One of two participants has indicated not to communicate with the other, however it is not clear whether this tie is completely non-existent or if the contractual communication would solely come from the participant that didn't take part in the SNA.
- **Blue** = Both participants didn't submit this (part of the) SNA survey.

Table 6: Communication matrix, indicating contractual and IST-relations

		Contractor																													
		58	28	24	42	8	44	66	31	34	12	86	21	98	32	83	17	1	63	59	18	16	74	87	62	50	48	68	36	57	
Receiver	58	█	I		I	I	I-C	I		I		I		I		I		I		I		I-C									
	28		█		I	I		I-C	I		I		I		I		I						I	I							
	24			█	I	I		I	I-C	I		I		I		I							I	I							
	42				█	I		I	I	I-C	I		I-C		I		I					I		I	I						
	8					█		I	I	I	I		I-C		I		I							I	I						
	44						█		I	I	I				I		I-C							I	I						
	66							█		I	I				I		I					I	I-C								
	31								█		I-C	I-C			I		I-C							I	I						
	34									█	I-C	I-C			I		I-C							I	I						
	12										█	I-C			I		I							I	I						
	86											█	I-C		I		I							I	I						
	21												█		I		I							I	I						
	98													█		I		I						I	I						
	32														█		I							I	I						
	83															█		I						I	I						
	17																█							I	I						
	1																	█						I	I						
	63																		█					I	I						
	59																			█				I	I						
	18																				█			I	I						
	16																					█		I	I						
	74																						█	I	I						
	87																							█	I	I					
	62																								█	I	I				
	50																									█	I	I			
	48																										█	I	I		
	68																											█	I	I	
	36																												█	I	I
	57																													█	I

When looking at table 6, an interesting observation can be made. This is that IREM seems to follow the formally described inter-organizational ties as specified in the contract better, compared to Fluor’s employees. This especially goes when one takes into mind that the contract allows two of IREM’s managers to contact any of the Fluor employees. Looking back at the description of Hofstede’s cultural dimensions in section 2.3.1 and looking at cultural scores of the three nationalities that are represented multiple times in the organization (appendix A), this difference might be explained by the difference in power distance and uncertainty avoidance scores. The graphs in appendix A show that Italy has a culture that has a higher power distance than the Dutch and American culture (NL:38, US:40, IT:50). It also shows that Italy has a considerably higher uncertainty avoidance (US:46, NL:53, IT:75).

As defined, high uncertainty avoidance indicates a preference for structure and avoidance of situations of which the outcome is ambiguous. In the role of agent, it might be unclear for the employees of the subcontractor what the consequences would be of communication outside of the contractually determined communication lines. When IREM would have been a Dutch company, this non-clarity wouldn’t have withhold the employees of leaving the structure determined in the contract. However, IREM as an Italian company (characterized by high uncertainty avoidance) is expected to respect this structure more. In table 6 it can be seen that this is indeed the case.

This might be strengthened by the higher power distance in the Italian culture. Fluor, as general contractor, is the employer of IREM. Therefore, power distance between the employees of both companies might be considered to weight more heavily by the IREM employees. High power distance often goes hand in hand with carefulness when approaching supervisors and such, this might be a second reason why IREM’s employees seemingly contact less persons with which they don’t have a formally described tie.

The contract in practice. Because of the numerous ties in the IST-state, it is interesting to investigate whether the contract's intention of 'solving as many issues as possible with counterparts' holds. Because problems are mainly solved with counterparts, which are in the same cluster, it is expected that persons in the same clusters clearly group together when analyzing whether the design of the contract holds. The used software provides a possibility to do so by computing the so-called modularity statistics. The software explains this term as a statistic measure that can be used to group persons together based on the ties between them. In theory, the 'modules' should at least resemble the clusters in any way. Some differentiation is to be expected since the contract also provides for inter-cluster communication but the modules should in general resemble the clusters. Tables 7 shows that the clusters are indeed represented by the modules in the contractual state. In the contractual state, the persons in the same clusters are most interconnected with each other, this represents the design of the contract that issues are solved with each others counterparts.

Table 7: The division of the clusters among the modules in the contractual state

Module 1	Module 2	Module 3	Module 4	Module 5
Construction	Preparation	Office	Prefab	Org. management
Construction	Preparation	Office	Prefab	Org. management
Construction	Preparation	Office	Prefab	Org. management
Construction	Org. management	Office		
Construction	Org. management	Office		
Construction	Prefab	Office		
Construction		Office		
Construction		Org. management		
Preparation				

It is virtually impossible to conclude from table 8 which module represents which cluster. This is because the participants are apparently highly interconnected which makes that persons from the same cluster are not most interconnected in the IST-state.

This shows the gravity of how the design of the contract is undermined, and the extent in which a network-structure is in place.

Table 8: The division of the clusters among the modules in the IST-state

Module 1	Module 2	Module 3	Module 4	Module 5
Construction	Preparation	Office	Prefab	Org. management
Construction	Preparation	Office	Prefab	Construction
Construction	Preparation	Org. management	Prefab	Prefab
Office	Construction	Org. management	Office	
Office	Org. management	Construction	Office	
Office			Construction	
Preparation			Construction	
Org. management			Org. management	

To show the difference graphically, figures 7 and 8 are presented. In these figures, the colors of the spheres represent the clusters of the organization. The clusters are also mentioned by name (in text) in the figures, but by assigning colored spheres to them, the difference between the contractual and IST-state becomes clear at sight.

- **Dark blue.** The organizing management-cluster
- **Red.** The construction-cluster
- **Green.** The preparation-cluster
- **Purple.** The office-cluster
- **Light blue.** The prefab-cluster

The idea behind the figures is the same as that of the modules, it shows which 'nodes' that are most interconnected, by 'pulling them together' in the SNA software.

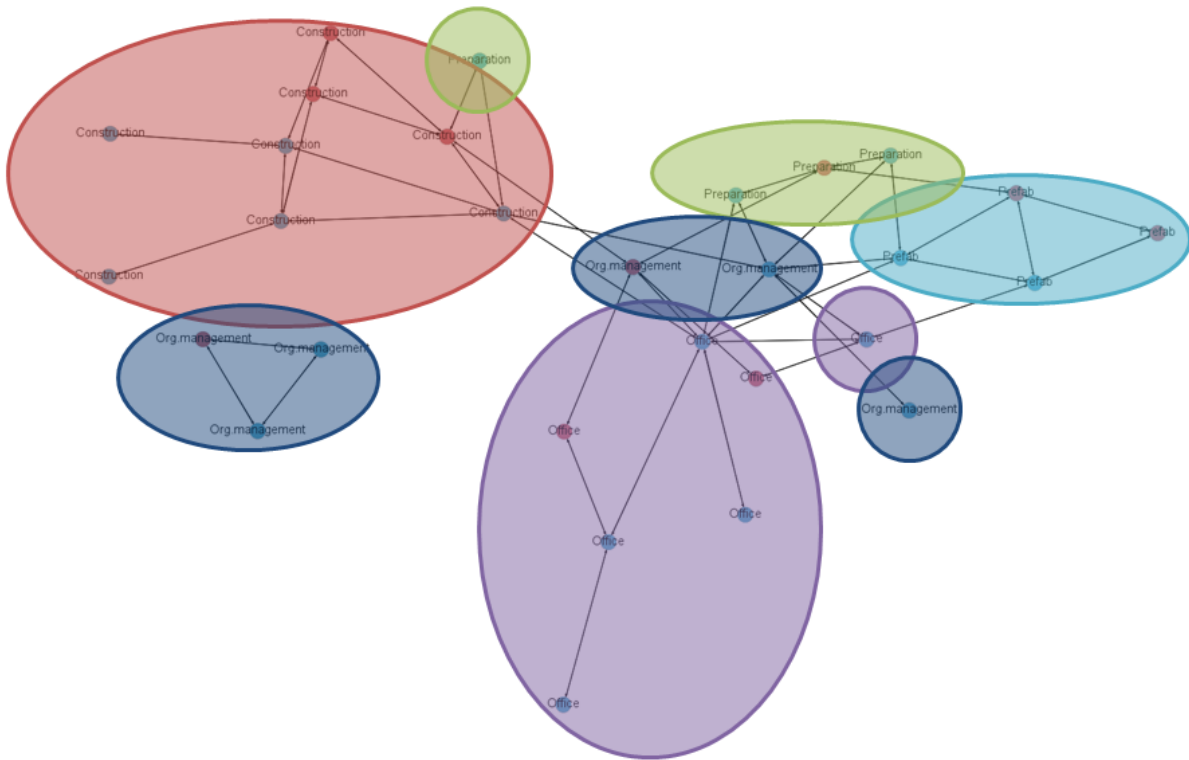


Figure 7: Inter-connectivity of participants in the contractual state

The contractual state is shown in figure 7 and it is relatively easy to see that the persons in the same clusters are most interconnected with each other. The placement of the organizing management-cluster might look peculiar. This is because the sponsors of the companies are involved, these have according to the contract only formally communication with each other when there are very severe problems. The other org. management person (with only one tie) can be derived to be the ExxonMobil counterpart of the Fluor employee it is contractually tied to.

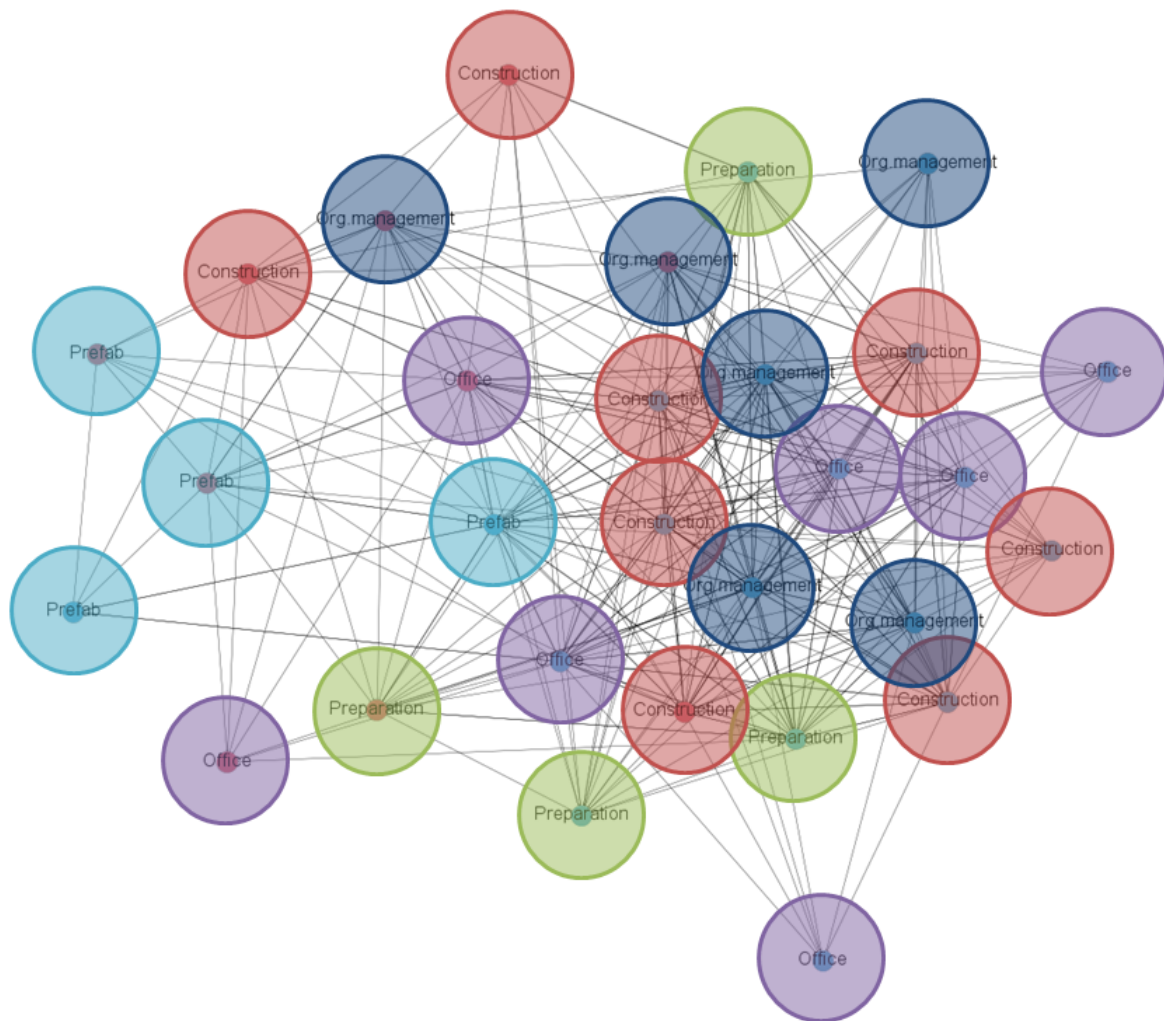


Figure 8: Inter-connectivity of participants in the IST-state

Figure 8 represents the same, only concerning the IST-state. Like table 8 suggested, the persons are highly interconnected with each other in the IST-state. The people are neither obviously 'pulled together', nor are the people from the same clusters clearly most interconnected. These results thus underpin the conclusion, earlier based on only the amount of inter- and intra-organizational relations, that there is a network structure. Not only do people have a lot of interconnections, they also no longer have most interconnections with people from their own cluster, the design of the contract is thus abandoned.

4.4 Presentation of SNA results

The results presented in section 4.3 were derived after changing the valued ties from the SNA’s element ‘frequency’ into a binary scale. It, thus, doesn’t show any value in the communication between parties. In this section the valued results of the SNA will be presented. In appendix D to G all results can be found in a circular lay-out. In this section the most important figures are shown in a different lay-out. In this lay-out the persons from the clusters are grouped together so that the low quality inter- and intra-cluster relations are immediately visible.

Because it is this research’s objective to identify improvement opportunities, this section will only look into these low quality relations between the key persons. What can be portrayed as low quality is considered to be self-evident in case of responsiveness, effectiveness and energy, that is: slow responses, low effectiveness of communications and being de-energized after communication. For frequency, this is not as clear. As mentioned before, one of the aims of this research is to see whether or not a linkage can be made between the frequency of communications, and the collaboration. For this purpose the SNA diagram representing high frequency of communication is presented and analyzed in this section.

In the following figures in this section, the color of the persons or nodes, indicate the two companies that are under investigation (blue being Fluor, and red being IREM). The same color scheme and meaning goes for all figures in this section.

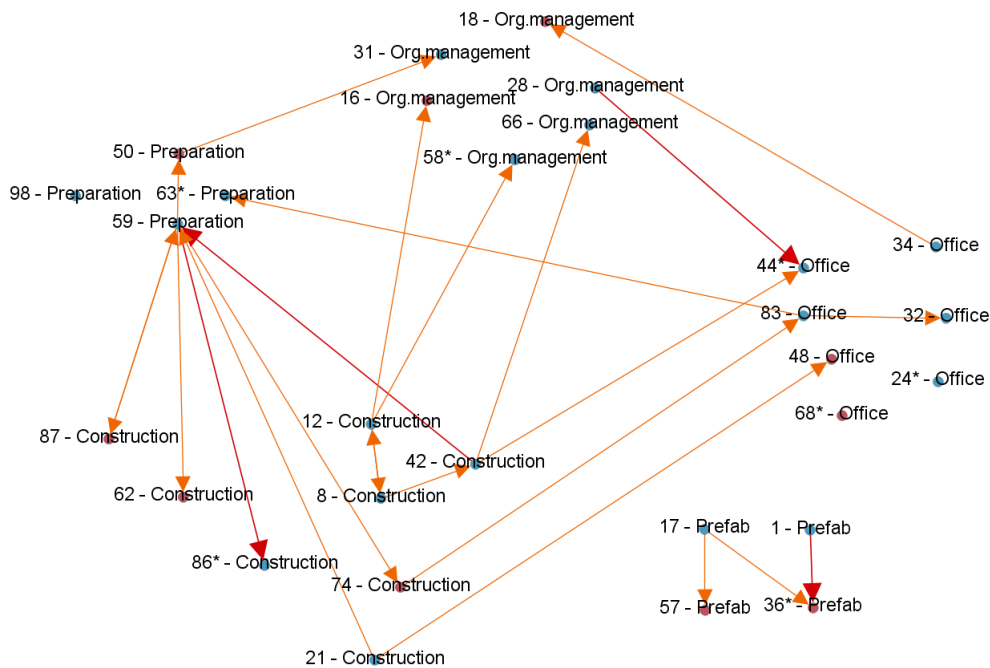


Figure 9: Communication ties, indicating slow responses (incoming node is slow responder)

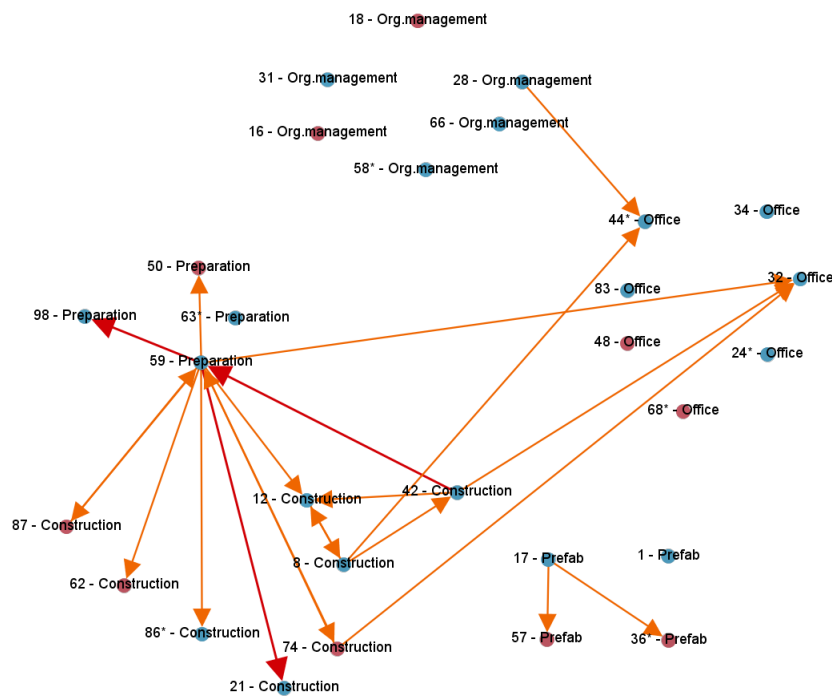


Figure 10: Communication ties with a low effectiveness (incoming node has low effectiveness)

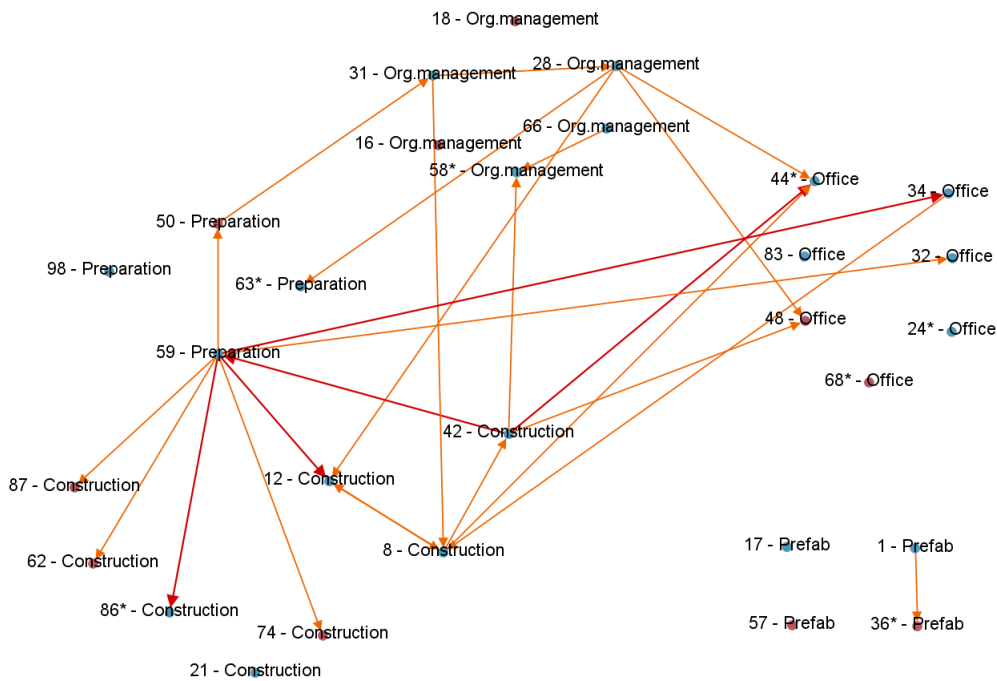


Figure 11: De-energizing communication ties (incoming node is de-energizing)

Figure 10 shows the relations between the nodes with respect to the effectiveness of communication, and figure 11 shows the most de-energizing ties between nodes.

From figure 9, 10 and 11 the following conclusions are drawn:

1. Person 59 is a definite opportunity for improvement. This person is heavily involved in communication that is slow, ineffective and de-energizing, both according to himself and to others that state this to be the case about him. The roles of the employees in Fluor's preparation-cluster are thus certainly a potential improvement opportunity. Person 59 may be better suited in a different working environment, both for the organization's sake as his own, since this participant himself has indicated to get very de-energizing while performing his work.
2. If one looks at the ties, it is striking how few low quality relations originate from IREM's nodes compared to those from Fluor's nodes. This implies that Fluor's employees are either more critical in their feedback about others or that the employees of the subcontractor, as a result of the principal-agent relationship between Fluor and IREM, have been careful while filling in the SNA survey.
3. The construction-cluster is definitely a cluster that presents an improvement opportunity. Although it might seem that the preparation-cluster is in most urgent need of improvement, almost all low quality relations originating from this cluster and coming into this cluster are linked to person 59. The construction-cluster shows next to low quality inter-cluster relations, also relatively many low quality intra-cluster relations compared to the other clusters.
4. Despite the remark about intra-cluster relations in the construction-cluster, it seems that the intra-cluster effectiveness is good in general. The three figures show remarkable few low quality intra-cluster relations in the other clusters. It, thus, appears that persons from the same cluster have less open communication problems than otherwise. This might indicate that people with the same field of expertise consider themselves well-helped in intra-cluster communication, potentially because people from the same clusters understand the needs of the other better, which allows for faster response rates and effectiveness. This better understanding might also be a cause of the few de-energizing interactions due to less miscommunication or need for explanation. This observation indicates that efforts to improve collaboration should not be targeted on the clusters individually.
5. The last observation is that in none of the three figures, the prefab-cluster has a low quality tie with the other clusters. This could be because the prefabrication site is in Italy and communication might not occur as frequently, thereby lowering the potential occurrence of inter-cluster clashes, and thus low quality ties in the SNA.

Continuing on the last observation, one would expect the prefab-cluster to have fewer ties (indicating frequent communication) in figure 12. This figure 12 shows the ties between people that have either at least daily communication or continuously. This figure contradicts the possible explanation given in the last observation, the prefab-cluster has quite frequent communications with persons from other clusters.

Based on figure 12 it is not possible to make any further interesting observation because of the high amount of ties and because it is not yet clear in this stage of the research whether high frequency is a sign of good or bad collaboration.

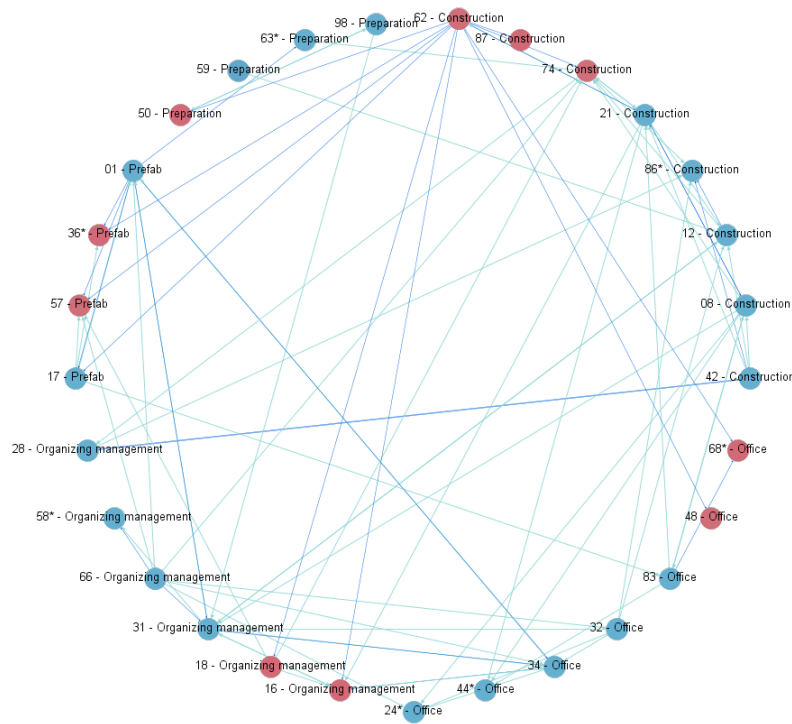


Figure 12: Communication ties with a high occurrence frequency

4.5 Conclusion SNA results

This chapter concludes with answering constructive questions 2 and 3, both enabled by performing a SNA.

Constructive question 2 (*What is the difference in the contractual and current collaboration structure between Fluor and IREM?*) can be answered as follows: The main difference is that the IST-state has an exorbitant number of ties between the participants which impairs the contract's aim to limit communication as much as possible to managers and their counterparts when resolving issues. The contract's design is abandoned in practice. Not only because there are a lot more inter- and intra-organizational relations but also because people from the same clusters are no longer most interconnected as one would expect based on the contract. IREM seems to follow the contractual procedures more closely than Fluor, based on the communication matrix presented in section 4.3. This behaviour can be explained by cultural differences, in particular because of the differences in Hofstede's uncertainty avoidance and project performance cultural dimensions. IREM, with a predominantly Italian culture, is characterized by a high(er) uncertainty avoidance and power distance score than the American and Dutch culture. This implies that the Italian culture prefers structure and rules more than the other two cultures. This can explain why IREM follows the contractual agreements concerning inter-organizational communication more strictly. The higher score on power distance may strengthen this because this implies that IREM's employees have a stronger sense of hierarchy, which implies that IREM's employees can be reluctant to contact those higher in the hierarchy of an organization. Based on Fluor being the principal of IREM, IREM's employees might perceive Fluor's employees as such.

Constructive question 3 (*What current relations could be interesting improvement opportunities?*) has been answered in section 4.4. Improvement is certainly possible in the preparation-cluster, person 59 in particular is to be addressed. The potential reasons for this obvious improvement opportunity is to be investigated in chapter 6. If one looks through the numerous bad relations of this person, one can see that also within the construction-cluster an opportunity presents itself. This is because it has a relatively high amount of low quality intra-cluster relations compared to the other clusters. More specifically; persons 59, 8, 12 and 42 have indicated to experience de-energizing, low effectiveness and slow response (or have been indicated to be the source of this). Strikingly, these persons are all employees of Fluor, which should logically lead to the recommendation and conclusion that Fluor should focus on its own organization. This doesn't mean that these persons are 'to blame' but inventorization of persons' concerns, troubles and other experiences might uncover insights that can be used to make improvement at these opportunities. This is aimed to be done in chapter 6.

Differences in results between Fluor and IREM. In the last paragraph it is mentioned that almost all low quality relationships in terms of responsiveness, effectiveness and energy originate from Fluor. This means that IREM is either very content with the communication and collaboration during the project so far, or that principal-agent roles and cultural factors may have influenced the answers of the respondents.

As shortly mentioned before, it is imaginable that IREM (as the agent of Fluor) might have given some socially desirable answers to the SNA survey. According to the principal-agent theory, agents might try to gain favor of the principal by retaining information, which would in this case possibly be low quality inter-organizational relations.

This effect might even be strengthened by the high uncertainty (75) avoidance in the Italian culture (Hofstede, 2010). The IREM management has expressed during the first alignment meeting that they were not used to alignment meetings at non-site locations, diners and other surveys aimed to playfully de-freeze in each other's company and to learn about different working styles people adopt during their work in different situations. Given that they are unacquainted with these kinds of collaborative practices, it is likely that they aren't used to this kind of researches too. This might have put the Italian employees in an unambiguous situation, which they typically (according to Hofstede, 2010) wouldn't prefer, and which might have influenced their answers to the SNA survey.

Hofstede also argued that the Italian culture is also very masculine (70) in contrast to the Dutch culture (14), which basically means that Italians are mostly focused on results and the Dutch on the quality of life. This could also be a cause of the low amount of bad ties originating from IREM's employees, because the Italians can be expected to have adopted a 'don't complain'- and 'the result counts'-attitude. Fluor's employees on the other hand can be expected to be more concerned with a good working atmosphere according to Hofstede (2010). This might be why these seem to have grasped the opportunity to improve this by expressing their opinions about inter- and intra-organizational relations during the SNA.

5 Analyses and presentation of RECAP results

In this section the results of the RECAP survey are presented. These results are most of all descriptive and focus on identifying differences between among different groups of participants (between companies, clusters and nationalities).

5.1 Presentation of RECAP results on company level

Figure 13 shows the radar-chart in which the six RECAP criteria are represented. What can be seen at first sight is that IREM has a better perception of five out of six of these criteria.

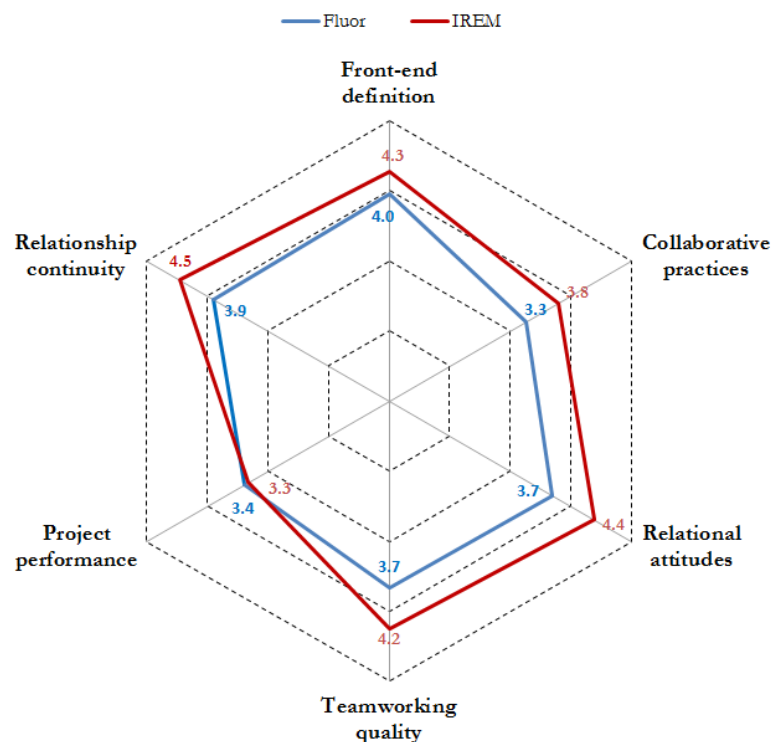


Figure 13: Radar-chart of six RECAP criteria on company level

Other results of the RECAP assessment, concerning the subcriteria, are presented in figure 14.

Although the radar-chart and horizontal bar-chart provides clear a view of how the perception about the RECAP factors differ, it doesn't show whether or not these differences are also significant. In order to investigate this, an independent-samples t-test could be executed. Since the pool of participants of the RECAP tool is relatively low ($N=23$), a normality test should be executed before the independent t-test can be executed. A Shapiro-Wilkinson test shows the likelihood that the data is normally distributed. After executing the Shapiro-Wilkinson test, it was concluded that the data concerning the relational attitudes and inter-teamworking quality factors was not normally distributed, which means that comparison of Fluor's and IREM's scores can't be scientifically underlined. These two factors are, however, expected to be influencing project performance and relationship continuity according to the selected project performance model of Suprpto (2016). When these two factors can't be subjected to an independent t-test, the relevance of it would therefore decrease sharply.

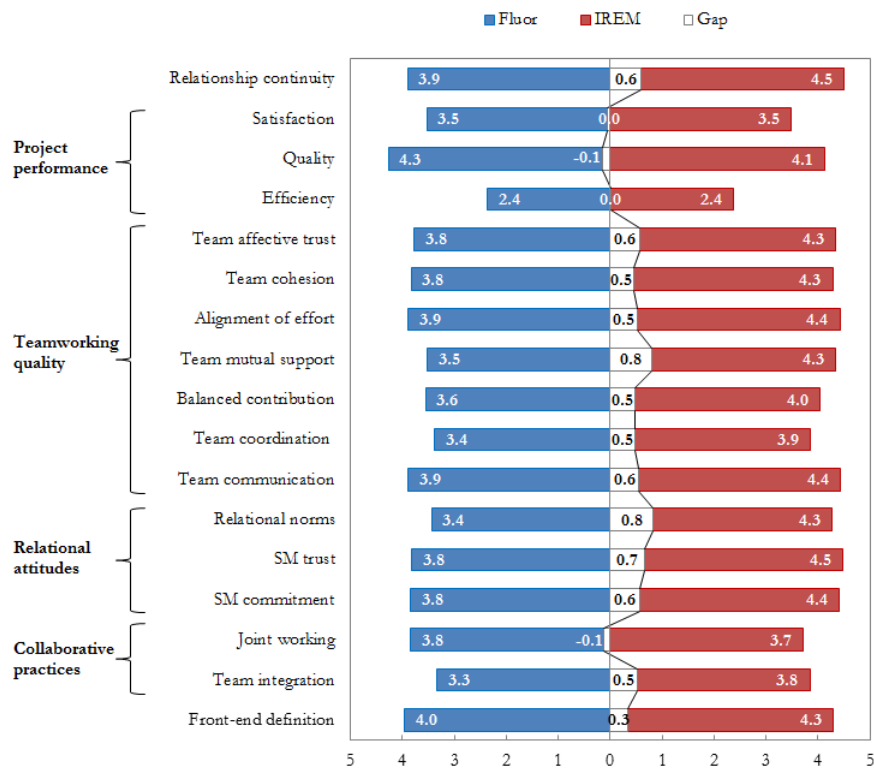


Figure 14: Fluor's and IREM's RECAP criteria scores and gaps by subcriteria

An independent samples t-test is, thus, not executed. The results of the RECAP tool can, however, still be analyzed with figures 13 and 14.

Front-end definition. This RECAP factor, or criterion, has no further subcriteria. The difference ($\Delta = 0.3$) is small. Fluor and IREM are thus considered to have a relatively equal view on the quality of the front-end definition of the RAHC-project. Their scores are also high, this criterion shouldn't have priority when trying to improve collaboration in the organization.

Collaborative practices. Two subcriteria determine the collaborative practices score. These are; joint working practices and team integration. Fluor scored quite low (3.3) on this criterion compared to IREM (3.8). If, while combining the SNA- and RECAP results, a reason is found why the collaborative practices of Fluor and IREM should be improved, efforts should go to increasing the integration of the team. Although IREM's employees seem to be content with the level of team integration (score: 3.8), according to the Fluor employees this subcriterion is viable to improve (score: 3.3).

Relational attitudes. The biggest difference ($\Delta = 0.7$) in Fluor's criteria scores can be found in the criterion 'Relational attitudes'. This criterion consists of three subcriteria (Established relational norms, senior management trust and senior management commitment). The big difference between Fluor's score (3.7) and IREM's score (4.4) isn't attributable to one of the three mentioned subcriteria specifically. The 'gap' in these subcriteria (see figure 14) is relatively the same for each of them. When further analysis indicates that the relational attitudes of the senior management should be improved, all three subcriteria could be targeted for improvement. However, since the established norms are rated slightly less compared to the other two subcriteria, this criterion is preferred to be targeted at first. This means that efforts should go to establishing a 'no-blame culture' in which there is open and honest communication aimed to accomplish win-win situations. Furthermore it is interesting to see that Fluor seems to be more suspicious of IREM to withhold information, to adopt a 'blame culture' or to strive for win-win situations. This is in accordance to the principal-agent theory. According to this theory the principal is often cautious about trusting the agent.

Teamworking quality. The difference ($\Delta = 0.5$) between the opinions about the teamworking quality is relatively big. As can be seen in figure 14, IREM scores better on each subcriterion. Because of IREM's predominantly very positive assessment of the subcriteria, it is somewhat striking to notice that they have a considerably lower team coordination and balanced contribution score. It is, thus, suggested that when teamworking quality should be improved, this will be targeted in first instance by improving the coordination between Fluor and IREM, the balanced contribution, but also the mutual support between Fluor and IREM. The latter since Fluor scores relatively low on this subcriterion. Again, the differences in subcriteria like 'Affective trust', 'Effort' and 'Mutual support' could be explained by Fluor's role as the principal in the relation with IREM.

Project performance. Regarding this criterion, there is as good as no difference between Fluor (score: 3.4) and IREM (score: 3.3). Notable differences are neither observed in figure 14. The efficiency of the project is definitely in need of improvement. According to both Fluor's as IREM's employees, the construction and placement of the piping in the RAHC-project is not progressing according to budget and planning. This research is aimed at improving project performance, which is expected to be possible by improving the collaboration between the parties involved. This subcriterion, however, shows that there is indeed a problem concerning the project performance. Not only because of facts (because the progression of the costs and schedule could also have been found on paper) but it shows that employees of both the general contractor as the subcontractor observe these problems.

Relationship continuity. IREM has a relatively high score (score: 4.5) compared to Fluor (score: 3.9). Both are, however, not 'bad'. Fluor's desire to improve project performance in the first place, and to improve the likelihood of relationship continuity in the second place can, thus, be justified by these scores. IREM's employees are at the moment more positive about the relationship continuity.

In general, IREM has assessed the RECAP factors better than Fluor. This raises the suspicion, but not the conclusion, that IREM might have given some socially desirable answers to the RECAP survey. The Fluor management stressed multiple times that this research is set up to be beneficial for both companies. This is explained again in an oral presentation of the importance of this research to the Fluor and IREM management on the RAHC-project, in the surveys and in the accompanying e-mails.

5.2 Presentation of RECAP results on cluster level

Figure 15 shows another radar-chart. In chapter 4 the organization concerned with construction and placement of the piping is divided in five clusters (organizing management, construction, preparation, office & prefab).

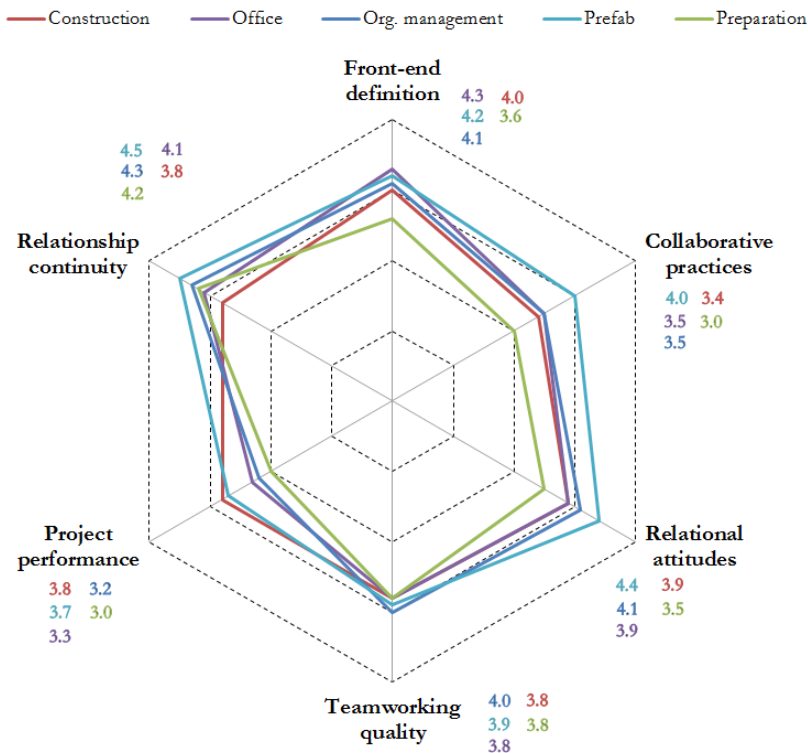


Figure 15: Radar-chart of six RECAP criteria on cluster level

Because the independent-samples t-test can only compare means of two data sets, it is not possible to perform this test in this way. By comparing the means of the highest scoring cluster with those of the lowest scoring cluster, this can be bypassed. When there is no significant difference between the bottom and top cluster-score, neither will there be a significant difference among the other cluster-scores. This method is, however, also not considered to be appropriate. This is due to the low amount of data per cluster and the volatility of the means.

A disadvantage of the averages of the clusters is that they are very versatile for the perceptions of one individual. Figure 16 shows the median (*the line in the box* indicating that 50% of the observations lie above and below this value), the 25-percentile (bottom of the box), 75-percentile (top of the box) and the biggest and lowest observation (lines outside of the box). The median is supposed to be a more robust measure than the average of a data set because the latter is known to fluctuate more with change.

When figure 16 is compared to figure 17, one can see the impact that one participant can have. Be aware of the change of scale of the y-axis. Even with the overall RECAP-score (which is an average of all 6 RECAP criteria), exclusion of one participant in the preparation cluster has a big influence on its boxplot. Where in figure 16 the median is 3.75, in figure 17 it is 3.95. This means that the average is even more volatile. Also, the box containing 50% of the observations is decreased and the minimum and maximum observation are very close to or included in this box.

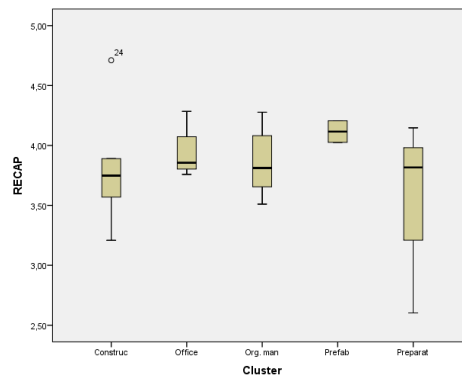


Figure 16: Boxplots of overall RECAP scores per cluster (including all participants)

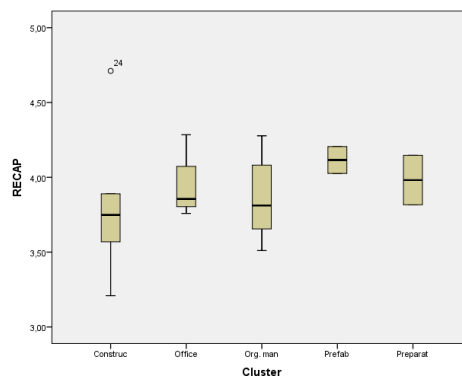


Figure 17: Boxplots of overall RECAP scores per cluster (without person 59)

Collaborative practices. As could have been expected after analyzing the RECAP results on company level, the scores of the collaborative practices also are not high on cluster level. It is, however, interesting that the prefab-cluster states that they have good joint working processes in place. In chapter 5.1 it is shown that there is some difference between Fluor’s and IREM’s scores. Figure 18 now shows that the perceptions about the collaborative practices in Fluor and IREM is widely shared among the functional clusters (except for the joint working processes of the prefab-cluster).

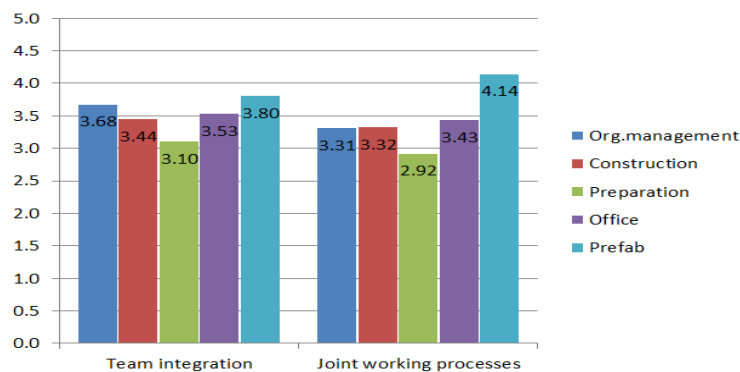


Figure 18: Average perception of subcriteria of collaborative practices

Given the volatility of the results, it can't be stated with certainty that certain clusters are in most immediate need of improvement. Measures should therefore be directed towards improvement of the collaborative practices on company level instead on the improvement between or within clusters. An other reason for this is that improvement focused on the collaborative practices within clusters doesn't seem to be logical after concluding that the cluster-structure is abandoned in section 4.3.

Relational attitudes. Figure 19 shows that the preparation-cluster finds that there is low trust among the senior management and that the relational norms could be better embedded. The bar-chart resembles the bar-chart from the previous paragraph (collaborative practices), and the same conclusions are drawn.

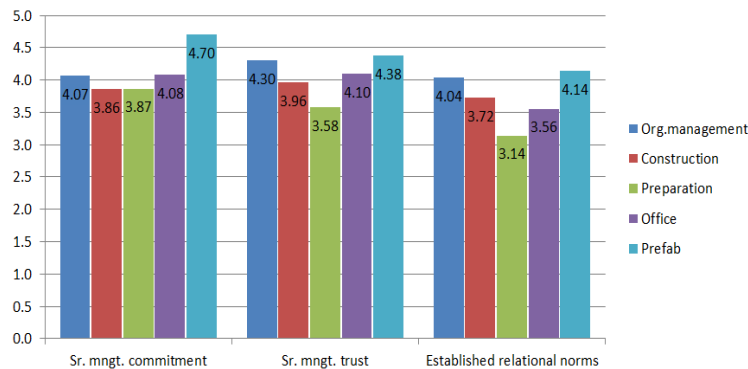


Figure 19: Average perception of subcriteria of relational attitudes

Measures should be taken on company level. It might however be worthwhile to ask the participants of preparation-cluster for feedback related to the relational norms in order to form a strategy to be executed on company level.

Front-end definition. The office-cluster rated this criterion best, the preparation-cluster worst (see figure 15). Most clusters are quite positive about the front-end definition of the RAHC-project concerning piping. It is therefore striking that the preparation-cluster is most negative about the front-end definition, since the activities of this cluster encompass among others workplace planning and engineering. It is not clear whether or not these participants have been involved in the project's earlier stages but this indicates that this cluster is either self-critical or that it simply runs into more issues concerning the front-end planning due to their working-activities (the office-cluster might, for example, have less front-end related issues).

Project performance. The construction-cluster has the best perception of project performance (see figure 20).

Construction managers are quite satisfied with the RAHC-project so far and more convinced than other clusters that it will have a positive impact on Fluor's and IREM's business. It should be said that the participants of the other clusters massively stated that they didn't know how to answer the satisfaction statements.

In terms of efficiency, the low perception of efficiency in the preparation-cluster and the high one in the prefab-cluster jump to the eye. The latter can be used to conclude that the management involved in the prefabrication of the piping in Italy might face better efficiency at their site. The high score, might thus indicate that most of the inefficiencies occur at the RAHC-site, and that this perceived inefficiency is not spread over the entire organization. The low score of the preparation-cluster is

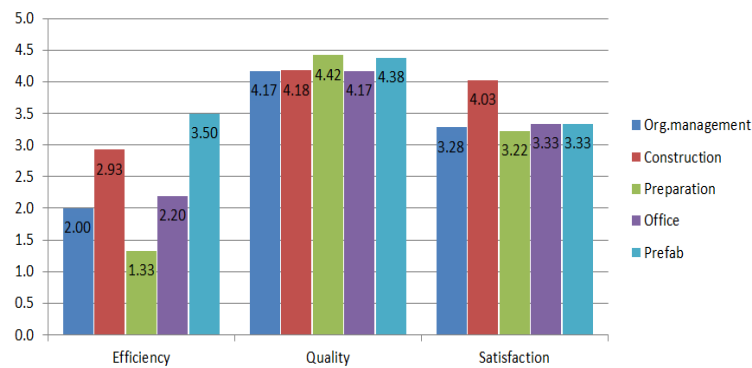


Figure 20: Average perception of subcriteria of project performance

due to the fact that all respondents answered DK on the statement 'The project is progressing in accordance with the estimated cost so far'. Next to this, they rated the statement of the same sort about schedule badly.

A good thing is that the perception of the quality of the facility is considered to be good according all clusters.

Relationship continuity In figure 15 one can see that the prefab-cluster scores highest on this criterion. This would have been expected according to Suprpto's model (2016) which predicts that relational attitudes and project performance are determinants of relationship continuity. On the other hand, the score of the construction-cluster wouldn't be expected.

Inter-teamwork quality The criteria scores of the clusters are distributed over a relatively small range (3.8 to 4.0, see figure 15).

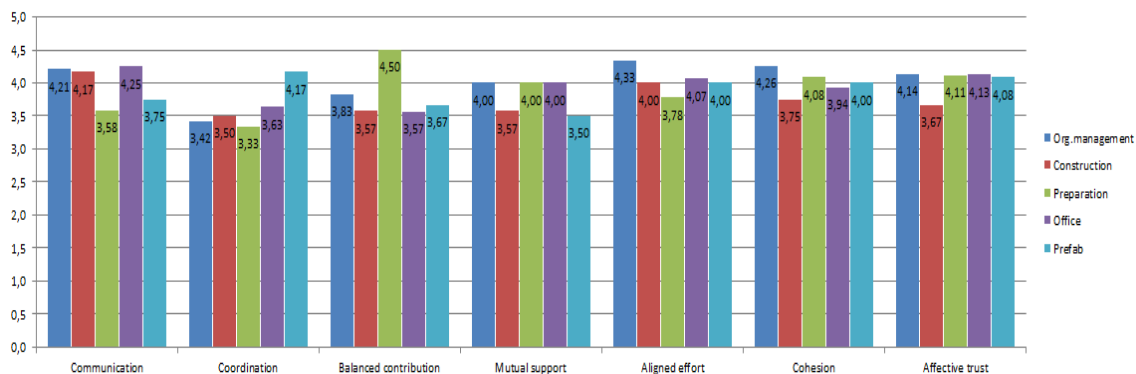


Figure 21: Clusters' average perception of inter-teamwork quality)

The construction-cluster owes its low score, compared to the other clusters, to three subcriteria in particular: mutual support (3.57), cohesion (3.75) and affective trust (3.67). The construction-cluster's other subcriteria scores are similar to those of the other clusters (see figure 21). Another cluster that stands out is the preparation-cluster. This cluster has a weaker perception of the communication than the other clusters and a very good perception of the balance of contributions of general contractor and subcontractor. About the balanced contributions subcriterion it is important to mention that a generally relatively negative respondent, answered 'DK' (Don't know) to this subcriterion's statements. However, the fact that the respondent didn't know how to answer these statements might indicate a

communication problem where experiences and expectations are not openly shared.

And indeed, it can be seen in figure 21 that the preparation-cluster has a lower perception of the communication between Fluor and IREM.

Coordination doesn't seem to be very good on cluster level in general. Except for the prefab-cluster, which seems to have good coordination and distribution of work on their location, the other clusters seem to think that this is yet sub-optimal. Looking deeper into how the coordination statements have been answered, the participants have answered them more or less equally, which means that the clusters think that work can be better synchronized between Fluor and IREM, linkages between firms can be more clear and there is still redundancy in work. The second statement is quite interesting when one looks back at the SNA results in chapter 4. It indicates that the participants desire a more clear communication matrix or different ones that alludes to different scenarios. The difference between the contractual state and the IST-state of communication can be the result of this, because participants reach out to whoever they think that might be able to help them when a change of plans occurs since it is not clear enough who they should contract according to the contractual agreements.

5.3 Presentation of RECAP results based on nationalities and observations

In this section some attention will be given to the differences between nationalities. As said in subsection 2.3.1, there are a lot of nationalities involved in the RAHC-project.

Among the 29 original participants, at least 12 nationalities are present. It has also been said in subsection 2.3.1 that, in order to secure the anonymity of the respondents and their valuation to the statements, it is not possible to give feedback or to reflect on the differences between all of these 12 (from which 11 nationalities responded to the surveys) nationalities. This is because 8 out of 11 nationalities are singular. When the results of these nationalities would be discussed, it would be possible to exactly derive the person 'behind' a certain nationality's score is.

RECAP results. Three nationalities (Dutch, American and Italian) are represented by multiple participants. Figure 22 shows the differences in valuation of the RECAP criteria for these 3 nationalities.

The biggest difference observable in figure 22 is between the American's and the Italian's perception of the relationship continuity. What is interesting to conclude about the relationship continuity difference is that the Americans scored lower (3.6) than the Dutch (3.9) and Italians (4.5). If one looks back at Hofstede's cultural dimension scores (appendix A) for the national culture in The United States, and compares America's scores to those of Italy and The Netherlands, one will notice that the only cultural dimension where the latter two stand out to The United States is the long-term orientation. Italy and The Netherlands score respectively 61 and 67 on this dimension, where The United States scores 26. Based on the findings of this case study some feedback to chapter 2 is given by concluding that there are indications that the long-term orientation of a person might influence his/her perception of relationship continuity. Long-term orientation has been defined to address a focus on the past and present day. Italians and Dutch people are, according to Hofstede's cultural dimensions, keeping an eye on the future, the long-term benefits and by doing this might be more open to the idea of a longitudinal collaboration.

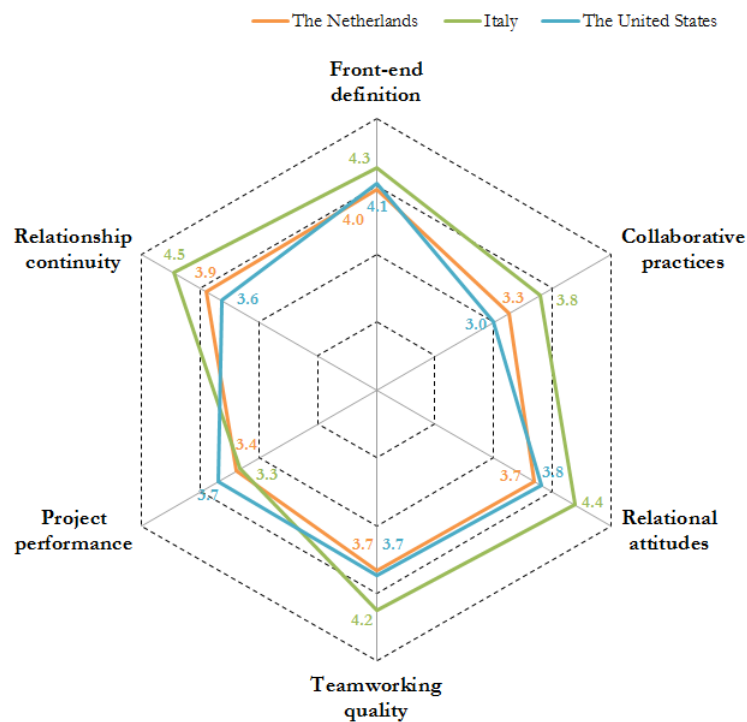


Figure 22: Radar-graph of six RECAP criteria perceptions per nationality

Personal observations. While performing and writing this research, it became clear that Fluor is well aware of the importance of culture in projects. Fluor has an online tool available for Fluor employees (Globesmart from AperianGlobal) to be used as guidelines or preparation for interactions with another culture. By organizing semi-informal and formal meetings between Fluor and IREM in an early stage of their collaboration, the Fluor management also tries to break the ice between them in an attempt to cross cultural boundaries and create a shared culture of openness. Both parties seemed to appreciate this meeting.

After a de-freezing period and after some activities, jokes could be made and cultural differences could be openly spoken of in the group. Something like these alignment meetings was completely new to the IREM employees and was seemingly highly appreciated by IREM's management. One activity consisted of a Life Orientation (LIFO) test which rated the participants on 4 categories and produced two outcomes. One of the outcomes rated the participants on the 4 categories under normal circumstances, and the other did the same for when the participants were subject to a stressful situation in general (LIFO Benelux B.V., n.d.). By organizing this test and discussing the results, participants became more self-aware of how their behaviour changes under different circumstances, what the benefits and disadvantages are in this switch, but also how the behaviour of the other participants changes. This was again completely new to IREM, clearly opened the atmosphere which turned more friendly, and apparent defensive boundaries and wait-and-see attitudes were lowered. However, it was not only the aim of Fluor's management to create a positive atmosphere by organizing this test, but also to prepare both Fluor's as IREM's employees for the communication during stressful periods of the project. Although the LIFO test and this kind of alignment meeting don't immediately address culture, it does show that Fluor is trying to mitigate differences, barriers and potential miscommunications or disputes between the companies. Cultural aspect are for this reason, the time constraint, limited resources and the availability and awareness within Fluor of the importance of possible cultural differences, excluded from this research.

At the RAHC-project, Italy (Individualism: 76) differs a lot from the the United States (Individualism: 91). It might thus be interesting for Fluor to pay attention to the incentive strategy applied to IREM. In section 2.3.1 it has been mentioned that individualistic cultures prefer incentives on a personal level, as a confirmation that one individual has performed well. More collective cultures prefer incentives or rewards that confirm the teams achievements and therefore prefer that the whole team gets rewarded. A potential Dutch incentive strategy is, based on the small difference in individualism between The Netherlands (80) and Italy (76), not expected to provide problems. Fluor is however an American company, it is thus imaginable that this is reflected in their incentive strategy, which might cause friction in their cooperation with IREM because of different expectations of what might motivate people.

Although the importance of incentives and culture on teamworking quality is established, it is not part of this research to identify what exact incentives should be given, because the Fluor management is clearly on the right track concerning incentives. Fluor provides individual incentives in the form of for example lunch vouchers and dinner cheques. Teams are rewarded monthly for their safe behaviour by receiving a gift and a free lunch.

5.4 Applicability RECAP tool on GC-SC collaboration

In this section the limitations and opportunities of the RECAP model of Suprpto will be discussed in a GC-SC collaboration setting. Attention will be spend in particular to the elements of the RECAP model and tool that might be less appropriate in this setting and the methodology of research that has been applied. To do this, the methodical differences as applied by Suprpto and this research will be discussed. The notions made can be used to guide future researchers to make eventual alterations to the RECAP tool and methodology in order to construct a generalizable model for GC-SC collaboration.

Methodology.

- This research was aimed to have 29 carefully selected participants to complete the RECAP (and SNA) survey, 23 of them responded. These respondents were all involved in the same (RAHC-)project. Suprpto has had the resources and time to call upon a much larger group of respondents from multiple projects.
- The second difference is that this research uses a broader set of participants per company in order to compare the perceptions of general contractor and subcontractor about collaboration on the RAHC-project. In order to limit the scope and be at the same time practically and scientifically interesting, this research has chosen to broaden the set of participants per company and to limit it to one project. By involving more persons, the perception of the companies will become more representative. In this research it has been noted that there are very big differences possible in how positive or negative participants fill in the RECAP survey. Suprpto only involved two persons for comparing the perceptions of project owner and general contractor. His RECAP model is thus based on the differences in perceptions of 1 project owner manager and 1 manager of the general contractor, for each of the multiple projects.

Meaning of values. One of the down-sides that has become apparent while processing the results of the RECAP survey is the use of DK (Don't know) and NA (Not applicable) in the survey. Suprpto argues that NA also carries value because it tells the researcher that this statement isn't in any way appropriate to the collaboration between (in this research) the general contractor and subcontractor. The contents of the statement could thus potentially still be applied. DK carries value because it indicates that the participants doesn't have information about the state of a certain statement, in these cases the organization could thus communicated better among the management of the general contractor and subcontractor.

However, it is considered to be more complex than this when analyzing the results of the RECAP survey. Although it is very logical to include NA and DK as possible answers in the RECAP tool, it can give a skewed view of the results.

For example; when 3 out of 4 statements of a subcriterion are answered non-numerically, the subcriterion value of that subcriterion should be based on the remaining numerical value according to Suprpto (2016). Following this reasoning in practice, the subcriterion of 'person X' is based on 5 numerical ratings, while that of 'person Y' is only based on 2 numerical ratings. Both averages will, however, carry the same weight in further analysis. This is considered to be suboptimal because 5x numerical is worth more than 2x numerical (and e.g. 3x non-numerical DK's).

Qualitatively DK's and NA's can thus be interesting, but when moving to quantitative analyses they can reduce the worth of a certain correlation/relation. In this stage it is not aimed to improve the RECAP tool or methodology but rather to critically assess and appoint the pitfalls and potential improvement points.

Statements and subcriteria. Four statements have a remarkable high amount of DK's and NA's among their answers. Two statements of them partly determine the subcriterion 'quality' score, and two partly determine the subcriterion 'satisfaction' score.

The two satisfaction-related statements are:

1. So far, this project will be a (commercial) success to the general contractor.
2. So far, this project will be a (commercial) success to the subcontractor.

This seems, based on this case study, to be widely unknown in GC-SC collaboration. Yet, respondents not only don't know or can't guesstimate whether or not, and to what extend, this project has a positive impact on the other party's business, but they also doesn't seem to know whether this is the case for their own company.

An explanation can be the broader set of participants per company. Suprpto only interviewed two managers per project (1 high level manager from the project owner, and 1 high level manager from the general contractor). High level managers are probably better up-to-date with the success of the project for its own and the other's company. Broadening the set of participants might thus bear the risk that less numerical answers will be given on these statements.

One should, however, also think of the possibility that both general contractor as well as subcontractor deliberately filled in DK for these statements because they might believe that truthfully answering these statements might give away their position (and their leverage during negotiations about scope changes).

The other two statements are part of the quality subcriterion:

1. So far, the facility or product constructed is taken into operation reliably without major problems.
2. So far, the facility or product constructed is functioning according to the specified capacity.

Almost all respondent weren't able to give a numerical answer to these statements, which was to be expected since the facility is not finished yet which makes numerical assessment of these statements very difficult. These two statements should thus be reviewed. When the research is subject to a live project, these should be replaced by other quality determining statements. When the survey is however only conducted among respondents of a general contractor and subcontractor that are asked to look back at a certain project, the quality statements of the original RECAP tool might still be appropriate. Otherwise they should be reviewed.

Two other statements that also stand out are: The other two statements are part of the quality subcriterion:

1. All functional/high level technical requirements (basic design) are reviewed together by both teams. (Front-end definition)
 - 5 People have indicated that they don't know whether this has been the case, 3 people have indicated that this is not applicable. It may be beneficial if this is better communicated in the organization. When people are aware of the fact that functional/high level technical requirements are reviewed together by both teams, this may lead to less suspicion and miscommunication than when people don't know this.
2. The subcontractor strives for business outcomes whereby both parties either win or both parties lose. (Established relational norms)
 - 6 People have indicated that they don't know whether this has been the case, 1 person has indicated that this is not applicable. Strikingly enough, these persons were not only employees of Fluor, which means that this is also not known by IREM employees. This observation underlines the recommendation that the RECAP tool shows address a less broad pool of participants, for the lower level management might not be aware of potential long-term strategies determined by the high/senior level management.

These statements are, however, not considered to be not applicable to the RECAP tool for GC-SC collaboration. Other than the quality-statements, these address the GC-SC collaboration but are simply not know by a part of the participants.

5.5 Conclusion RECAP results

Some interesting and concluding remarks can be made as a result of the analysis in the last few preceding sections, at the same time enabling formulation of the answer to **constructive question 4** (*What elements of collaboration can be improved, and which groups should be targeted?*). From the analysis of the RECAP results, it has become clear that efforts should be directed on company level instead of on cluster level. This is due to the observation that, although the preparation-cluster often scores lower, it can't be stated with certainty (due to the volatility of the cluster averages) that this cluster is in most immediate need of improvement. There is however another reason why company level measures are preferred. This is because of the network structure that is in place (section 4.3) and the observation that the so-called modules, that are mentioned in the same section, don't only contain people from a certain cluster as expected based on the contract.

According to the RECAP analysis, Fluor could improve project performance and relationship continuity best by improving the teams integration (collaborative practices factor), the team's coordination, balanced contribution, mutual support (3x teamworking quality factors), senior management trust, -commitment and established relational norms (3x relational attitude factors).

Both Fluor as IREM seem to agree that the efficiency in the project is far from optimal but it is interesting to see that the management involved with the prefabrication of the piping element doesn't experience these inefficiencies. Fluor's management on the RAHC-construction site could, thus, perhaps learn from their colleagues at the prefabrication site and try to copy their collaboration mechanisms. This is also an indication that this research is not in vain, and there is considerable progress to be gained on this aspect. This recommendation not only stands for the difference in efficiency but the prefabrication also valued collaborative practices, and the relational attitudes highest.

It is quite logical that the subcriteria of collaborative practices are perceived to be less present in GC-SC collaboration, since Fluor's and IREM's collaboration strategy is not designed to form an integrated team. The participants in particular miss formal procedures for joint decision making (potentially also one of the causes for the crowded IST-state of inter-cluster and inter-organizational communication), robust mechanisms to resolve conflicts/disputes, jointly performing monitoring, controlling, reporting and jointly conducting planning.

These improvement points are identified by looking closer to the total average of the statements of joint working processes themselves. Team integration can be improved by removing as many boundaries between the companies as possible and by encouraging collaboration via fun and excitement more than Fluor does at the moment. If the Fluor management improves these subcriteria and points, the project might benefit and will have a positive impact on their relationship continuity.

Furthermore, there are indications that cultural aspects are, indeed, potential factors of interest determining relationship continuity. This should be explored in future research, together with the relevancy of Hofstede's other cultural dimensions. This could improve the determination coefficients (R^2) and thus improve the RECAP model.

Concerning **constructive question 5** (*Is the RECAP model and tool applicable for the relationship between general contractor and subcontractor?*), it can be said that the tool is applicable. Some minor alterations are necessary to address general contractor and subcontractor instead of project owner and general contractor. One should, however, still be wary of the setting. Two questions concerning the quality of the facility/project are not applicable when the project is still in progress. One should, while conducting the RECAP survey, thus only call upon managers of projects that have been completed or should look for replacement for these two quality related statements. Future researchers that have proper resources and time to construct a scientifically robust RECAP model for the collaboration between general contractor and subcontractor, should also think critically about the desired set of respondents. Analyzing the result has led to the conclusion that the participating set of managers should not be too broad, but it is believed that it should neither be too small in order to assess potential difference between general contractor and subcontractor. A broader pool of participants makes a company's assessment of collaboration more representative but might also increase the likelihood of returning the amount of statements answered by DK's or NA's. It is recommended that a few of the managers on a higher strategic levels (and their counterparts) are selected because it is observed in this case study that when managers on a lower strategic level are also included, these frequently don't know how to answer a RECAP statement.

6 Combination SNA– & RECAP results

Chapter 4 has identified where improvement opportunities pose themselves, and chapter 5 has identified which criteria of collaboration are worthwhile to invest in and in what setting the improvement measures should be implemented (company or cluster). This chapter goes more in depth and tries to combine the results of the SNA and RECAP analysis.

6.1 Justification of technique-combination

As stated before, the RECAP criteria globally resemble the attitudinal factors (commitment, equity, trust, mutual goals) described by Wang et al. (2016) and the SNA elements globally resemble the open communication factors described by the same authors as problem resolution, timely responsiveness, openness and effective communications.

Together they might be able to indicate how (the success of) partnering could be improved, since Wang et al. (2016) have concluded that partnering consists of these two types of factors. It is furthermore expected that the attitudinal factors influence the open communication factors. For example: It is believed that when there are no mutual goals, this might affect the other party's responsiveness (because of back-room consultation) or the effectiveness of communication (because of adversarial principal-agent relations). The same goes for commitment, when persons aren't committed they are believed to respond slower to issues because the project isn't a priority to them. This chapter will investigate whether there are indications that the SNA elements might be symptoms of the RECAP criteria, and thus also how the attitudinal factors relate to the open communication factors.

There is, however, a difference in set-up between the RECAP and SNA method that should be addressed. The RECAP method has been used to identify one's perception of the collaboration level between companies in general. The SNA method is more of an individual character and is used to identify whether responsiveness, effectiveness and energy during communication is good or not, and between which persons, clusters and organization. This chapter will look into the potential trend between the incoming SNA edges (i.e. arrows) and the RECAP criteria scores.

The combination of the RECAP results (with a company-level character) and SNA results (with a more individual character) can be justified:

Imagine two companies. Company X employs persons A, B, C, D; company Y employs persons K, L, M. Person A has a global perception of the collaborative practices (RECAP criterion) between companies X and Y of 3,00. Persons B, C and L have communications with person A and rate his responsiveness (average) to be 2,50.

Person A based his RECAP score (3,00) on his perception of the global collaboration. However, he only collaborates with persons B, C and L. He, thus, bases his RECAP scores on global perception, however this global perception can only be based on the people he collaborates with (B, C and L). This justifies why the RECAP score can be meaningfully used in a trend analysis with one's SNA scores.

6.2 Presentation and analysis of combined results

In this section the combined results will be presented and analyzed. Each subsection will first spend some attention to the clusters. It will be investigated if these show remarkable behaviour (lot of low quality relations) and if there are indications that these may be linked to their average RECAP score. An individual analysis will go further in depth.

The letters in this section's figures might require explanation:

- A = Front-end definition
- B = Collaborative practices
- C = Project performance
- D = Relationship continuity
- E = Relational attitudes
- F = Inter-teamworking quality

6.2.1 Results technique-combination, frequency

Cluster. In this paragraph the figures for frequent communication will be presented. This is to attempt to determine whether high frequency of communication is a sign of good or bad collaboration. Figure 23 will be the basis for this analysis because figure 52 (appendix H) is too crowded to properly analyze the combination between SNA and RECAP.

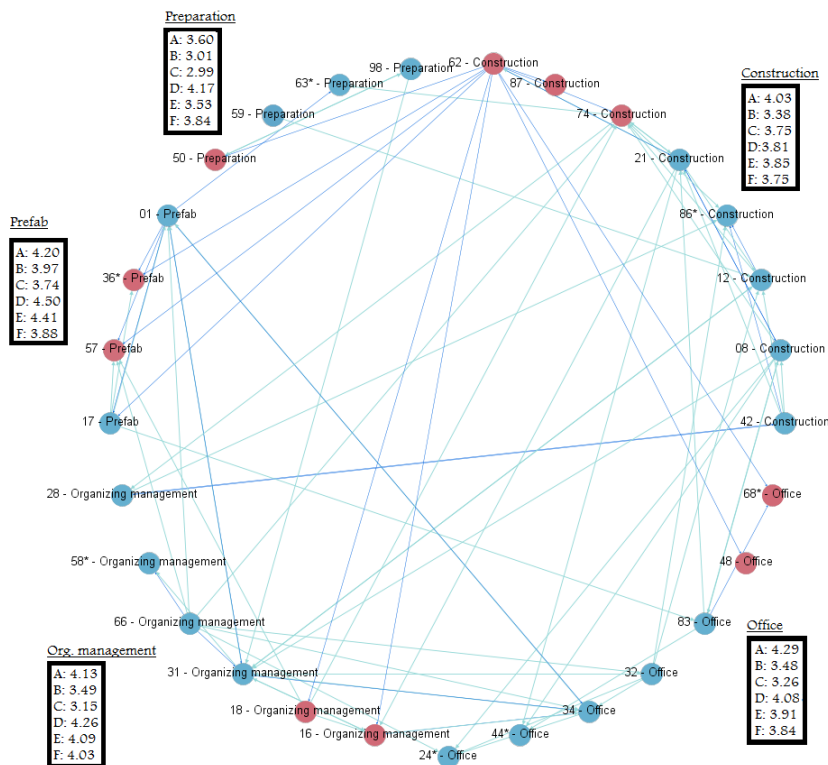


Figure 23: Combination of RECAP cluster scores with SNA's high frequency relations

In figure 23 the dark blue lines indicate highest frequency (almost continuously) and the light blue line high frequency (at least once a day). On basis of this figure, no clear statements can be made whether or not high frequency is linked to high or low RECAP scores. The results are quite capricious, which means that in the one cluster low collaborative practice scores seem to be linked to the number of high frequency relations, but in the other clusters this is contradicted. There are quite a lot high frequency relations in the organization, which makes it difficult to identify meaningful trends between the two sets of results.

In table 9 the overall RECAP scores are given per cluster, because it is eventually this value that indicates the collaboration level between organizations.

However, as a result of the volatility of the RECAP results (section 5.2), person 59 pulls down the preparation-cluster's average RECAP score (with 59 = 3,52; without 59 = 3,99). Most frequent communication happens within and between the organizational management-, office- and construction-cluster. With exclusion of person 59, these three clusters have the lowest average overall RECAP score, and thus the lowest perception of the overall collaboration between Fluor and IREM. This might imply that a low frequency of communication is not a sign of bad collaboration but rather of good collaboration.

Table 9: Overall RECAP scores per cluster

Cluster:	Prefab	Org. mngt.	Office	Construction	Preparation
Overall RECAP:	4.12	3.86	3.78	3.75	3.52 (with outlier) 3.99 (without outlier)

Individual. Figure 24 is very comprehensive to analyze without filtering out the irrelevant information. Therefore, first the scores of nodes with no incoming scores were crossed.

Secondly the RECAP scores above 4 were crossed (since these are without doubt considered to be good).

Thirdly the RECAP scores of C and D (project performance and relationship continuity) were ignored because these couldn't logically influence, for example, one's energy.

These steps are made for each SNA element in the coming subsections.

In figure 24, the first step is not possible since every node has incoming edges (i.e. arrows) and the second step is reversed because this figure focuses on the low-weight ties (indicating high frequency). This means that all RECAP scores below 4 are crossed to see whether a high frequency of communication might be linked to the RECAP scores.

By looking at figure 12 the nodes with the most inter-organizational ties can better be identified (IREM: 62, 74, 16, 18 and 50; Fluor: 21, 8, 66, 1 and 98). With this information, and looking at figure 24, it can be observed that in none of the RECAP scores a trend can be observed. Only the relational attitudes criterion might show a trend (7 out of the above mentioned 10 nodes scored high on this criterion). A trend is however not expected because almost all nodes in figure 24 have a lot of frequent communications, thereby making it unlikely that one can speak of a trend between high communication frequency and relational attitudes.

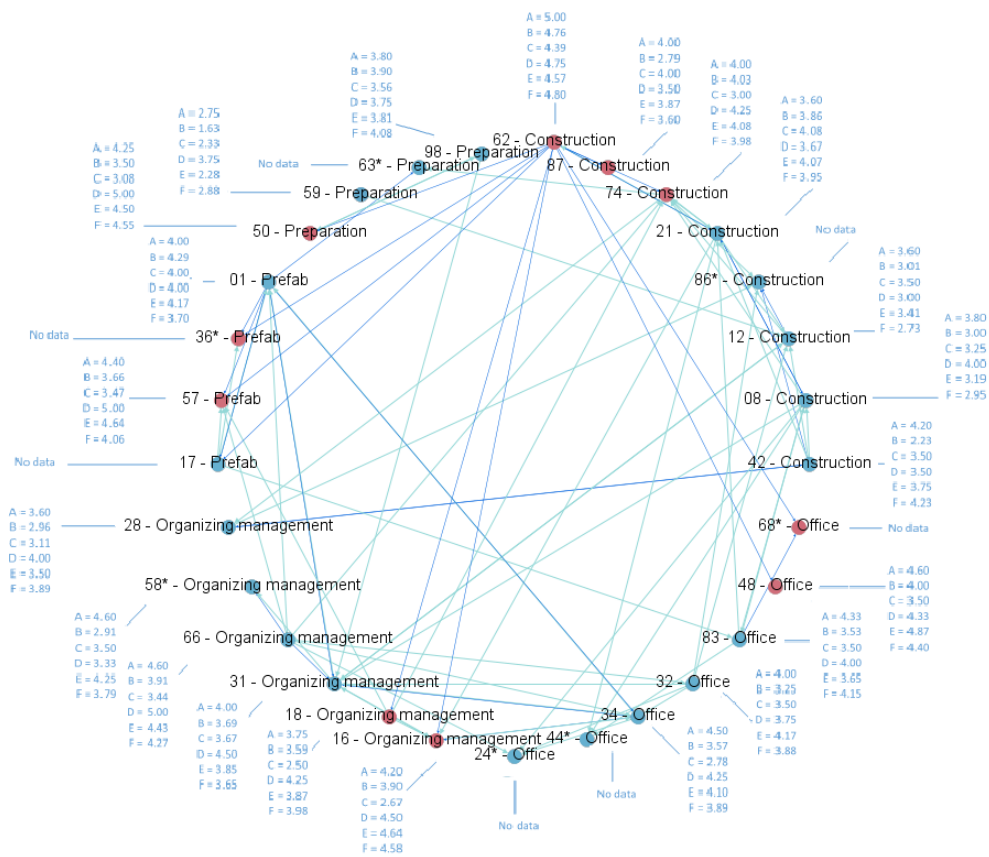


Figure 24: Ties with high communication occurrence frequency linked to RECAP scores

6.2.2 Results technique-combination, responsiveness

Cluster. Because this research's aim is to identify the improvement opportunities, only low quality relations will be discussed.

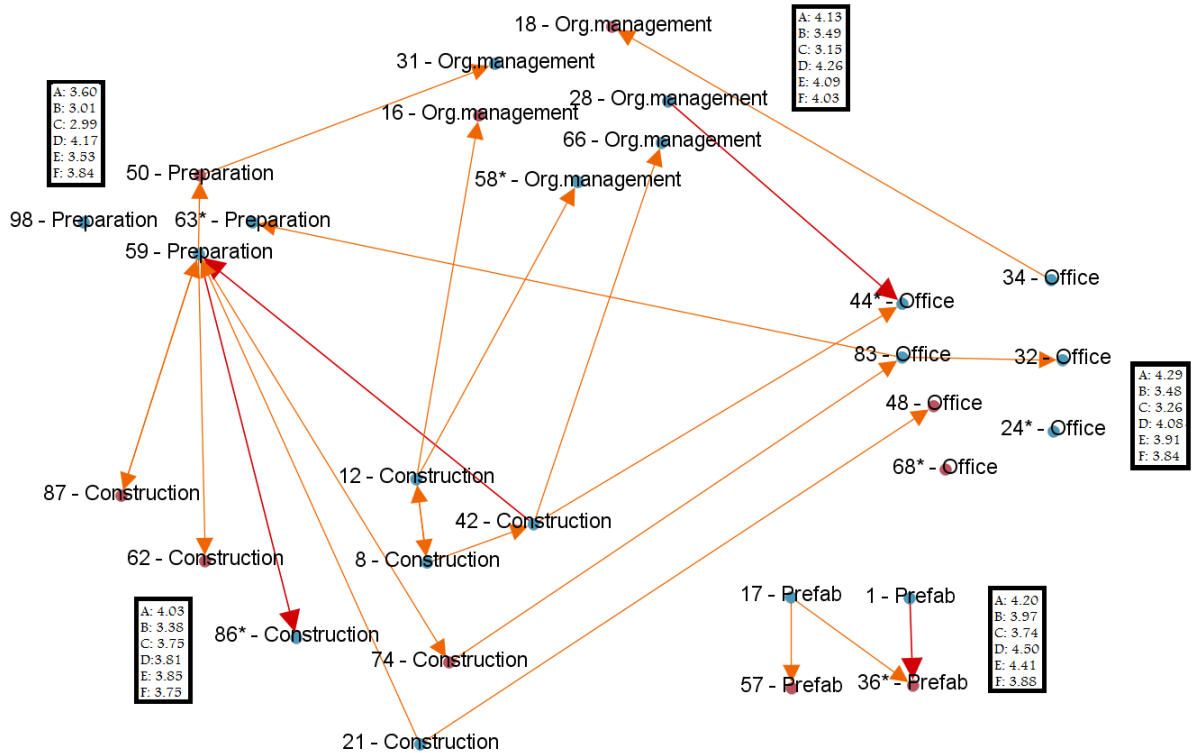


Figure 25: Combination of RECAP cluster scores with SNA's slow response relations

Based on figure 25 four observations are made:

1. Firstly, the prefab-cluster stands on its own without bad inter-cluster relations. When looking at this cluster's RECAP scores it can be seen that it has a higher perception of the collaborative practices.
2. Secondly, the construction- and preparation-cluster have the lowest perception of the collaborative practices in the organization, and it is also observed that these clusters have most low quality responsiveness relations.
3. The same observations (as in last two points) can be made when looking at the relational attitudes of the clusters. This indicates that these two RECAP criteria (collaborative practices and relational attitudes) might play a role in inter-cluster responsiveness.
4. At last, it is interesting to see that the organizational management-cluster has no low quality intra-cluster relations and only one outgoing inter-cluster relation. It is also the only cluster with a teamworking quality score above 4.00, based on this it doesn't look like these can be correlated, but rather that clusters with a lower inter-teamworking quality score rate other people more often to be slow respondents.

Individual. Figure 26 shows the individual RECAP scores of the participants. Chapter 4 has concluded that the preparation-cluster (in particular person 59) and the construction-cluster (in particular persons 8, 12 and 42) lend themselves for improvement. At these nodes, the collaborative practices (in 59, 8, 12, 42) are low but also that relational attitudes and inter-teamworking quality is low (in 59, 8, 12). These four participants are the only few that have multiple low quality relations originating from them or ending in them (with exception of 83, 50 and 74, which have a better perception of collaborative practices, relational attitudes and inter-teamworking quality).

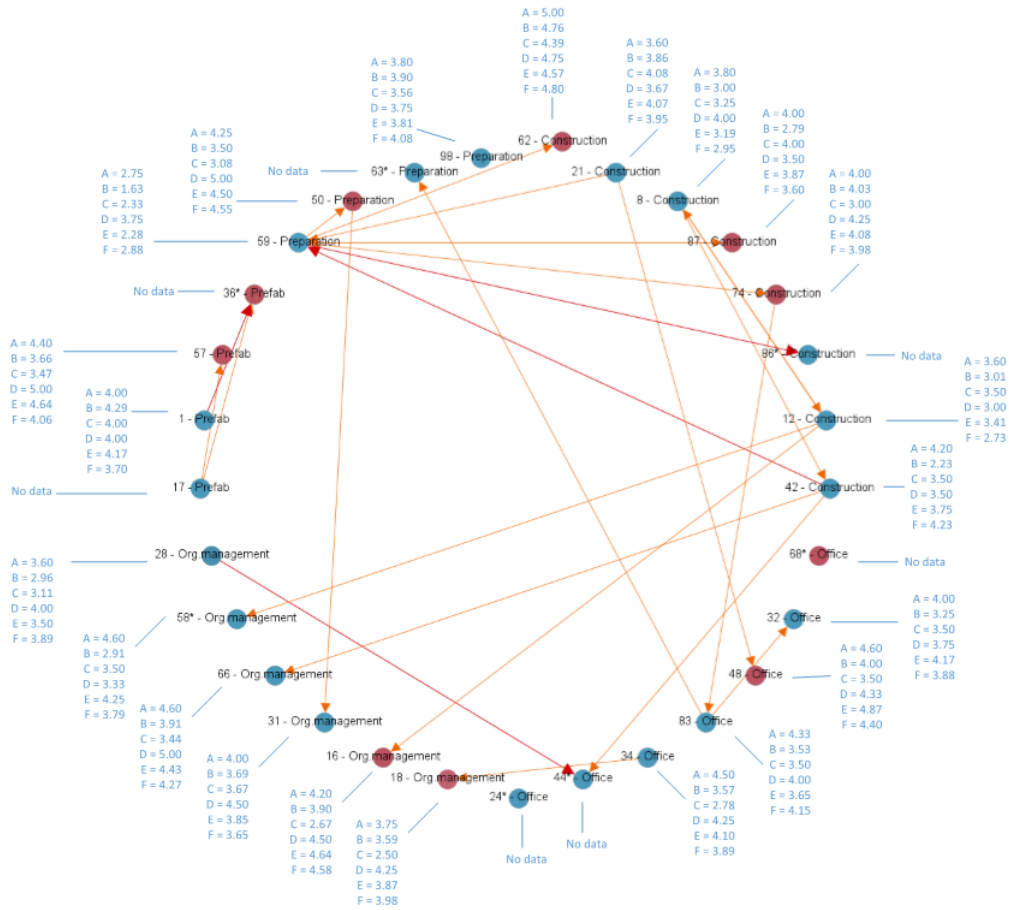


Figure 26: Ties indicating communication with slow response, linked to RECAP scores

When looking at these three RECAP criteria at the participants with only one low quality SNA relation ending in them, their scores are relatively good. This implies that SNA improvement opportunities are more likely to occur where at least (one of) these RECAP criteria (collaborative practices, relational attitudes or teamworking quality) is considered low. This indicates that there is a trend between these RECAP criteria and slow responses.

6.2.3 Results technique-combination, effectiveness

Cluster. Both the office- as construction-cluster are to be considered to give more low effective responses according to the other clusters. Within the construction-cluster it can, however, also be seen that there are some low quality effectiveness intra-cluster relations.

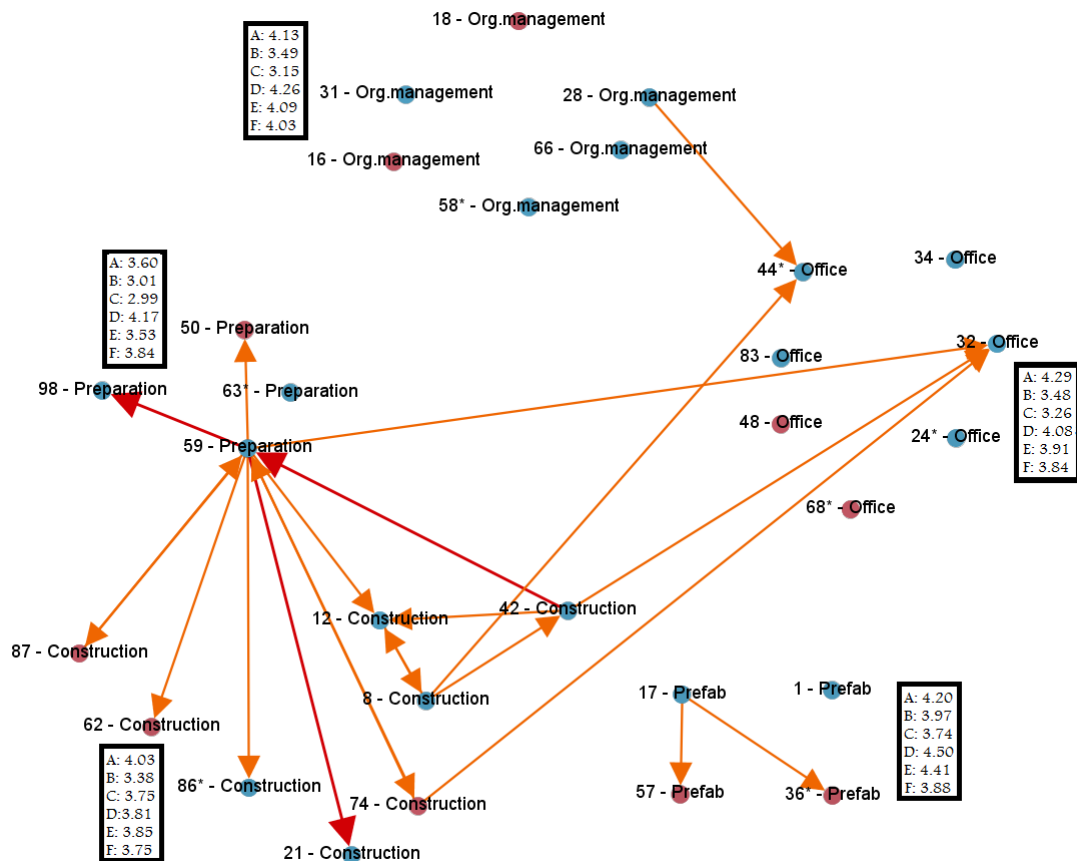


Figure 27: Combination of RECAP individual scores with SNA’s relations with low effectiveness

The preparation-cluster is not considered to have low effectiveness in its communication because all incoming low quality inter-cluster relations are addressed to one person (59). Based on the office- and construction-clusters, it looks like low effectiveness of communication might be correlated to collaborative practices. This, however, doesn’t gain support when looking at the other clusters which also have low perception of collaborative practices (org. management and preparation) and relational attitudes (preparation).

Individual. Looking at the identified improvement opportunities (mainly persons 59, 8, 12, 42 and the construction-cluster in general), it can be seen that their perceptions of collaborative practices and relational attitudes is weak. It is therefore reasoned that there is a trend between the effectiveness of communication and whether one believes that there is trust and commitment in the senior management and a correlation between the effectiveness of communication and the extent of additional collaboration-based activities being undertaken.

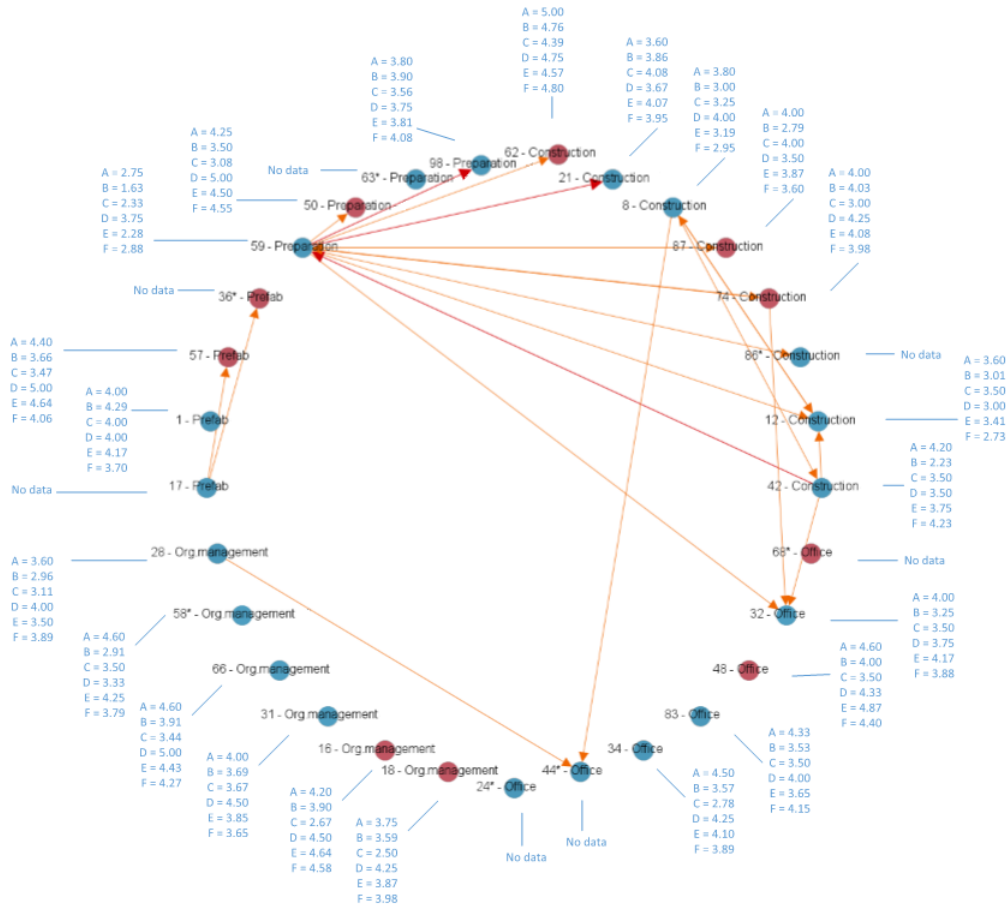


Figure 28: Ties with a low level of effectiveness, linked to RECAP scores

It is difficult to draw much more conclusions based on figure 28 because of the low amount of bad 'non-59'-related relations and missing data. However, when looking at figure 28, a 'new' observation can be made. It seems like node 32 isn't very effective while communicating about solving an issue. This node is together with node 12 and 44 (the latter unfortunately missing RECAP-data) the only node with multiple incoming edges. Node 32 has, however, a good perception of the relational attitudes between both Fluor and IREM, contrasting its perception of the inter-teamworking quality (3.88). Although this score isn't bad in itself, if one looks at the inter-teamworking quality scores of the nodes with one incoming edge, it can be seen that this is often lower than the boundary score of 4. It could therefore be argued that there is a trend with teamworking quality also.

6.2.4 Results technique-combination, energy

Cluster. As stated in section 5.2, there are almost no low quality relations concerning energy among the clusters. Although the construction-cluster seems to experience more de-energizing communication within the cluster, this is (with 2 low quality ties) not the case.

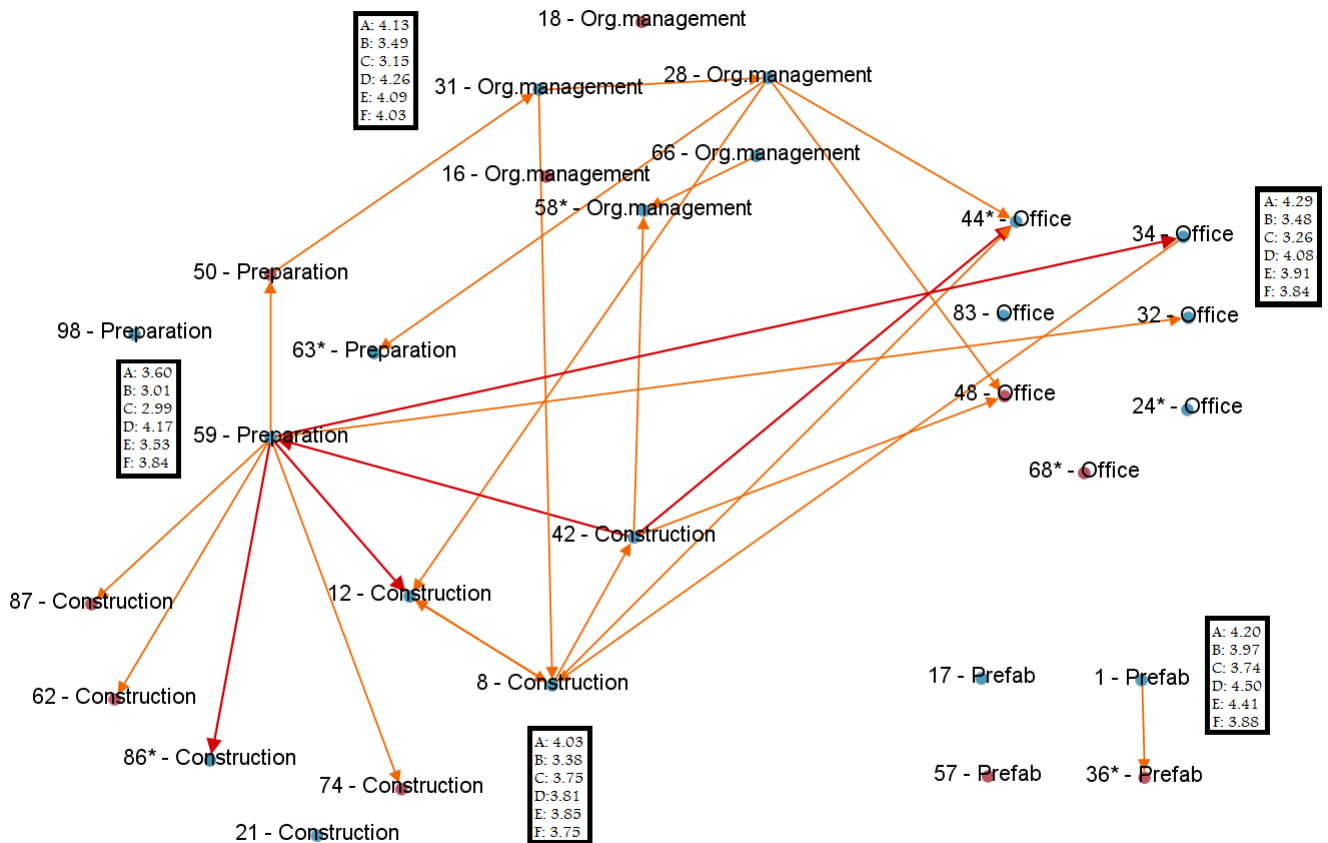


Figure 29: Combination of RECAP individual scores with SNA’s de-energizing relations

It is interesting to see that in figure 29, other than figures 25 and 27, all clusters (except the prefab-cluster) are judged to be de-energizing during interactions. It looks like de-energization and the collaborative practices in clusters are connected. Given the volatility of the RECAP cluster averages, the average of this criterion in the preparation-cluster would be 3.70 when the person 59 is excluded. Person 59 also accounts for the majority of the low quality ties of the preparation-cluster (9 out of 11 incoming and outgoing ties are related to person 59). When this person is ignored, one can see that the preparation-cluster does quite well, which unveils a trend. The preparation-cluster (B=3.70, with exclusion of person 59) and the prefab-cluster (B=3.97) have few low quality ties. The other three clusters have 4 to 6 low quality ties, and these are also the clusters with lowest collaborative practices scores.

The same goes for relational attitudes. The preparation-cluster scores 4.15 when person 59 is excluded, which again unveils a trend. The higher the relational attitude score, the fewer low quality ties are related to that particular cluster.

Individual. First of all, the nodes with multiple incoming low quality ties are reviewed (58, 8, 12, 48 and 44). Person 44 didn't submit both surveys.

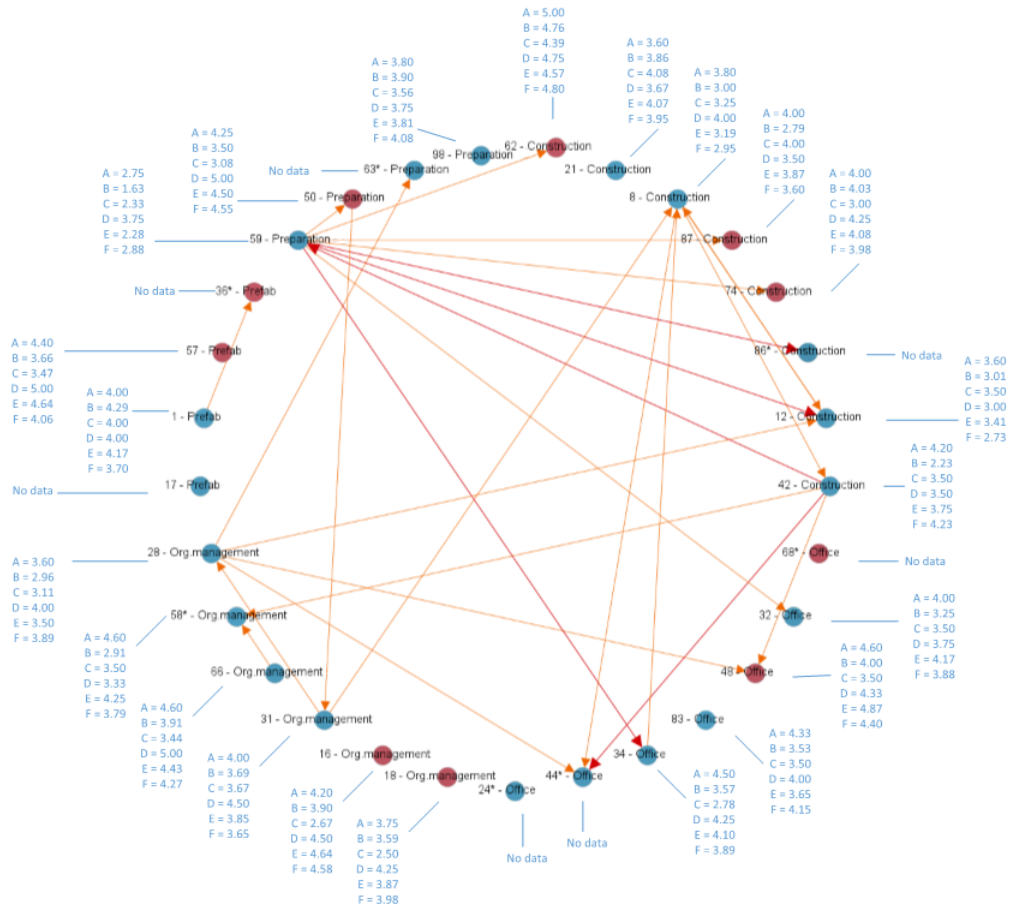


Figure 30: Communication ties that work de-energizing, linked to RECAP scores

Three out of four remaining persons score low on collaborative practices and inter-teamworking quality, and two out of four low on relational attitudes. Looking at the other nodes in figure 30, which have only one incoming edge, it shows that 8 out of 10 have a low collaborative practices score, 5 out of 10 a low relational attitudes score and 7 out of 10 a low inter-teamworking quality score. This gives reason to assume that when Fluor spends more efforts to increase collaborative practices and relational attitudes (which will have their effect on the inter-teamworking quality according to Suprpto's model), less de-energizing will take place.

6.3 Conclusion combined results

This section will answer **constructive question 6** (*Is there a trend recognizable in the RECAP results at the improvement opportunity areas?*).

One's score of the RECAP criterion 'collaborative practices' shows a trend with one's responsiveness, effectiveness and the energy one gives forth during interactions. Because this RECAP tool's statements of this criterion concerns topics like the organization of meetings and whether or not planning is conducted jointly, this trend is logically only possible to direct from this RECAP criterion to the SNA results. It is not possible that one's effectiveness influences whether or not meetings are organized. It is, however, possible that when meetings are organized, one's effectiveness gets better and due to the familiarization with each other the responsiveness between and energy during communication also increases.

The same goes for the 'relational attitudes' criterion. One's score on this criterion also couldn't logically be affected by one's responsiveness, effectiveness or energy. When someone responds slow or have a low effectiveness according to another party, this could be the result of this persons perception of the relational attitudes. This person might not feel backed-up by the senior management and is therefore, by means of the role-model effect, reluctant to put a lot of effort in developing a situation of good collaboration.

Most interesting is the subcriterion 'established relational norms', when one's perception of the honesty or transparency of one's counterparty is bad, it is according to the findings of this chapter likely that one's responsiveness and effectiveness decreases.

The decrease in responsiveness might be because one will become more reluctant to openly share information. This will result in strategy developments in which information will be carefully selected before it is shared, this takes time.

The decrease in effectiveness is also attributable to this because communication concerning issue-solving gets less effective by definition when information is withheld.

According to Suprpto's model, 'teamworking quality' is influenced by the two previously mentioned criteria. This in itself already indicates that this criterion is able to be influenced. Besides the effect that improved collaborative practices and relational attitudes can have on this criterion, it can not be ruled out either that one's responsiveness, effectiveness or energy might influence one's perception of the teamworking quality and it's subcriteria. The above three conclusions are summarized in figure 31.

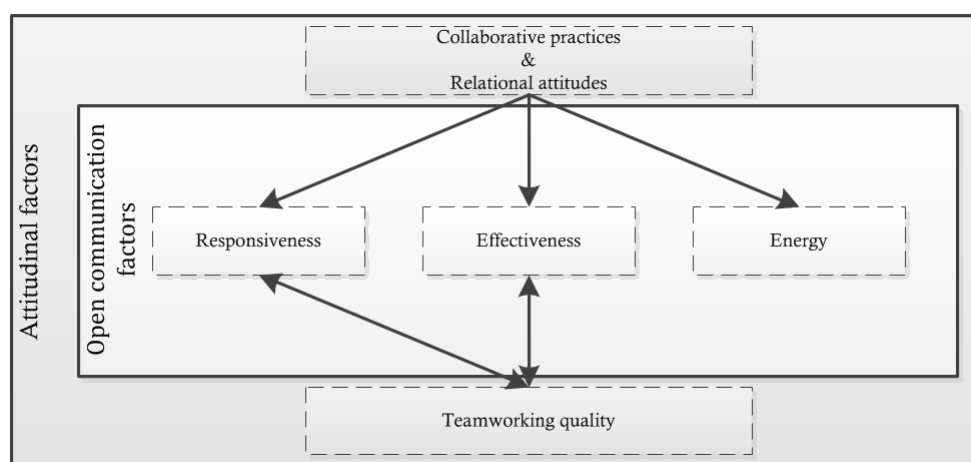


Figure 31: Theoretic model of interdependencies based on qualitative trend analysis

This model is theoretic, without statistical foundation but is useful to quickly understand how the different elements of research are interconnected on basis of this trend analysis.

It couldn't be concluded from this research unfortunately that there is a trend between the RECAP criteria scores and the responsiveness, effectiveness and energy of the participants. When analyzing possible trends, the overall RECAP score has also been subject to the trend analysis. This overall RECAP score gives an indication of the collaboration level between general contractor and subcontractor. When analyzing the low quality ties between the clusters, it became apparent that the clusters with the lowest perception of overall collaboration also have most frequent interactions. This might indicate that low frequency of communication is a sign of good collaboration.

6.4 Feedback on cultural differences

In this research it is mentioned multiple times that feedback will be given on the cultural differences. Throughout this research, where it was possible and appropriate, some feedback has already be given.

Cultural differences can generate opportunities as well as threats. Based on the RECAP results, it is shown that the Italians are much more positive about the collaboration in the organization than the Dutch and Americans. This might be attributable to the principal and agent roles in the organization but also to culture. Italy has a higher power distance and uncertainty avoidance score, according to Hofstede (2010) than The Netherlands and The United States. This might have manifested itself in higher assessment of collaboration because they, being dependent of the general contractor, are uncertain where a more negative assessment would lead to.

This is logically explainable behaviour on behalf of IREM, and should be attempted to be mitigated by Fluor.

Although the Italian culture might be a bit reluctant to change without knowing the consequences of this change, it also poses opportunities. Just like the Dutch culture, the Italians have a long-term orientations, which means that they are generally willing to make investments for benefits on the long-run. Together with high uncertainty avoidance, it is expected that when uncertainty is taken away (by describing both risks and proven benefits) the Italians can be convinced to participate in this new way of working together.

The high masculinity of the Italians (Hofstede, 2010) might also cause some friction with the Dutch, because of the competitive attitude in the first mentioned ('there can only be one winner') compared to the compromise making attitude of the Dutch. It is therefore very important that Fluor organizes frequent goal setting and alignment meeting in order to mitigate differences of interests and thus the need to express both nationalities' behaviour.

In general, Fluor should make very clear why certain teambuilding or collaboration improving measures are taken (like frequent meetings or co-location), in order to commit the Italians. This is not only to reduce uncertainty, but also because the Italian culture is more restraint according to Hofstede (2010). This implies that it should be clear how their jobs benefit from these activities in order to get them invested.

Also the American influences in the collaboration should not be underestimated. Regarding the individuality, the Dutch and Italian culture are scoring relatively the same. The American culture is more individualistic. This might obstruct teamworking but might become Fluor's advantage by implementing an incentive strategy. By using the individuality characteristics and rewarding individuals for good collaboration. By putting a monetary incentive on teamwork, teamwork also become accessible for the more individually oriented employees.

7 Research discussion

Reflecting on the research, a discussion will be held on whether the expectations on the theoretical contribution have come true and/or if the research contributed in a not predicted manner to the scientific literature. This chapter also states what the practical contribution is of this research. In this last subsection of the discussion, the research itself is critically reviewed.

7.1 Theoretical contribution

This research pioneers in combining a (valued) SNA with the RECAP tool. It provides future researchers with a new methodology in which both the SNA as well as the RECAP results are given more meaning than when they are carried out individually. By combining the RECAP tool with SNA, it became clear how the factors determining the succession of partnering and collaboration can effectively be improved.

Several trends have been observed in the combination of these two sets of results. This implies that this new methodology might give an indication of how the factors of partnering (attitudinal- and open communication factors) are interconnected.

The trend analysis has shown that elements of these attitudinal- and open communication factors are likely to be related with each other. This means that when a partnering strategy is pursued, improvement in for example elements of attitudinal factors affect elements of open communication factors positively, according to this case-study, thereby increasing the overall success of partnering on multiple levels.

After analyzing the results of the RECAP survey, some interesting contributions are for example conclusions about the applicability of the SNA survey and the factors of the original RECAP model.

These trends between the results might also have identified how good collaboration improves project performance and relationship continuity via short-term benefits like faster responsiveness, higher effectiveness and a better energy in the organization.

Another contribution of this research concerns the applicability of the RECAP tool and its factors in a general contractor and subcontractor setting. The recommendations and notions made in this research can be considered and be used by future researchers who want to further develop a generalizable RECAP model specifically for general contractor and subcontractor collaboration.

7.2 Practical contribution

This research is commissioned by Fluor, it is therefore good to describe what this research has delivered Fluor. This will be described in this subsection, more concrete actions and recommendations are given in the conclusions (chapter 8).

First of all, the results of this research can help the Fluor management to improve the collaboration between Fluor and IREM in future projects, but also on the RAHC-project. The installation of the piping has already started but is not expected to be finished in the near future. This leaves the Fluor management with the opportunity to look at the findings of this research and to direct their actions accordingly.

With the results of the SNA, the Fluor management knows where improvement is necessary regarding factors of open communication (effectiveness, responsiveness, energy). The results and conclusions of the RECAP analysis help the Fluor management by comparing the companies', clusters' and most occurring nationalities' perceptions on collaboration related factors. This made clear on what level they should direct their actions and which elements of collaboration are in most immediate need of improvement.

The trends that have been found between the SNA and RECAP results can help Fluor to more easily improve collaboration. They also show that improving collaboration is only interesting on the long-term. As the analysis concluded, improvements also bring forward short-term benefits (increased effectiveness, responsiveness and energy), which at their turn could explain why better collaboration results in better project performance.

When the Fluor management makes note of slow responses or low effectiveness during communication, they now know that poor collaborative practices, relational attitudes and/or inter-teamworking quality might be the cause of this.

Finally, as far as known, this is the first time that a valued SNA is conducted among Fluor's employees that assesses the quality of communication lines. The Fluor management now knows the added value that a valued SNA can bring to the company by identifying improvement areas and inefficiencies.

7.3 Research limitations

Every research has its boundaries and as a result of this, potentially interesting things have to be left out of the analysis, thereby limiting the research. It can also be that the data collection didn't go as smooth as expected, the turn-up was disappointed or other process related matters that could be better.

The limitations of the research:

- **Small sample.** For this research the 29 key persons, concerned with decision-making and issue-solving during the construction and installation of the piping, have been identified. Out of these originally targeted 29 key persons, 22 responded. This relatively small sample made it unfeasible to carry out statistical correlation or regression analyses to construct a generalizable RECAP model for GC-SC collaboration including the explained variances of the criteria.
- **Case-study.** Other than Suprpto, the presented models and conclusions are based on a case-study, which makes generalization difficult, if not impossible. Fluor can use the results to improve collaboration, project performance and likelihood of relationship continuity in this and future projects with IREM. This is not possible for other general contractors. This doesn't mean that the subcriteria and criteria of the RECAP tool, aren't important for good collaboration with other subcontractors. This importance is established. What is meant is that other subcontractors might score low on other subcriteria when the RECAP tool is reused.

It is however possible to subtract important lessons from this research to develop a collaboration strategy to be used as a benchmark in the collaboration with other subcontractors. Future research might build upon the findings of this report but should target a far wider pool of participants to construct generalizable models.

- **Data collection.** As mentioned before, 22 out of 29 initial key persons responded to the call to submit their SNA and RECAP surveys. This resulted in a data set that is too small to conduct regression analyses. This also resulted in a high sensitivity of the average RECAP scores of clusters for individual perceptions of persons in a particular cluster.

RECAP is originally designed to be completed among 1 high level manager of a project owner and 1 high level manager of a general contractor. In this research a broader set of participants of each company (general contractor and subcontractor) is called upon. This holds the advantage that the differences between both companies are not based on the perceptions of a sole person but give a more representative view of the collaboration between companies. On the other hand, it is noticed that the lower level management was not able to answer some of the statements in the RECAP survey.

Another limitation concerning the data collection is that culture and the principal and agent roles might have determined how the SNA and RECAP surveys are answered. People may have been inclined to give desirable answers due to their cultural background and role as an agent in this project.

- **Data transformation.** The RECAP subcriteria and criteria scores have been composed by taking the average of the statements (for subcriteria) and the average of the subcriteria (for criteria), according to Suprpto's design of the RECAP methodology. Combined with the inability of the lower level management to give answers to certain statements, this resulted in a dataset in which, following Suprpto's methodology, some subcriteria scores of some participants were composed of only 1 or 2 statements.
- **RECAP factors.** This research is based on the assumption, and the substantiation in the literature study, that the collaboration between general contractor and subcontractor is based on the same factors as those applicable and significant in the collaboration between project owner and general contractor. This choice has been deliberately made in order to test whether this was indeed the case. However, Suprpto has performed extensive preceding analyses before developing the RECAP tool he used to construct his RECAP model for PO-GC collaboration. It could thus be possible that where Suprpto has eliminated certain factors in these analyses before developing his tool, these factors could be of importance for GC-SC collaboration and are, as a result, overlooked in the RECAP tool when it is applied to this other setting.

8 Conclusion and recommendation

In this final chapter, section 8.1 will summarize the conclusions to the six constructive questions, section 8.2 will answer the research question, after which several recommendations will be made to Fluor and future researchers in section 8.3. At last, this chapter will reflect on the past four months in which this research was actively conducted.

8.1 Conclusions constructive questions

This chapter will discuss the answers to the constructive questions in summary. Although the results are summarized one by one, attempt is made to fluently concatenate the answers.

1. **Constructive question 1 - *What model and factors can be used to explain project performance and relationship continuity?***

Several models and/or theories have been discussed and compared with one another. The model of Suprpto (2016) has ultimately been chosen because it is most elaborate, detailed and quantified. It is also concluded that Suprpto's relational capability (RECAP) model encompasses all factors found by Hoegl & Gemuenden (2011) and shows close similarities with the theory of Low (2011). Both are discussed in this research. Applying the RECAP tool of Suprpto also poses the opportunity to test the applicability of the RECAP tool in a general contractor and subcontractor setting.

The RECAP model for project owner and general contractor shows the inter-dependencies of collaboration-related factors resulting in project performance and relationship continuity. Both are desired by the Fluor management in their collaboration with subcontractors. The factors and their subfactors that have been investigated on their relation with project performance and relationship continuity are: Front-end definition, collaborative practices (team integration & joint working processes), relational attitudes (senior management commitment, senior management trust & established relational norms) and inter-teamworking quality (communication, coordination, balanced contribution, mutual support, aligned effort, cohesion & affective trust).

2. **Constructive question 2 - *What is the difference in the contractual and current collaboration structure between Fluor and IREM?***

After a documentation research in the contract between Fluor and IREM, and an expert consultation, the participants of this research have been identified and confirmed by Fluor's and IREM's high level management.

Fluor has developed a strict communication protocol, fitting its role as a principal, in which formal inter-organizational communication between the 29 participants is low (12 communication lines in the contractual state). Minor issues should be solved in direct communication by the responsible counterparts of both organizations. Bigger issues should be communicated through IREM's project manager and Fluor's contract engineer. In both cases, the people can call upon people from their own organization but the contract doesn't allow for a network structure among both companies.

This network structure is, however, what is found in practice (74 inter-organizational communication lines in the IST-state). What is remarkable is that IREM employees follow the procedural communication lines better than Fluor employees. This is attributed to cultural differences. IREM is predominantly Italian, where Fluor is predominantly Dutch and American. Italians have a higher power distance and uncertainty avoidance score (Hofstede, 2010) which can explain why they are inclined to follow procedures.

An additional analysis has been conducted that goes further on the extend in which a network is in place than looking at the number of ties between the organizations. This test that looks at the so-called 'modularity' of the participants, shows which groups of people are most interconnected with each other. When this test was applied to the contractual state, it was observed that the 'modules' closely resembled the clusters that have been made (organizing management, construction, office, preparation and prefab). When applied to the IST-state, this pattern didn't show, the 'modules' consisted out of persons from multiple clusters. This means that the cluster-structure of the contract is abandoned since people are not longer interconnected strongest with their own cluster, and that a network structure is thus confirmed.

3. **Constructive question 3 - *What current relations could be interesting improvement opportunities?***

The IST-state doesn't contain a value judgment, as is the case for the valued social network analysis (SNA) results. The valued SNA has been conducted to assess the quality of communication, and to thereby identify interesting improvement opportunities.

Looking back at the high amount of inter- and intra-organizational relations that have been shown while answering constructive question 2, the overall quality of communication can be considered good. The valued SNA shows a relatively low quantity of low quality relations between the participants. It is, however, still interesting to look at these few low quality relations, in order optimize Fluor's collaboration strategy.

The most obvious improvement point lies within the preparation-cluster and is an employee of Fluor (person 59). In the SNA diagrams containing the ties indicating slow responses, low effectiveness and de-energizing during communication, this employee accounts for a large part of the low quality relations.

Intra-cluster relations seem to be good, although the construction-cluster differentiates itself in this. This cluster is therefore one of the improvement opportunities in which intra-cluster as well as inter-cluster communication is sub-optimal. More generally, it seems like especially inter-cluster communication could be improved, rather than intra-organizational communication. Regarding inter-cluster communication, most attention should go to the communication between the construction- and the office-cluster, when looking at all three open communication factor (responsiveness, effectiveness and energy).

In addition to person 59, employees 8, 12 and 42 are considered to present more specific improvement opportunities.

4. **Constructive question 4 - *What elements of collaboration can be improved, and which groups should be targeted?***

This constructive question is meant to identify the (sub)criteria of the RECAP model that could be, and are most viable to be, improved.

Both the average perception of project performance according to the companies as well as according to the clusters is low, predominantly due to low efficiency in the RAHC-project. The urgency is thus widely acknowledged among the management of Fluor and IREM. It is this research' aim to improve project performance by improving the criteria for good collaboration. First of all, the analysis of the RECAP results suggested that the collaborative practices between Fluor and IREM should be improved, especially the integration of the team is believed to be able to significantly increase collaboration.

In terms of relational attitudes, the establishment of relational norms should be prioritized. By reducing the 'no-blame culture' and creating a win-win attitude among the contractors, the collaboration level is expected to increase. It is in this context interesting to see that Fluor's trust in IREM is lower than vice versa, and they also have a more negative view of the transparency and the adoption of a 'no-blame'-culture at IREM.

This feeling might be attributed to Fluor's role as the principal during this project. This might also explain the significance in the perceptions of mutual support, aligned effort and affective trust, all part of the criterion 'inter-teamworking quality'.

Concerning the latter subcriterion, mutual support should be increased, as well as the balance of contribution of both companies and the coordination between them.

It can't be concluded that there is a difference in the clusters' perceptions about these (sub)criteria. Because of this, and the conclusion of construction 2 that the cluster-structure of the contract is abandoned (network-structure), efforts to improve project performance should be aimed on company level.

5. Constructive question 5 - *Is the RECAP model and tool applicable for the relationship between general contractor and subcontractor?*

The RECAP tool applicable in a general contractor and subcontractor context, although some minor alternations have to be made and one should be aware of the setting it is used in. Blindly copying of the RECAP tool from Suprpto's (2016) dissertation would make it definitely inapplicable because it is clearly designed to address project owners. However, this research remained as faithful as possible to the original RECAP tool by only translating 'project owner' to 'general contractor' and 'contractor' to 'subcontractor'. Besides these translations, only 2 statements have been transformed to make them applicable to the collaboration between general contractor and subcontractor. By doing this the applicability of the survey, the model (including its factors) is tested. It is observed that some statements were not possible to answer by lower management. The tool as it is used in this research is, in short, applicable to assess the collaboration between general contractor and subcontractor when it is completed to high level management, in situation where the project is finished (otherwise the statements concerning project performance should be altered) in order to assess the collaboration and use these insight for future projects.

6. Constructive question 6 - *Is there a trend recognizable in the RECAP results at the improvement opportunity areas?*

After constructive question 3 made clear where improvement opportunities lie, and constructive question 4 which criteria of collaboration are most viable to improve, it was observed that there are trends observable at these improvement areas. This means that the improvement opportunity areas (the construction cluster and more in particular a number of employees), the collaborative practices and relational attitudes were often perceived to be improvable. This implied that there is a trend between the organizations' collaborative practices and relational attitudes, and the responsiveness, effectiveness and energy within these organizations.

There were also clues that there is a trend between inter-teamworking quality and one's responsiveness and effectiveness.

This implies that better collaboration not only bears benefits on the long-term (like better project performance and relationship continuity), but can also have a more direct, short-term effect on the organization and project by improving open communication factors. These short-term benefits/improvements (better responsiveness, effectiveness and energy) might actually explain why project performance increases through better collaboration.

8.2 Conclusion research question

The research question is to be answered in this section is: *'What can be improved in the collaboration between general contractor and subcontractor to attain higher project performance and relationship continuity?'*.

The model of Suprpto (2016) shows that collaborative practices and relational attitudes indirectly increase project performance through better teamworking quality. Next to this effect of relational attitudes, this criteria for good collaboration also increases the likelihood of relationship continuity.

This Relational Capability (RECAP) model and the accompanying RECAP tool, form the foundations for this research's assessment of the overall collaboration quality between the general contractor (Fluor B.V.) and the subcontractor (IREM S.p.A.). By performing a Social Network Analysis (SNA) together with analyzing the RECAP results, a new methodology has created a synergy while assessing the (quality of) collaboration within and between the general contractor and subcontractor.

One of the most important conclusions of this research is that strengthening the collaborative practices and bettering the relational attitudes within the organizations, not only bears long-term benefits (i.e. higher project performance and likelihood of relationship continuity) but also short-term benefits (i.e. increased responsiveness, effectiveness and energy within the project organization). The short-term benefits could be seen as open communication factors. These factors determine, together with attitudinal factors, the success of partnering. The criteria that are investigated in the RECAP analysis can be seen as attitudinal factors.

This research has shown that two attitudinal factors (collaborative practices and relational attitudes) determine the open communication factors (responsiveness, effectiveness and energy). The other attitudinal factor (inter-teamworking quality) can both increase the responsiveness and effectiveness of communication, as well as be influenced by increases in these two open communication factors.

In order to increase project performance on the long- and short-term, and secondly to increase the likelihood of relationship continuity, focus should thus lie on improving teamworking quality, strengthening collaborative practices and bettering the relational attitudes.

The RECAP analysis has identified that efforts are best directed towards some specific subcriteria of the above mentioned three criteria.

1. Teamworking quality
 - Mutual support
 - Balanced contribution
 - Coordination
2. Collaborative practices
 - Team integration
3. Relational attitudes
 - Established relational norms

Improving these (sub)criteria are expected to be most viable to direct efforts to because these are generally low scoring factors, in which there is thus more to gain. This shouldn't be interpreted as if the other collaboration related (sub)criteria shouldn't be addressed eventually. They shouldn't, however, be prioritized.

The RECAP analysis didn't show a strong basis to assume that there were any clear differences between the (sub)criteria scores among the five clusters. Besides that, the comparison of the (formal) communication lines in the contractual state with those that are in place in practice, has shown that the cluster-structure as designed by the contract is abandoned. This conclusion is the result of analyzing the inter-connectivity of the participants, which has shown that the participants are most interconnected with people from all clusters and no longer with those of the same cluster (as would have been expected on basis of the contract). The organization between Fluor and IREM follows a network structure of communication lines.

Because the people in the organization are no longer most interconnected with their own cluster, and because there is insufficient basis to conclude that the clusters' perception of the RECAP (sub)criteria are different, measures to be taken should be implemented on company level instead of on inter-cluster level. Improving the above mentioned list of (sub)criteria of good collaboration, should be prioritize when pursuing better project performance.

By directing efforts focused on the mentioned RECAP (sub)criteria on company-level, all improvement opportunity areas are expected to be improved, because combined analysis of the SNA and RECAP result has shown trends between them (as mentioned the third and fourth paragraph of this section). However, some specific improvement areas are identified (i.e. inter-cluster communication between the construction- and office-cluster, the intra-cluster communication within the construction-cluster (of which persons 8, 12 and 42 specifically), and person 59 of the preparation-cluster). The inter-cluster opportunity should be solved when the company-level measures are taken for aboved mentioned reasons. The intra-cluster communication can however be targeted separately, and should be targeted by improving teamworking quality over improving the collaborative practices and relational attitudes within this cluster.

8.3 Recommendations

In this section, first some practical recommendations will be given to Fluor to put into practice, after which some more theoretical recommendations and guidelines related to this research will be given to future researchers.

8.3.1 Recommendations to Fluor

Fluor is recommended to take the following direct actions:

1. Address person 59. This person is clearly not at ease with his current position in the current organization. Fluor should provide this person with feedback, ask for more specific reasons for potential causes of his RECAP and SNA results. When finalizing this research, feedback has been given and Fluor is currently addressing this improvement opportunity.
2. Take cultural differences into concern. The collaboration between Fluor and IREM is rather traditional. When the Fluor management wants to shift to a more relational type of contract with IREM, they have to realize that the Italian culture has a high uncertainty avoidance. It might thus prove to be difficult to engage them to this relatively new way of working together due to cultural reasons. Since uncertainty avoidance is something different than risk avoidance, Fluor is advised to carefully explain the entire IREM management of the opportunities, benefits and risks accompanying this more relational way of working together. Since the proven opportunities outweigh the potential risks, it is expected that IREM will eventually see the added value that better collaboration or partnering can bring in terms of project performance and relationship continuity, based on the long-term orientation in the Italian culture.

3. Stimulate team integration by organizing frequent alignment and goal setting meetings with all key persons. In the RAHC-project, office locations are already fixed, and other measures should be taken in order to improve the integration of the team. By organizing frequent meetings, preferable including a small break, people see each other more often and talk to each other more (also about informal topics), which is a first step to lowering the boundaries and raising trust and commitment between two companies.
These meetings can also be used to increase the established relational norms by jointly looking for a win-win situation, and jointly determining milestones and aligning objectives.
4. Better the established relational norms by create an environment of trust, commitment and 'no-blame'. As mentioned, frequent alignment and goal setting meetings can facilitate this recommendation. It was however not the objective of this research to bring forward very specific improvement activities, but rather to identify what potential measures should address.
5. Improving teamworking quality. Fluor should invoke a 'teambuilding expert' or 'collaboration facilitator' to help them guide and formulate a better teamworking strategy. This strategy should prioritize the improvement of mutual support, balanced contribution and coordination among Fluor and IREM. This person could also help to achieve the previous recommendation point. This person should be advised of the cultural differences between Fluor and IREM. IREM, as an Italian company, is expected to be more restrained than Fluor, being an American company with a high number of Dutch employees. This means that the Italians are more serious while performing work related activities, there is less room for other activities that don't immediately contribute to their task. The teamwork facilitator should thus make the objectives of the activities very clear in order achieve a constructive teambuilding result.

On future projects Fluor can improve the collaboration between Fluor and IREM by implementing the following actions:

1. Eliminate distance. In order to increase team integration, the distance between both contractors should be eliminated as much as possible. Co-location in the same building is preferred. Fluor is recommended to co-locate itself with its most important subcontractors for meeting the critical path of the project. Employees from different companies are expected to meet each other more frequently and walk by instead of sending an e-mail. This increases the personal relations among people, which should result in increased trust and feeling of unity.
2. Ask someone on a freelance basis or within the organization, who is experienced with conducting a social network analysis (SNA), to conduct this analysis on future projects. Based on this research, it is found to be extremely helpful in identifying inefficiencies within one or between multiple organizations. When the target group is known and are gathered during an alignment meeting, the SNA survey can be filled-in within 10 minutes and the results could be shown the next meeting, or even on the same day. Fluor is recommended to conduct a SNA in their collaboration with its subcontractors one or two months after initializing their collaboration, this leaves time to implement improvement measures.
3. Individual incentives for good teamwork for Fluor and IREM employees. During personal observations it is seen that, although teamwork among companies is widely celebrated and said to be understood, the employees are still choosing sides when disputes occur, or they purposely withhold information to protect their own organization's position during eventual future negotiations. When individuals are personally rewarded for good collaboration and looking for win-win situations, this might be a way to gradually teach them new behaviour.
More general incentives, for example for safe work or good performance of IREM employees should be collective instead of individual.

8.3.2 Recommendations for future research

This subsection will provide future researchers with some directions for future research.

1. Future research should be aimed at further development of the collaboration model and tool for general contractor and subcontractor collaboration (GC-SC collaboration). This is a relatively unexplored field of study, which became apparent when a project owner and general contractor model provided the most elaborate view on collaboration, project performance and relationship continuity. Future efforts should be focused the development of a generalizable RECAP model for GC-SC collaboration.
2. It is furthermore believed that future researchers should investigate which factors to include in the RECAP tool. In this research the applicability of Suprpto's selected factors and his tool are tested. It is possible, however, that Suprpto has eliminated relevant factors for the collaboration between general contractor and subcontractor prior to designing his RECAP tool. He might have done this because his analyses, prior to the design of the RECAP tool and model, concluded that these were not relevant for or applicable to the collaboration between project owner and general contractor. Future researchers should thus perform a critical analysis of the factors Suprpto has identified in the early stages of his research on their potential interest and relevance in this different context. The RECAP survey is, with minor alterations, applicable but might thus be extended with other criteria and subcriteria. One of which might be culture.
3. A more practical recommendation is to increase the number of participants per organization for a more representative overall perception on the (sub)criteria. These participants should, however, be part of the high level management, to prevent guesses or 'missing data'.
4. Last of all, future researchers could work out the linkage that has been made between the two types of partnering factors (i.e. open communication factors and attitudinal factors). Efforts may go to determining the (directions of the) correlations between collaborative practices, relational attitudes and teamworking quality at one side, and responsiveness, effectiveness and energy at the other side. They may thereby further develop insights in project management on how improved collaboration exactly affects the organization on the short-term in order to achieve better project performance on the long-term.

8.4 Reflection

The past 4 months (from kick-off to green-light meeting) have been a real kick for me. Throughout the years (first during my Bsc. 'Technology, Policy and Management', and later during my Msc. 'Construction Management and Engineering') I've developed an interest in the construction of (the oil & gas) industry because of the impact of, magnitude of and diversity within projects in this sector. I've seen that it is a relatively conservative business, which makes the challenge of working on improving the collaboration strategy here-within, even more rewarding.

In the past 4 months that I've been actively working on the content of this research at the RAHC-site, I have learned a lot about the organization-structure, -culture and the way of doing things at Fluor. The management of Fluor (and IREM) embraced me in their midst during the alignment meetings, other informal meetings, my presentations and of course whilst performing my research. I'm grateful that a big part of the participants submitted their surveys.

The Fluor management immediately put me in the middle of the organization which enabled me to reach out easily to employees that could provide me with the necessary information.

The execution of the research went exceptionally smooth. After the kick-off meeting, the direction of the research became more specific but the linkage of the RECAP tool and SNA still had to be accomplished. After this link was given substance, no significant deviations from the schedule had to be made and no challenges occurred that could have influenced the critical path of this research. The only challenge, and this has been a very minor one, has been the selection of the appropriate software to properly carry out a valued SNA.

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Appendices

A Cultural dimensions

In this appendix, the cultural dimensions per nationality are presented. These are not test results of this research, they are global/generic/average scores of people from a certain nationality. This appendix is referred to in the body of the research to see whether cultural differences can be an explanation of the occurrence of potential improvement opportunities.

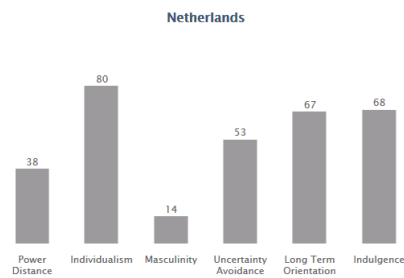


Figure 32: Hofstede's cultural dimensions, The Netherlands

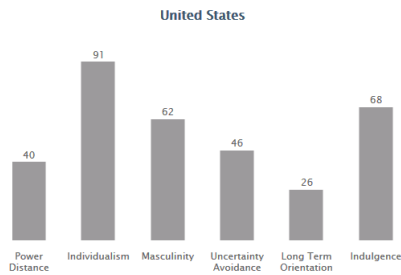


Figure 33: Hofstede's cultural dimensions, United States

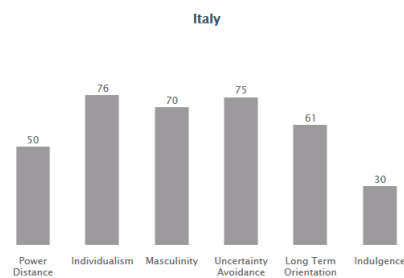


Figure 34: Hofstede's cultural dimensions, Italy

B SNA survey

Thank you for your participation.

This survey will provide the input of the Social Network Analysis (SNA). This will be the basis of my graduation thesis for the Master course 'Construction Management & Engineering'.

We ask you to fill in your name because without it, the construction of the network is not possible. Don't forget to write your own name at the top of the SNA survey sheet.

The result will, however, be made anonymous when imported in the analysis-software.

Please fill in the matrix truthfully and on your own, so that the Social Network Analysis can *really* contribute to Fluor's and IREM's understanding of how the collaboration between general contractor and subcontractor could be improved, in this project and in potential future projects. The first impression is often best.

Table 10: Corresponding names with numbers in SNA survey table

Number	Corresponding name	Number	Corresponding name
0		15	
1		16	
2		17	
3		18	
4		19	
5		20	
6		21	
7		22	
8		23	
9		24	
10		25	
11		26	
12		27	
13		28	
14			

The table above links names of key persons to the numbers in the SNA survey table. Please hold this sheet next to you when filling in the SNA survey table.

This survey is about **work-related issues coming up during construction** (For example; (minor) scope changes, (minor) construction problems, change orders, potential change alerts, associated revisions, etc.) **and decision-making concerning these topics.**

In short: All communications concerning issues and changes that come up that need to be solved and decisions that need to be taken or approved in consultation with the other party.

You are asked to rate the matrix below with scores between '0' and '5' for every person.

A description of what each score means can be found on the next page.

Again, don't forget to write your own name as well.

If you don't know a person you can give that person a '0' on frequency and a '0' on the other 3 elements as well, since those would be not applicable in that case.

Table 11: SNA survey table

OWN NAME:				
	Frequency	Responsiveness	Effectiveness	Energy
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				

Table 12: Description scores, frequency

Frequency*How often do you contact ... for work-related issues as described above and decision-making?*

0	I do not know this person / I don't have interactions with this persons about these topics
1	At least montly
2	At least weekly
3	At least every 2-3 days
4	At least every day
5	Multiple times a day

Table 13: Description scores, responsiveness

Responsiveness*How quickly does ... respond when you contact ...**for the work-related issues described above and decision-making?*

0	I do not know this person / Not applicable
1	Often fails to respond
2	Usually responds, but slowly
3	Generally within the week
4	Typically responds within 24 hours
5	Always responds the same day

Table 14: Description scores, effectiveness

Effectiveness*How effective is ... in solving work-related issues as described above or decision-making?*

0	I do not know this person / Not applicable
1	Very ineffective
2	Ineffective
3	Reasonably effective
4	Very effective
5	Exceptionally effective

Table 15: Description scores, energy

Energy*How does interaction with ... affect your energy level?*

0	I do not know this person / Not applicable
1	Very de-energizing
2	Slightly de-energizing
3	No effect
4	Slightly energizing
5	Very energizing

C RECAP test survey

RElational CAPability (RECAP) assessment form

This assessment will test the applicability of Suprpto's model about the collaboration between project owner and general contractor, on the collaboration between general contractor and subcontractor. Your result will form the basis of a new model for general contractor and subcontractor collaboration and will also be used to give the Social Network Analysis from this morning more meaning. The assessment results will provide an overview regarding the achievement of specific critical success factors of collaboration in projects.

For the reason of linkage with the results of the Social Network Analysis, your name is asked. Since the SNA is anonymous, the RECAP result are as well.

OWN NAME:

The ability to collaborate in projects is embedded in the project team, which is a temporary organization that both firms (general contractor and subcontractor) establish in order to deploy their resources in projects. Relational capability in projects is the ability of the two parties, their teams and their people in aligning and integrating their knowledge, skills, and energy to perform interdependent project activities for accomplishing a better outcome.

What's in it for participating firms? By participating in this assessment, the pair of firms will gain insights regarding their achievement and identify specific aspects to improve during this project or the future. The assessment focuses on how well the firms 'work together' and not on the 'individual performance' of the firms. When used in an ongoing project, the two parties can formulate joint actions more constructively to achieve better project performance. This assessment also identifies the potential value of continuing the relationships in the future.

Instruction

- The assessment is designed to be filled in **separately** by senior management representatives, project directors or equivalent position, and/or managers representing the general contractor and subcontractor.
- Keep the situation of the RAHC-project in mind, while filling in the assessment.
- Rate each statement by selecting the appropriate level of achievement, realization or performance (1 to 5, explained per table). The rating you give should be based on your own perception that best describes the actual situation occurring in the RAHC-project.

A. Front-end definition and B. collaborative practices

This section examines the extent of how well the front-end definition is understood/comprehended by the project teams and how well collaborative practices are actually being implemented in the current project. Collaborative practices are additional practices used to enhance the collaboration between parties (general contractor and subcontractor) and their project teams.

The words 'Both teams' and 'We' refer to the general contractor and subcontractor teams. Please mark 'X' on the associated rating column, where:

1=Very Poor, **2**=Poor, **3**=Moderate, **4**=Good, **5**=Very Good, **NA**=Not Applicable, **DK**=Do not Know.

Table 16: Front-end definition and collaborative practices

Criteria/Indicator	1	2	3	4	5	NA	DK
A1. Front-end definition							
a. The project goals, objectives, and scope are understood by the subcontractor team.							
b. The project goals, objectives, and scope are understood by the general contractor team.							
c. All functional/high level technical requirements (basic design) are reviewed together by both teams.							
d. The project execution plan is reviewed together by both teams and adjusted accordingly if needed.							
e. There are clear roles and responsibilities assigned to both teams.							
B1. Team integration							
a. We form an integrated project team (IPT) where the general contractor and the subcontractor teams are structured and integrated as a single team with no apparent boundaries.							
b. We perform goal setting and alignment meetings with subcontractors and suppliers.							
c. Subcontractor's team performs goal setting and alignment meetings together with the general contractor's business and operation representatives							
d. We exercise inter-team building workshops to encourage collaboration via fun and excitement.							
e. We have a recognition and rewards program to stimulate individual and team level's collaborative behaviour.							
B2. Joint working processes							
a. We jointly conduct planning.							
b. We jointly perform monitoring, controlling, and reporting.							
c. We jointly conduct issue management.							
d. We jointly define and monitor the achievement of key performance areas.							
e. We jointly identify and monitor risks and formulate a necessary mitigation plan.							
f. We have robust mechanisms to resolve conflicts/disputes.							
g. We have formal procedures for joint decision making.							

C. Project performance and D. Relationship continuity

This section is concerned with the perceived current achievement of the collaboration output, the project performance. The assessment aspects include measures of efficiency, quality of output, and satisfaction, and potential continuity of the relationship in the future.

Please rate the following statements reflecting *the current achievement or progress* of the project *so far*. Please mark 'X' on the associated rating column, where:

1=Very Poor, **2**=Poor, **3**=Moderate, **4**=Good, **5**=Very Good, **NA**=Not Applicable, **DK**=Do not Know.

Table 17: Project performance

Criteria/Indicators	1	2	3	4	5	NA	DK
C1. Efficiency							
a. The project is progressing in accordance with the estimated cost so far.							
b. The project is progressing in accordance with the planned schedule so far.							
C2. Quality							
a. far, there are no significant reworks due to major defects regarding the project deliverables.							
b. So far, all project activities are performed or completed safely with no accidents causing severe injury.							
c. So far, the facility or product constructed is taken into operation reliably without major problems.							
d. So far, the facility or product constructed is functioning according to the specified capacity.							
C3. Satisfaction							
a. Both general contractor and subcontractor are satisfied with the project results and outcomes so far.							
b. So far, this project will be a (commercial) success to the general contractor.							
c. So far, this project will be a (commercial) success to the subcontractor.							

Please mark 'X' on the associated rating column, where:

1=Unlikely, **2**=Slightly likely, **3**=Moderately likely, **4**=Highly likely, **5**=Completely likely (almost certain), **NA**=Not Applicable, **DK**=Do not Know.

Table 18: Relational continuity

Criteria/Indicators	1	2	3	4	5	NA	DK
D1. Relationship continuity							
a. Beyond this project, we will likely work with each other in the future with the same partners.							
b. The relationship experience we gained so far will be useful in future project(s), even with different partners.							
c. Because of collaboration in this project, we gain benefits that enable us to compete more competitively.							
d. This collaborative relationship makes our companies able to develop unique capabilities (truly innovative products/solutions).							

E. Relational attitudes

This section is concerned with how well the senior management of the general contractor and subcontractor commits to support the collaboration, taking into account the degree of trust and interactional norms to bring together the necessary resources into a project.

The words 'senior management' refers to *high level managers or executives* (the people in this room) representing a company with the authority to make a final decision about a project. Please mark 'X' on the associated rating column, where:
1=Very Poor, **2**=Poor, **3**=Moderate, **4**=Good, **5**=Very Good, **NA**=Not Applicable, **DK**=Do not Know.

Table 19: Relational attitudes

Criteria/Indicators	1	2	3	4	5	NA	DK
E1. Senior management commitment							
a. Senior management of the general contractor commits to provide necessary resources and support to the project teams.							
b. Senior management of the subcontractor commits to provide necessary resources and support to the project teams.							
c. Senior management of the general contractor shows consistent and passionate leadership.							
d. Senior management of the subcontractor shows consistent and passionate leadership.							
e. Senior management of both parties actively work together to resolve potential conflicts when needed.							
E2. Senior management trust							
a. There is an atmosphere of mutual trust between senior management of both parties.							
b. There is a mutual enthusiasm from senior management of both parties in achieving the project goals.							
c. Senior management of both parties has confidence in each other to do what is right.							
d. Senior management of both parties keeps their promises truthfully.							
E3. Established relational norms							
a. The general contractor intentionally adopts 'no blame culture' when problems arise.							
b. The subcontractor intentionally adopts 'no blame culture' when problems arise.							
c. The general contractor is intentionally open and honest in any interactions, with no hidden agenda.							
d. The subcontractor is intentionally open and honest in any interactions, with no hidden agenda.							
e. The general contractor strives for business outcomes whereby both parties either win or both parties lose.							
f. The subcontractor strives for business outcomes whereby both parties either win or both parties lose.							
g. Both parties agree to have an equal say in any critical decision that matter to both parties.							

F. Inter-teamworking

This section is intended to assess how the general contractor's team and the subcontractor's team work together in a project across their company's boundaries.

Please mark 'X' on the associated rating column, where:

1=Very Poor, **2**=Poor, **3**=Moderate, **4**=Good, **5**=Very Good, **NA**=Not Applicable, **DK**=Do not Know.

Table 20: Inter-teamworking

Criteria/Indicators	1	2	3	4	5	NA	DK
F1. Communication							
a. Both teams communicate directly with each other.							
b. Project-relevant information is shared openly by both teams.							
c. Whenever a problem is detected, it is immediately and honestly communicated to the other team.							
d. Both teams are satisfied with the usefulness of the information shared by the other team.							
F2. Coordination							
a. The work needed to be done in cooperation with the other teams is closely synchronized between the teams.							
b. There is a clear linkage between the teams for their interdependent tasks.							
c. There is no redundancy regarding the work done between both teams.							
F3. Balanced contribution							
a. Both teams recognize the specific strengths and weaknesses of each team's competence.							
b. Both teams are contributing their knowledge/expertise in accordance with their full potential.							
c. There is a balanced contribution of ideas between the teams.							
F4. Mutual support							
a. Both teams help each other as well as they could.							
b. Whenever problems occurred, they are resolved constructively.							
c. Every critical decision is made together by both teams.							
F5. Aligned effort							
a. Both teams give this project the priority it needs.							
b. Both teams put their best effort into this project.							
c. There is no conflict regarding the effort that each team put into this project.							
F6. Cohesion							
a. Members of both teams are personally engaged to this project.							
b. Members of both teams are integrated as one team.							
c. Members of both teams feel proud to be part of the project team.							
d. Members of both teams feel responsible for maintaining the relationships within the project team.							
F7. Affective trust							
a. Both teams are comfortable being dependent on each other.							
b. Both teams keep their promises.							
c. Both teams work with high levels of integrity.							
d. Both teams are fair to each other.							
e. Both teams look out for the interests of both companies.							
f. Both teams can rely on each other for not taking advantage of the other team's weaknesses.							

D SNA results, frequency

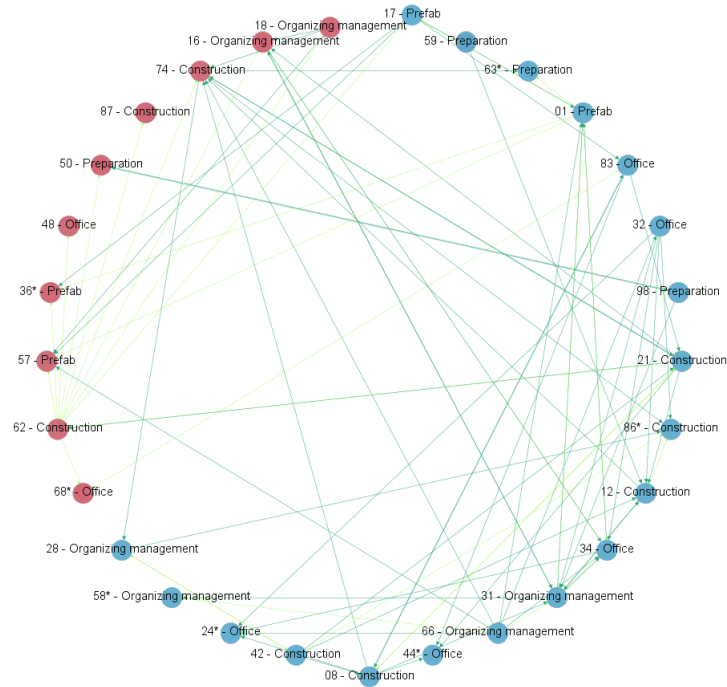


Figure 35: Communication ties with a high frequency of occurrence, sorted by company

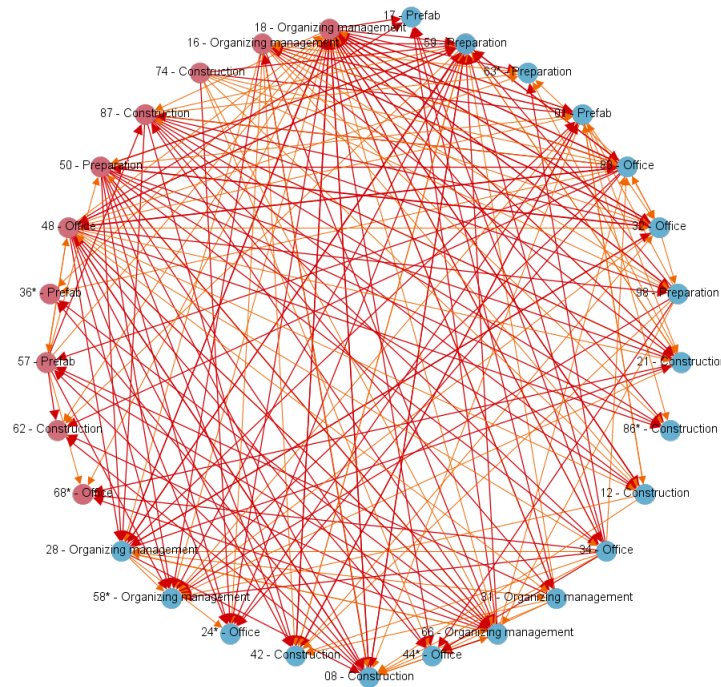


Figure 36: Communication ties with a low frequency of occurrence, sorted by company

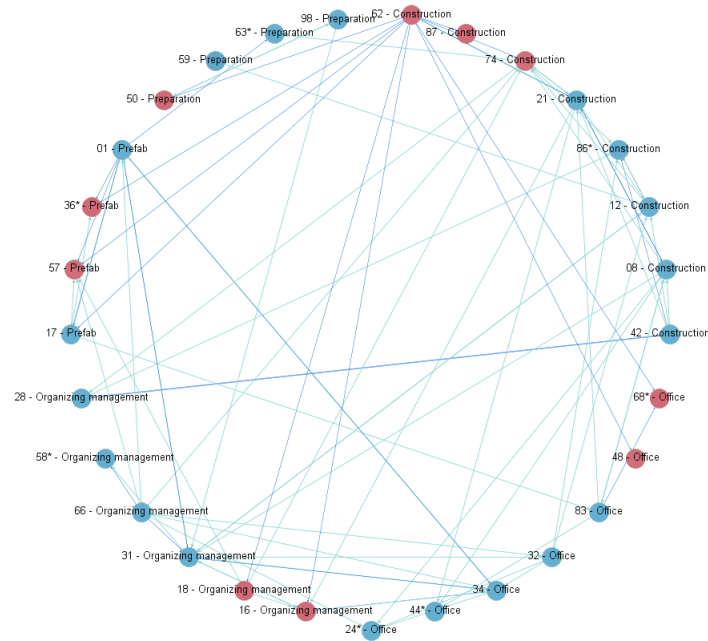


Figure 37: Communication ties with a high frequency of occurrence, sorted by cluster

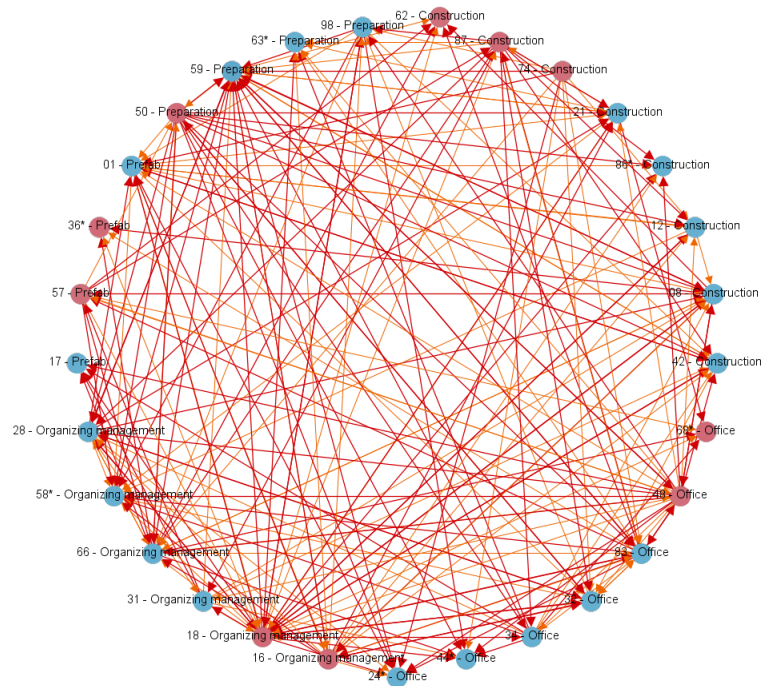


Figure 38: Communication ties with a low frequency of occurrence, sorted by cluster

E SNA results, responsiveness

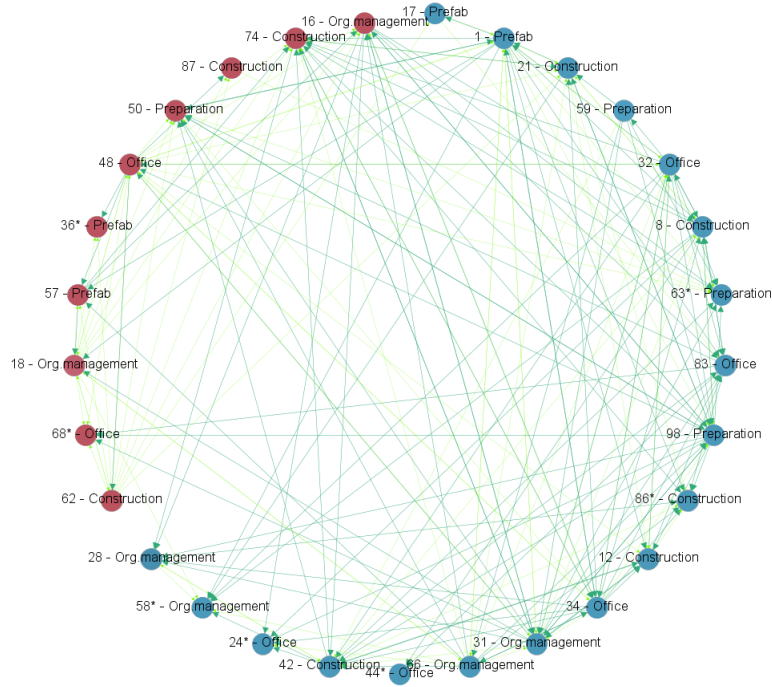


Figure 39: Communication ties characterized by a fast response, sorted by company

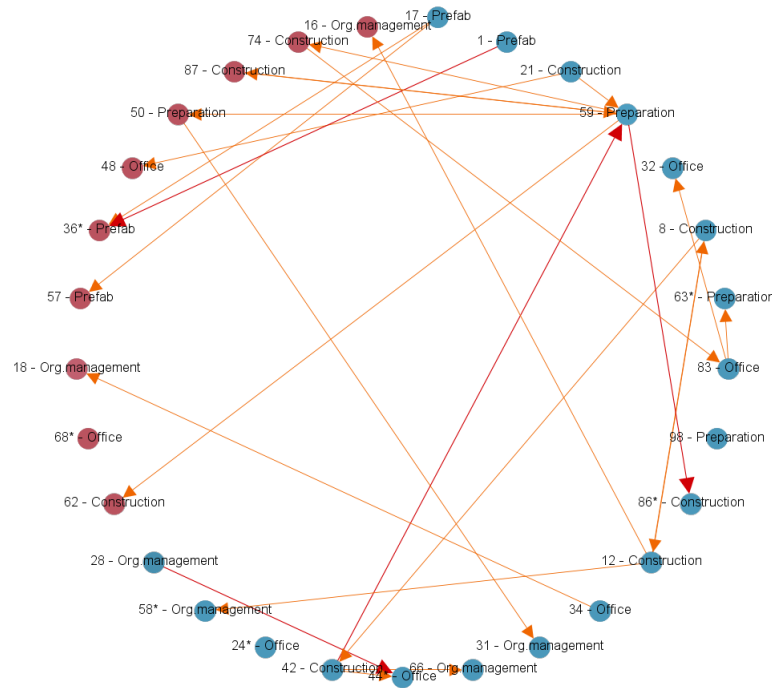


Figure 40: Communication ties characterized by a slow response, sorted by company

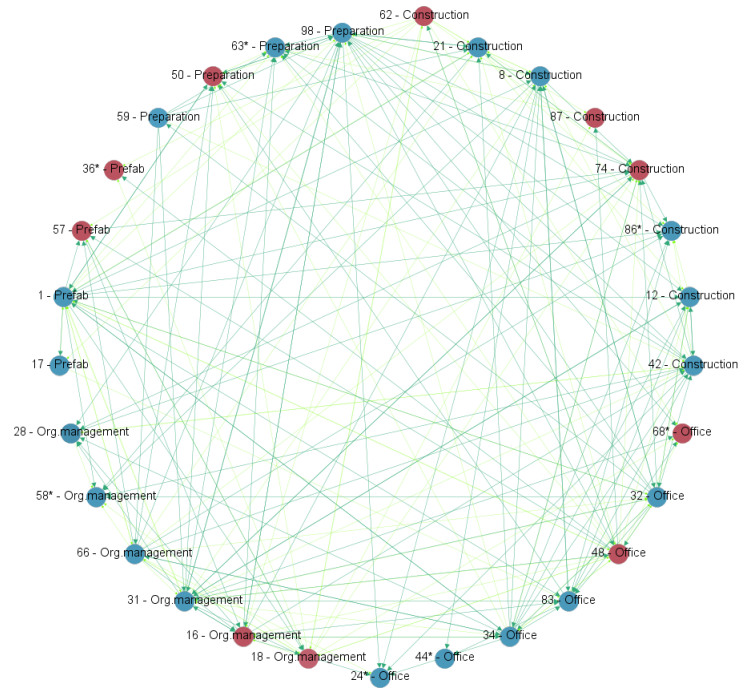


Figure 41: Communication ties characterized by a fast response, sorted by cluster

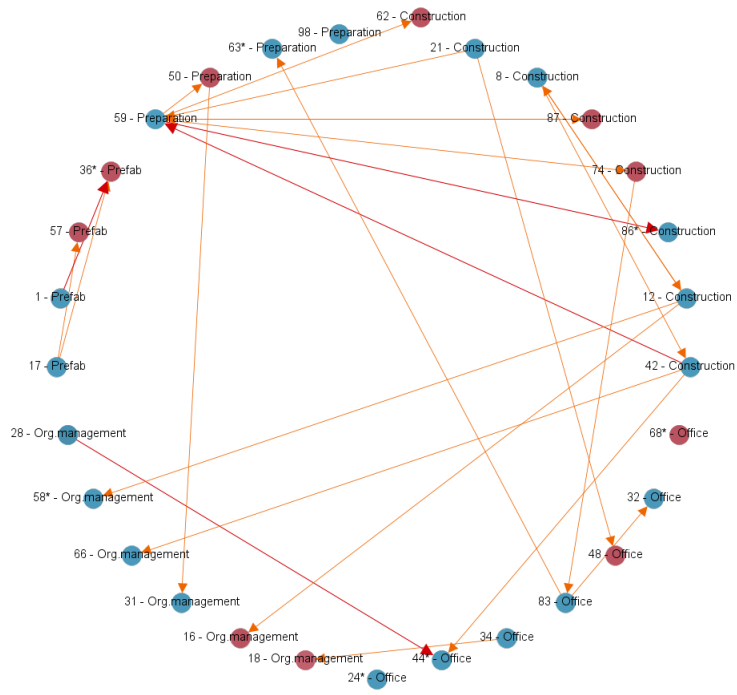


Figure 42: Communication ties characterized by a slow response, sorted by cluster

F SNA results, effectiveness

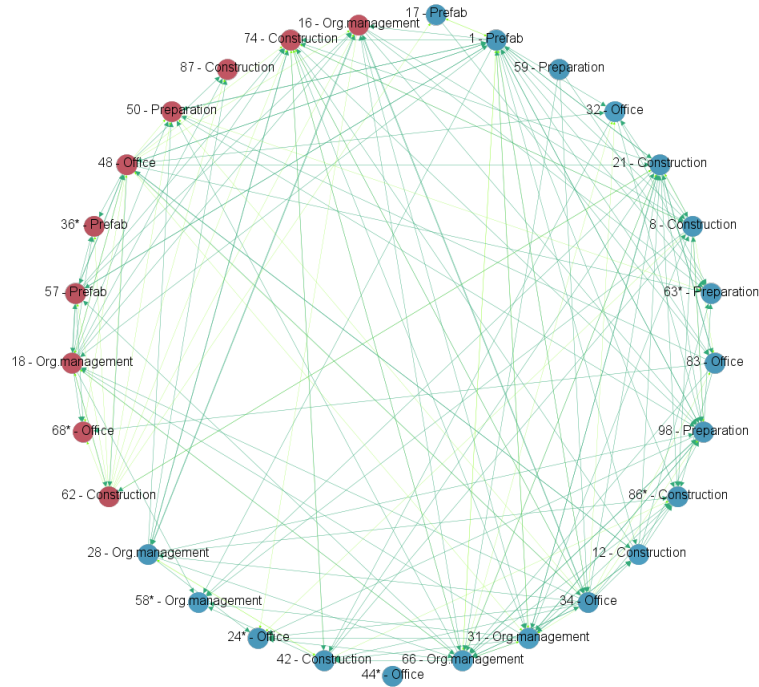


Figure 43: Communication ties with high effectiveness, sorted by company

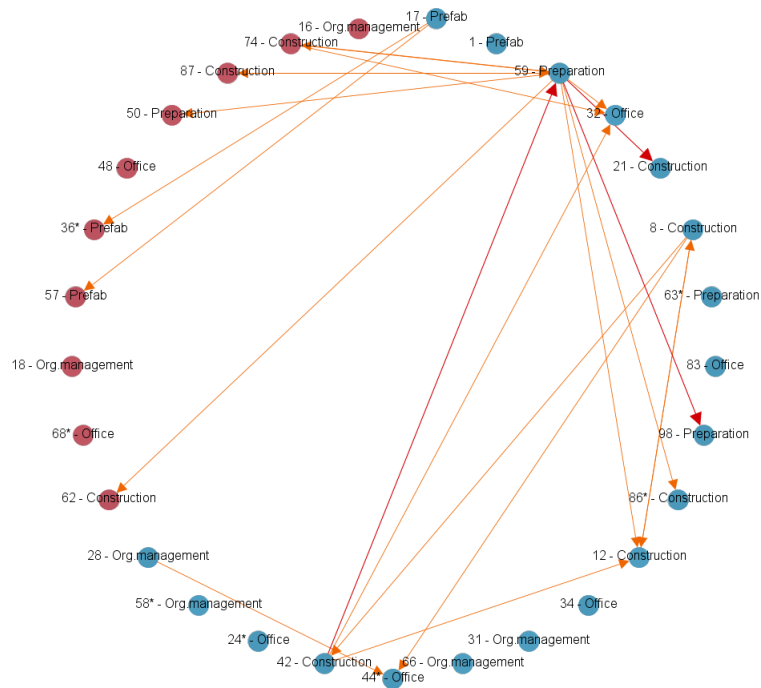


Figure 44: Communication ties with low effectiveness, sorted by company

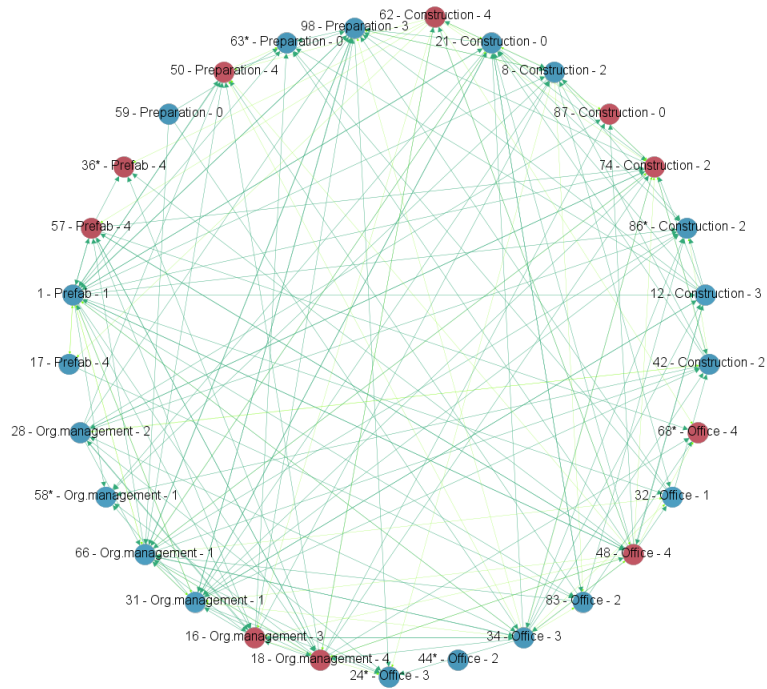


Figure 45: Communication ties with high effectiveness, sorted by cluster

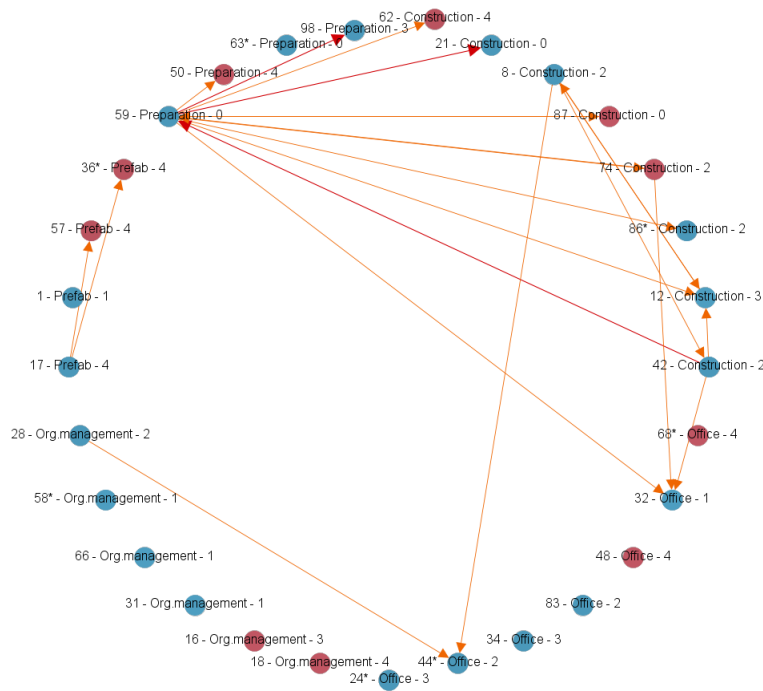


Figure 46: Communication ties with low effectiveness, sorted by cluster

G SNA results, energy

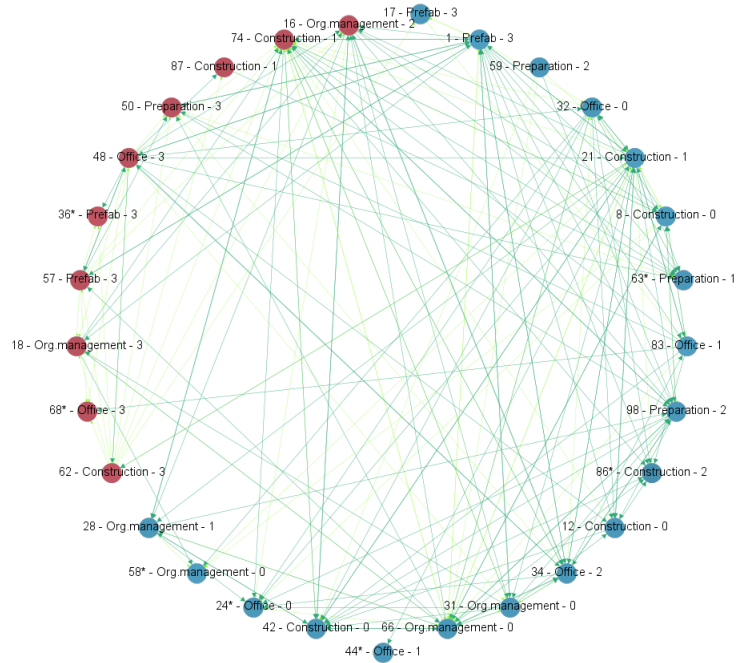


Figure 47: Energizing communication ties, sorted by company

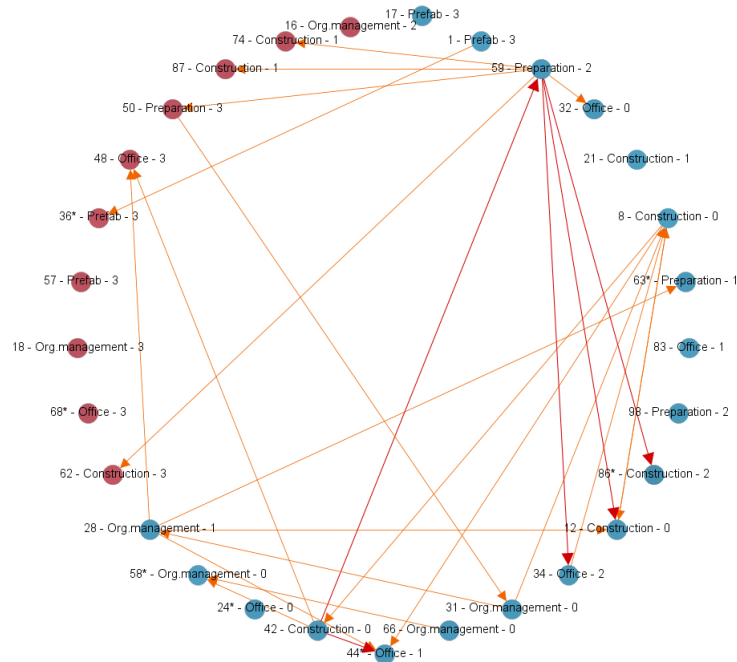


Figure 48: De-energizing communication ties, sorted by company

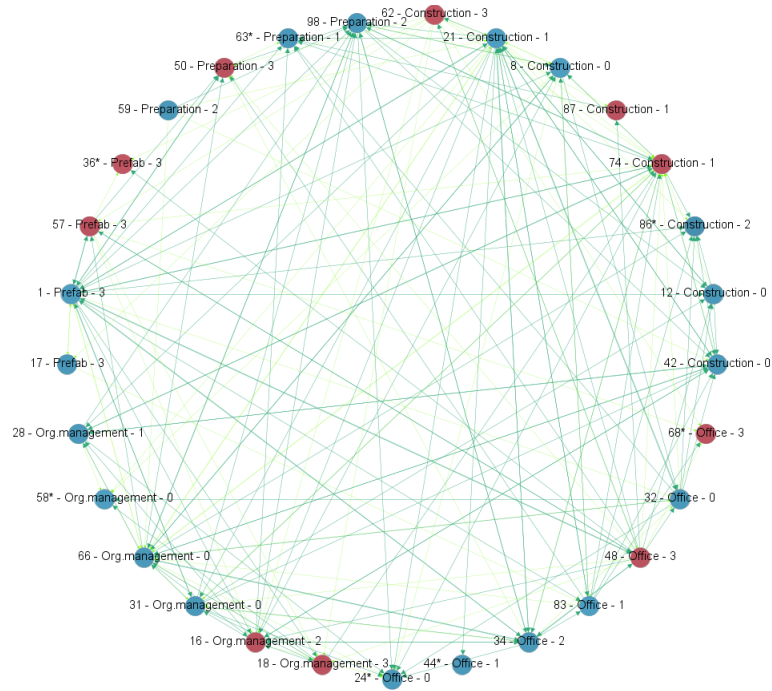


Figure 49: Energizing communication ties, sorted by cluster

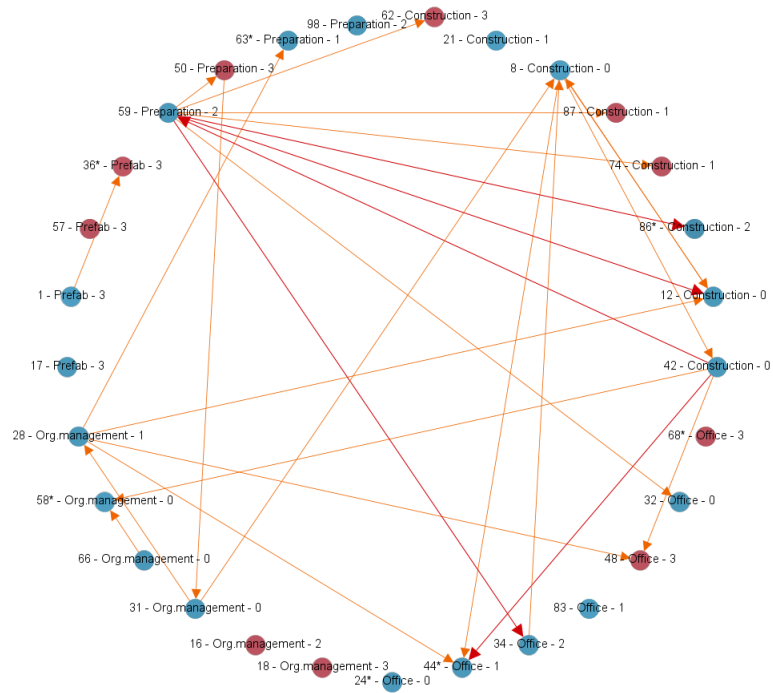


Figure 50: De-energizing communication ties, sorted by cluster

H Combined SNA and RECAP results

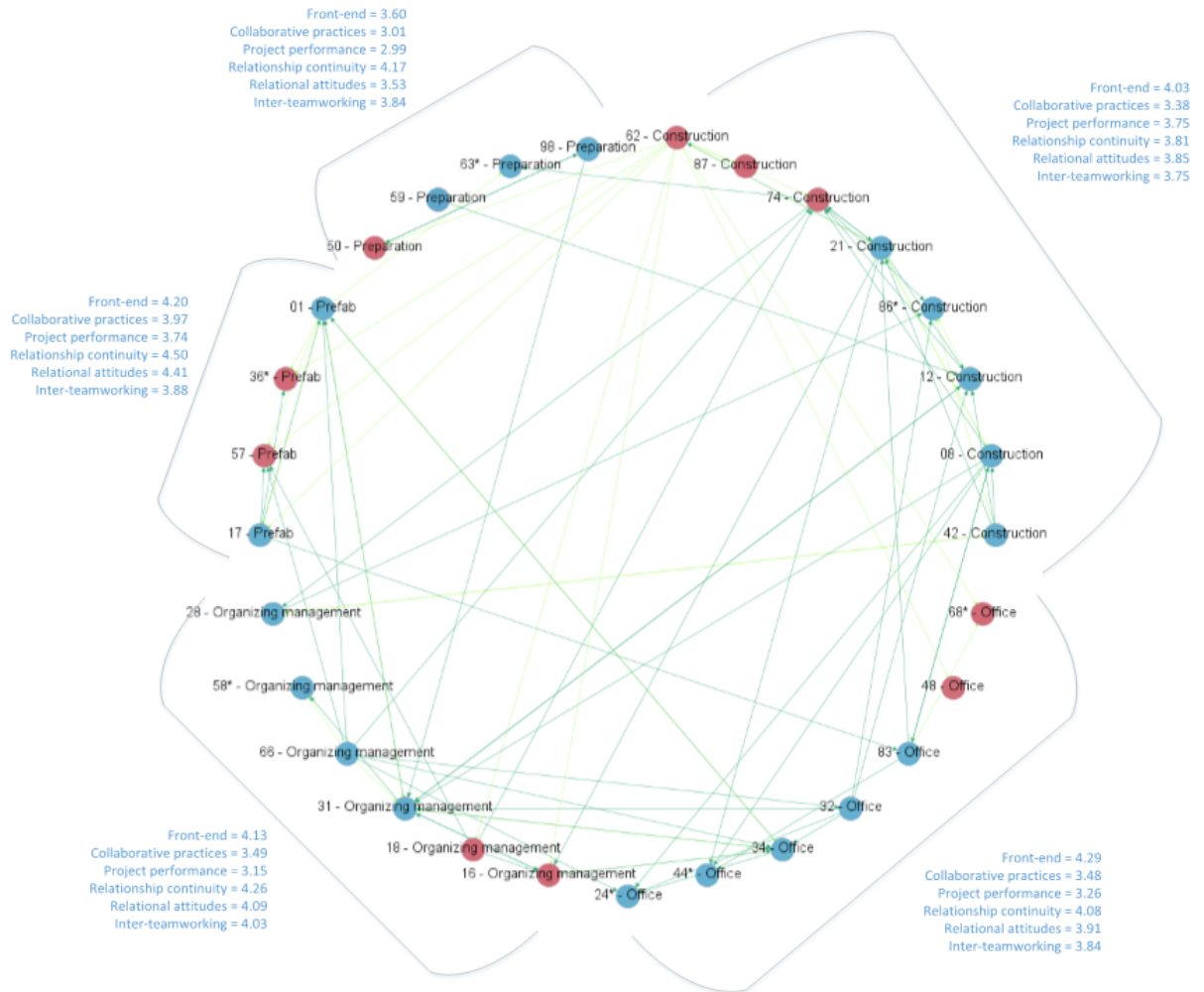


Figure 51: Combination of RECAP cluster scores with SNA's high frequency relations

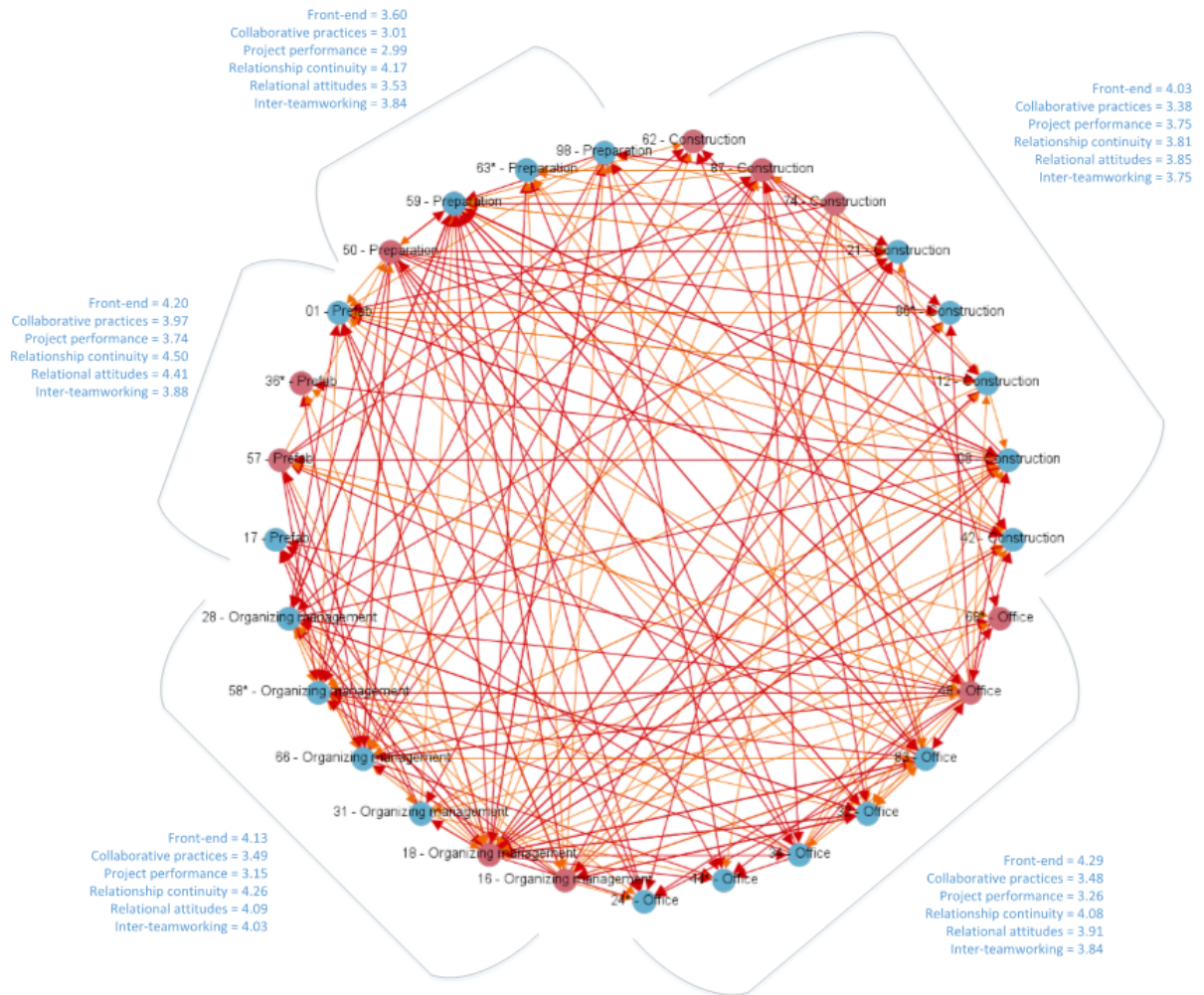


Figure 52: Combination of RECAP cluster scores with SNA's low frequency relations

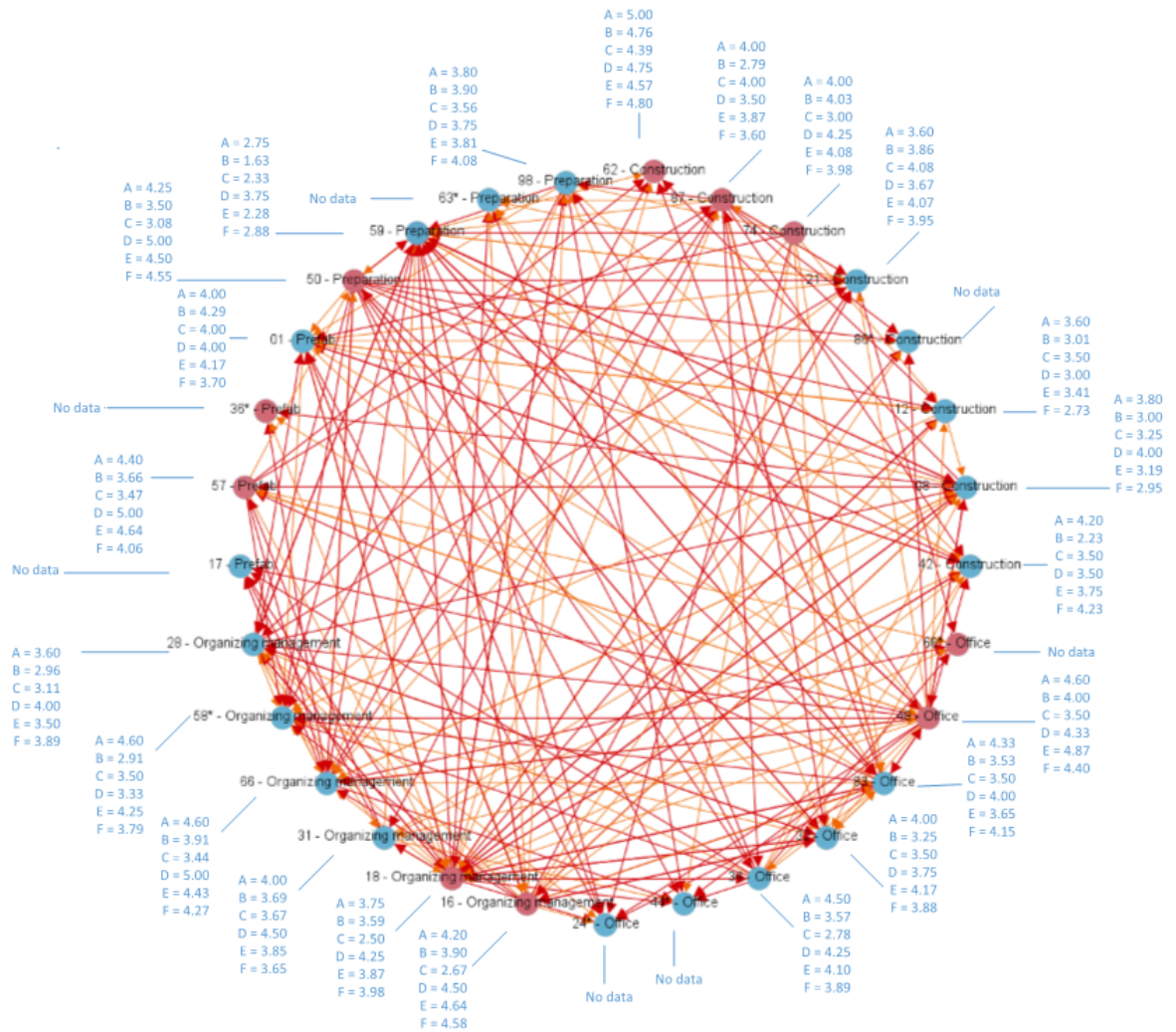


Figure 53: Combination of RECAP individual scores with SNA's low frequency relations

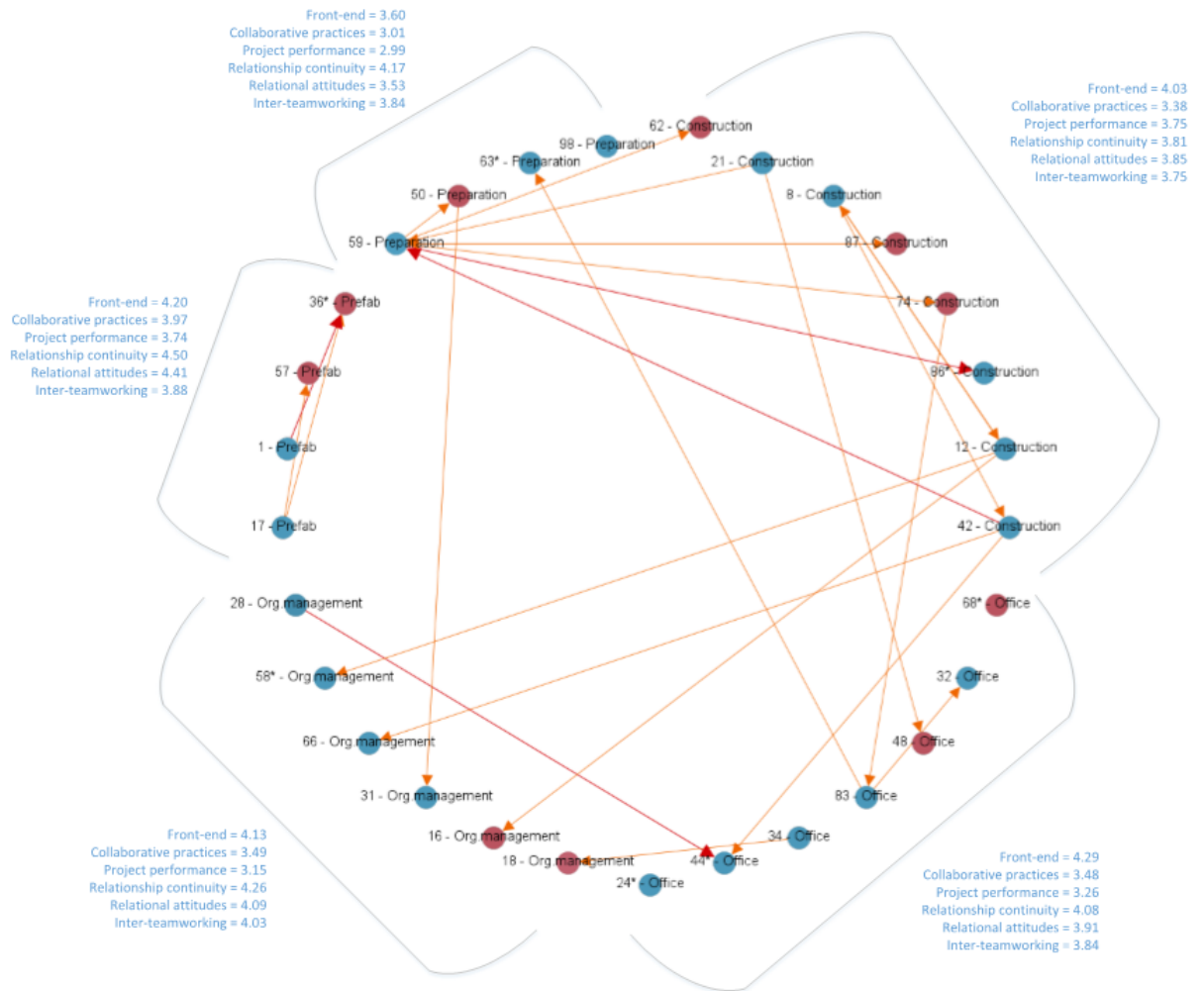


Figure 54: Combination of RECAP cluster scores with SNA's slow response relations

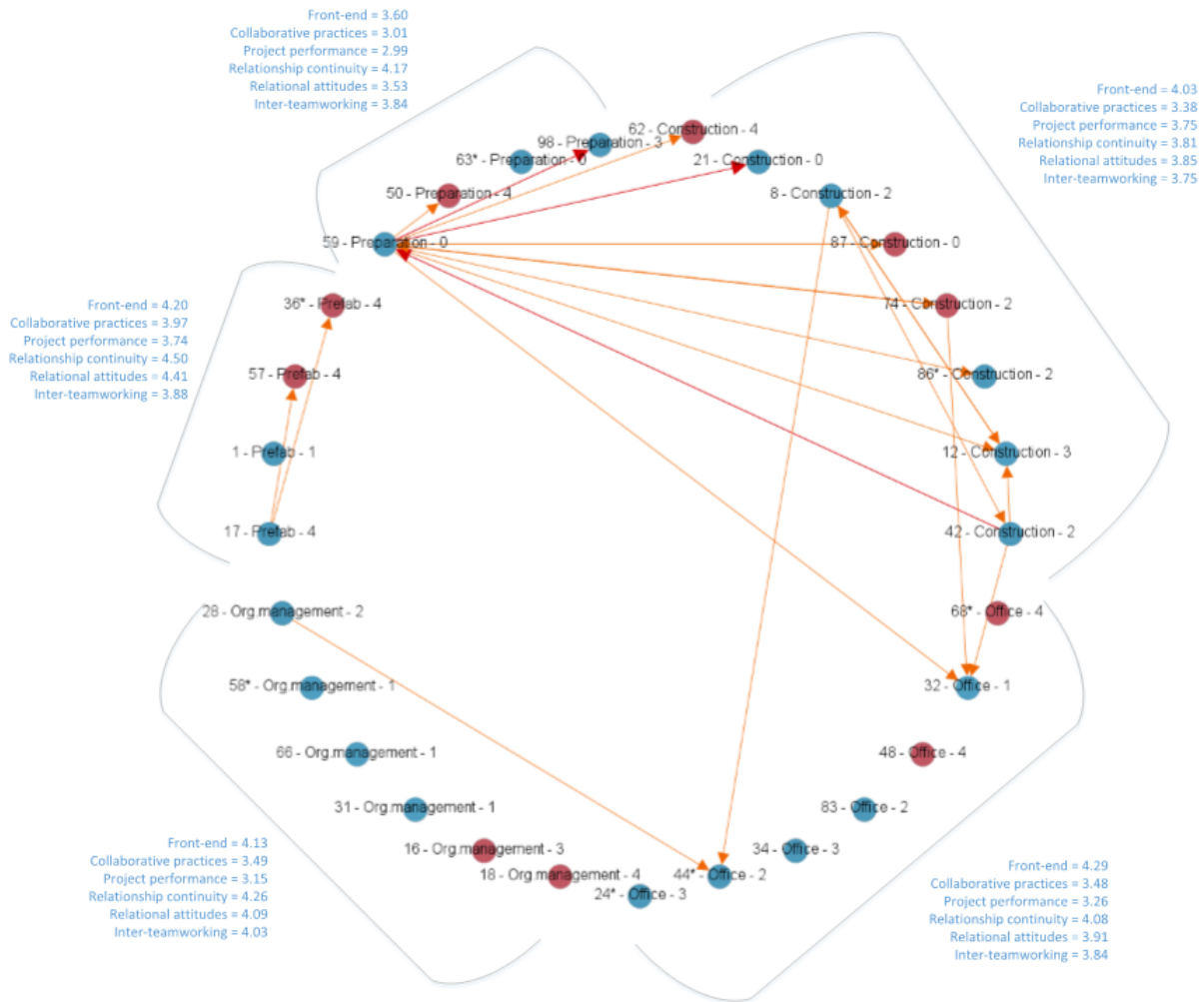


Figure 55: Combination of RECAP individual scores with SNA's relations with low effectiveness

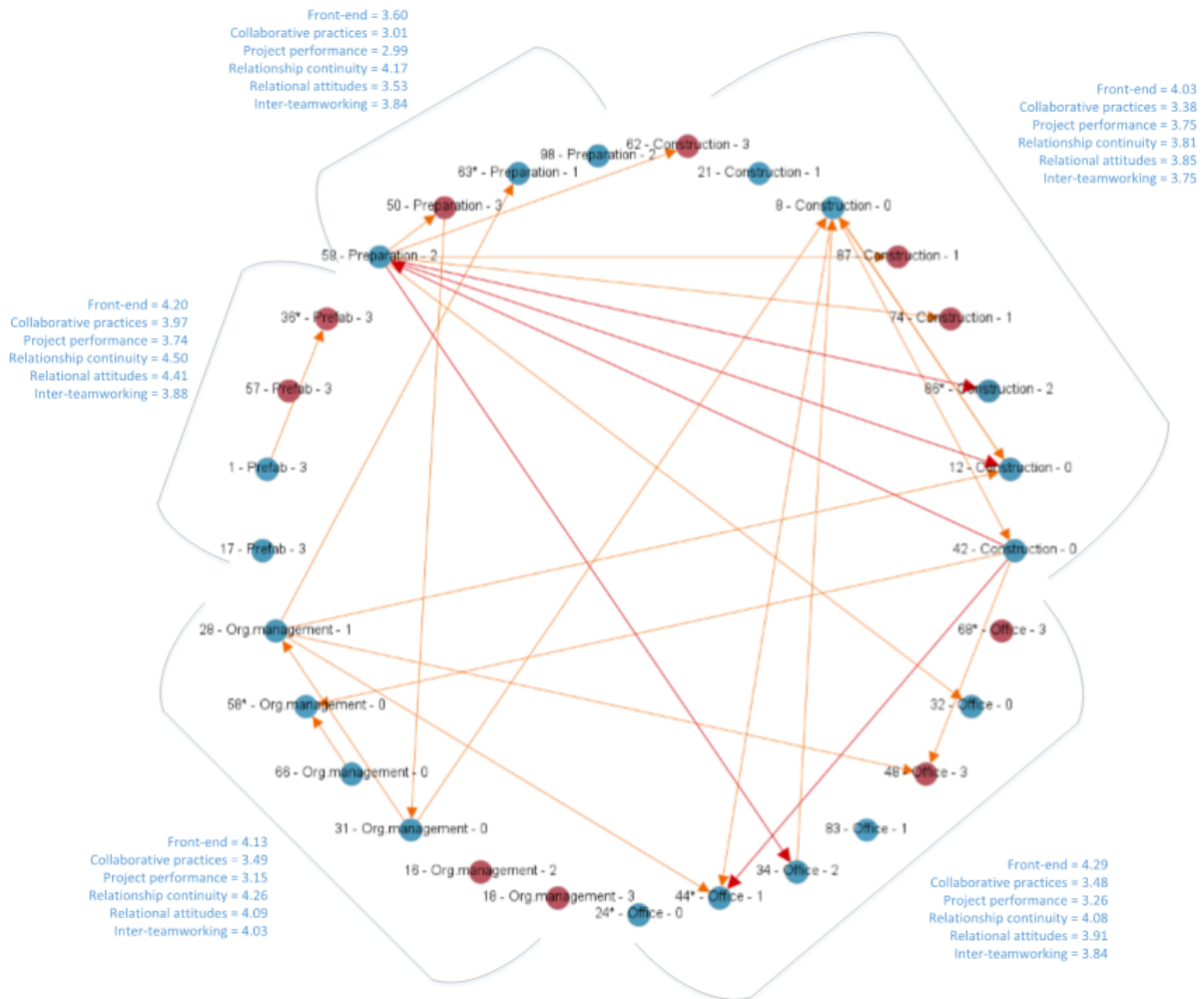


Figure 56: Combination of RECAP individual scores with SNA's de-energizing relations