Navigating the Path to Success

Harnessing Shared Leadership Behaviors for Increasing Team Effectiveness

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by

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Preface

Before you lies the master thesis ”Navigating the Path to Success: Harnessing Shared Leadership Behaviors for Increasing Team Effectiveness”. The thesis is about influences of shared leadership behaviors on team effectiveness in engineering design teams, in which I did an internship at Royal HaskoningDHV. The thesis has been written in order to fulfill the graduation requirements for the master program Construction Management and Engineering at the Delft University of Technology in Delft, the Netherlands. Conducting the research and writing this thesis started from January 2024 until June 2024.

My academic journey started with the bachelor's program in Civil Engineering which has a strong focus on hard engineering and calculations. However, throughout my studies I noticed that something was missing in this curriculum that held me back from my academic pursuit. This feeling of uncertainty resulted in a gradual shift from hard engineering to drawing my attention to a more holistic view of the AEC industry. Eventually, after successfully completing the bachelor's program, I discovered the master's program in Construction Management and Engineering that offered a curriculum with a blend of knowledge from architecture, technology and policy management, and civil engineering which appealed to me. The motivation for this research area stemmed from my curiosity about the soft side of project management, in particular leadership. The courses Project Management and Leadership & Strategic Management offered in this curriculum further piqued my interest in which the latter inspired me to write my graduation thesis about this topic.

I want to express my gratitude to my thesis supervisors Dr. Jelle Koolwijk and Dr. Clarine van Oel for their expertise and exceptional guidance and support during the entire process of writing this master thesis. I also would like to thank my supervisor Niek Grobben from Royal HaskoningDHV for his contribution to the collection of data and information for this study, as well as guidance and support with his practical experience throughout the research on the two construction projects.

I would like to thank all members of the engineering design teams and individuals involved in the construction projects for their participation in this study. Your involvement as an observation group and interviewees contributed to the finalization of this research study.

Finally, I wish to express my appreciation and gratitude towards my family for their unwavering support throughout this entire journey.

C.D. (Duc) Bui
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Executive Summary

This graduation project sets out to explore shared leadership behaviors of team members in Dutch project design teams, to promote a comprehensive understanding how it influences and enhances team effectiveness. Specifically, the purpose of this study is to provide insights into shared leadership and team effectiveness of two case studies, namely the 50/10kV main station and 150/20kV main station. The research objectives are: 1) to get acquainted with team members; 2) to identify leaders and their leadership behaviors; 3) to measure team effectiveness of team members and; 4) to identify patterns, commonalities and differences between the two cases. Subsequently, this study aims to answer what effects do shared leadership behaviors have on team effectiveness in Project-Based Cross-Functional Design Teams under different project-delivery methods in the Dutch construction industry? This is organized into two sub-questions that aims to answer what leadership behaviors can be recognized and how does it contribute to the development of team functioning in Project-Based Cross-Functional Design Teams; and how does team effectiveness of a Project-Based Cross-Functional Design Team with a Bouwteam project-delivery method compare to an integrated project-delivery method?

This study adopted the mixed methods approach, with a comparative case study as the research strategy. The sample of the study consisted of 16 team members from various disciplines across two cases with nearly identical team members. Data was collected through a context analysis, participatory observations, semi-structured interviews with various experts from the teams, and in-person questionnaires. Qualitative data was analyzed by coding and annotating audio transcripts of the observations, while semi-structured interviews served to getting acquainted with the team members. Quantitative data was analyzed by calculating the baseline scores, average team effectiveness scores, standard deviations, and individual difference team effectiveness scores. Subsequently, qualitative and quantitative data were integrated into a diagram and analyzed again for more inclusive findings.

The study's first main finding revealed that every task-focused and person-focused leadership behavior was exhibited and that they can be exhibited individually or in various combinations in both project teams. This indicated that there is no one-size-fits-all leadership behavior, probably because of open communication and steering of other team members, which allowed for discussion of various topics besides the agenda topics, resulting in highly dynamic interactions. Initiating structure and boundary spanning were the most prominent task-focused behaviors, while consideration and empowerment were the most prominent person-focused behaviors. Occurrence of task-focused behaviors indicated high perception of value for task and goal achievement, likely due to the team being project-based that strongly emphasized taking into account important stakeholders and adherence to the contents, scheduling and planning. Occurrence of person-focused behaviors indicated drawing attention to facilitating interactions and prioritizing development and needs of team members.

Moreover, the findings revealed the presence of situational leadership in both teams. It emerged from the data that the project leader and architect adjusted their leadership behaviors according to their role and the roles of the team members. This is an important finding as it shows the ability of the individuals to adapt their leadership behaviors by prioritizing, steering and meeting the needs of the team, that is consistent with the result of Jon (2019), in which the author found adaptation of leadership behaviors in engineering design teams in accordance with the situation at hand.

The study's second main finding suggested that high exhibition of leadership behaviors, especially person-focused behaviors during milestones, was associated with higher team effectiveness. Milestones were unveiled as critical moments that had a substantial impact on exhibited leadership behaviors and team effectiveness. The notable increase in person-focused behaviors seemed to indicate that a milestone provided space for meeting the needs of team members and to discuss how to proceed in the next phase. This also seemed to suggest that reaching a milestone allowed for reflection not only about the deliverables (task-focused), but also about team processes (person-focused), in particular

recognition of what the team had achieved, which contributed to enhancing team effectiveness. This finding is an extension on Wu and Cormican (2021) that conducted quantitative research on shared leadership and team effectiveness, but did not take into account cross-functional communication and coordination, which was the essence in this study.

An unexpected but interesting finding suggested that team composition -more than the project-delivery method- moderates the relationship between shared leadership and team effectiveness, likely due to not all project phases being observed amongst others. This means that the relationship between exhibited leadership behaviors and team effectiveness would differ between the presence and absence of team members. Case 1 - 50/10kV indicated fluctuating team dynamics, likely due to the frequent absence of various team members across meetings, which was in agreement with Jon (2019), who found that constantly varying presence across meetings made it challenging for comparisons between observation and between cases. Case 2 - 150/20kV on the other hand, had a more consistent team composition. This novel finding contributes to addressing the research gaps identified by Mathieu et al. (2008), that there is scant research on dynamic team composition and studies that mention dynamic team composition as a result of individuals moving on and off teams during projects, and individuals being part of multiple teams simultaneously. Therefore, two hypotheses are formulated that deserve further research, specifically suggesting that: 1) team composition moderates the relationship between shared leadership and team effectiveness in Project-Based Cross-Functional Design Teams; and 2) team composition in Project-Based Cross-Functional Design Teams are project phase-dependent.

This research adds to the body of knowledge about the role of shared leadership behaviors in enhancing team effectiveness in Project-Based Cross-Functional Design Teams (Daspit et al., 2013; Edmondson & Lei, 2014; Koolwijk et al., 2020) and extends the findings of the works by Syed (2017), Jon (2019), and Wu and Cormican (2021) by conducting mixed methods research to leverage the strengths of each method for more inclusive findings, as many studies did not integrate qualitative and quantitative data (Guetterman et al., 2015). It underscores the need to incorporate cross-functional communication, coordination, and the longitudinal approach.

The findings reinforce the recommendation that team members need to be instructed in task- and person-focused behaviors and adopting situational leadership to enhance team effectiveness. This study might contribute to developing new approaches in leader training. The second recommendation is that all team members need to contribute to facilitating presence and team coordination to avoid frequent absence. Moreover, it is recommended to carefully consider which parties to involve early.

The limitations of the study were the subjectivity that was partly mitigated by taking into account Guba's Four Criteria to attain trustworthiness in this study, which can be improved by adopting objective measures and other strategies mentioned by Shenton (2004). The second limitation is constrained time span preventing observation of the project-delivery method influences, in which a follow-up study of the two cases would be interesting. The third limitation is generalizability as the study was industry and team-specific, that can be addressed by conducting multi-site studies to assess the generalizability of the findings in this study across various sectors and types of teams.

In conclusion, this study provided valuable insights into the importance of shared leadership on team effectiveness in engineering design teams in the Dutch construction sector and has shown how various task-focused and person-focused leadership behaviors manifest in practice and how they can shape team effectiveness through time. The findings strengthen the idea that person-focused behaviors are equally important, if not, more important than task-focused behaviors in enhancing team effectiveness in Project-Based Cross-Functional Design Teams. Emphasizing person-focused behaviors should be beneficial to increasing overall performance, satisfaction and quality effectiveness. However, the 50/10kV team was facing challenges with presence and team coordination, which must be resolved first. All team members can contribute to addressing this challenge, which promotes cohesion, satisfaction and improved team work. Ultimately, the findings are valuable for Project-Based Cross-Functional Design Teams and organizations involved with the two cases in enhancing team effectiveness.

Contents

List of Abbreviations

A/E firm Architectural/Engineering firm. 10

DBB Design-Bid-Build. 8

IMO Input-Mediator-Outcome. ix, 11, 13, 108

IPO Input-Process-Outcome. ix, 10, 11

KSA knowledge, skills, and abilities. 12, 109

PBCFDT Project-Based Cross-Functional Design Team. iv, v, 2–4, 7, 10, 15, 93, 100, 106–111

PT-Ratio Person Task-Ratio. 20, 101, 103–106

TNR 2011 The New Rules 2011. ix, 9, 24, 60

UAC 2012 Uniform Administrative Conditions for the Execution of Works and Technical Installation Works 2012. ix, 9, 24

UAC-IC 2005 Uniform Administrative Conditions for Integrated Contracts 2005. ix, 9, 10, 59, 60

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1
Introduction

1.1. Background and Context

In the preceding years, a trend is observed in the construction industry in which projects are swiftly growing not only in size, but in complexity as well (Luo et al., 2017). Construction projects can range from simple small-scale projects to mega construction projects that are inherently complex (Chan et al., 2004). A meta-analysis article by Zhi-Bin et al. (2023) found that complexity of projects poses a significant challenge to project success, and negatively affects project quality, project performance, project schedule and project cost. Moreover, increasing project complexity contributes to project delays and cost overruns. The authors have established the multidimensional nature of project complexity, in which project complexity can arise from factors such as technical complexity, organizational complexity and environmental complexity. In addition to that, rapid changes in the environment, complexity of deliverables and rising time pressure are also factors contributing to increasing complexity of projects (Williams, 1999).

Cross-functional teams are commonly arranged for these types of complex projects to facilitate comprehensive problem-solving and decision-making (Daspit et al., 2013). Increasingly complex projects require individuals from different fields of expertise with specialized skills and knowledge to work closely together in cross-functional teams with the purpose of leveraging different knowledge domains, perspectives and capabilities to address multifaceted problems. This necessity and leadership, a critical success factor in project management, have a growing impact on project outcomes (Edmondson & Lei, 2014; Nixon et al., 2012). Shared leadership in particular plays a pivotal role in cross-functional teams as it influences team effectiveness and therefore can address organizational complexity, which encompasses decision-making, coordination of activities and dynamics between team members (Daspit et al., 2013).

The relationship between leadership and team effectiveness is a challenging area of research, but studies by Pearce and Sims (2002) and Ensley et al. (2006) show that shared leadership has a greater impact on team effectiveness compared to traditional leadership. Traditional top-down management with only downwards influence is no longer adequate to effectively respond and adapt to rapidly changing conditions and project complexity (Remington & Pollack, 2007). In recent years the concept of shared leadership has gained increasing attention from researchers and has been associated with various benefits for team effectiveness (Wu & Cormican, 2021). The pivotal role of shared leadership has been supported by recent empirical studies by Nicolaides et al. (2014) and Sousa and Van Dierendonck (2016) amongst others. Moreover, a study by Katzenbach and Smith (1993) demonstrated that teams practicing shared leadership had a higher team performance.

1.2. Problem Statement and Research Gaps

Although there are extensive research studies and contributions to the literature of shared leadership and team effectiveness, our understanding of the influences of shared leadership behaviors on team effectiveness is still limited, and little qualitative and mixed methods research have been conducted on shared leadership and cross-functional engineering design teams operating under various project-delivery methods. These limitations are represented by three research gaps.

First, Wu and Cormican (2021) have demonstrated the positive relationship between shared leadership and team effectiveness through a quantitative method. Qualitative approaches such as interviews and questionnaires have been frequently used, and the social network approach has been widely applied in shared leadership studies to quantify the degree of shared leadership (Wu & Cormican, 2021). However, a literature review shows that research into shared leadership behaviors and team effectiveness of an engineering design team through an ethnographic study is still limited aside from the works by Syed (2017) and Jon (2019), and a study by Kramer (2006) that conducted research on shared leadership in a community theater group. Although network density can give the degree of shared leadership, there are limitations to the study by Wu and Cormican (2021) that can be better addressed through ethnographies. The first limitation is that team environments such as cross-functional communication and coordination were not directly examined that could simulate the dynamics of shared leadership. The second limitation is that their research was not longitudinally oriented, which neglected aspects of iterations and cyclic feedback loops. Lastly, qualitative research approach concerns interpretation of data, which is however subject to bias. Quantitative research approach on the contrary involves numerical data that may lack contextual understanding of individual experiences and perspectives. Thus, it is aimed to address this theoretical gap and methodological gap by combining qualitative and quantitative approaches into a mixed methods research to leverage the strengths of each method for more inclusive findings.

Second, even though increasing interest has drawn attention to shared leadership, according to Scott-Young et al. (2019) exploration of engineering design teams are still limited and understudied compared to top management teams, entrepreneurial teams and consulting teams. Nowadays, the work environment becomes more project-focused in the construction industry, nonetheless studies focusing on engineering design teams still remain deficient. An engineering design team is defined as a Project-Based Cross-Functional Design Team (PBCFDT) according to Koolwijk et al. (2020). Important characteristics of a PBCFDT are interdependence, coordination, information exchange and integration which proves to be a challenge for team collaboration because of diversity in expertise (Shen et al., 2018). Therefore, shared leadership is particularly important in a PBCFDT because of the emphasis on dynamic interactive distributed influences among team members, that allows for decentralized decision-making, promotes collaboration and creative problem-solving, and facilitates leveraging knowledge from different expertise (Pearce & Conger, 2003). Additionally, research by Wu and Cormican (2021) only focused on engineering design teams in China. As a result, this research study aims to address the contextual gap by exploring two PBCFDTs based in the Netherlands.

Third, there is a growing attention and body of literature exploring the concept of team functioning in the construction industry, however a literature review shows that there is scant research on team functioning in Project-Based Cross-Functional Design Teams aside from the work by Syed (2017) and Jon (2019). The authors both implemented the concept of team functioning into participants observations. There was a focus on determining team functioning through observing team member's behaviors, actions and meeting topics. Determining team functioning only by observations and through the perceptions of the researcher that conducts the observations introduces limitations of subjectivity and bias as well as a lack of contextual understanding of participant's perspectives in relation to team functioning. In order to address these shortcomings, this study aimed to gain more comprehensive insights into team functioning in PBCFDTs through the perspective of participants.

Lastly, a PBCFDT operates according to various project-delivery methods which is legally binding through contracts to deliver a construction project (Koolwijk et al., 2018). However, each project-delivery method has a different approach to organizing and executing a project and must be formalized with a different contract that each has its unique involvement, responsibilities, liabilities and other agreements resulting in changing dynamics and relationships between parties and between team members. While project-delivery methods and contracts are different concepts, they are interrelated aspects in project management. The choice for a specific project-delivery method may be dictated by the type of contract. Literature review has shown that there is scant research focusing on the influences of different project-delivery methods on shared leadership.

Collectively, this study aims to explore and to develop theories on how shared leadership unfolds in practice and to deepen the understanding of its relationship with team effectiveness in Project-Based Cross-Functional Design Teams based in the Netherlands by observing the actual dynamics and how this develops through time and differs depending on the organizational and team context. Subsequently, the objectives of the study are: 1) to get acquainted with the team members; 2) to identify leaders and their leadership behaviors; 3) to measure team effectiveness perception of team members; and 4) to identify patterns, commonalities and differences between two project cases.

This research is a comparative case study that looks into two PBCFDTs. The teams are involved with two similar main station projects from the Masterplan Powergrid 2060 as initiatives to respond to the climate goals and future electricity demand. The teams consist of nearly identical team members in which the 50/10kV team operates under a Bouwteam and the 150/20kV team under an integrated project-delivery method. The principal research method is ethnography to observe behaviors, steering and communication during meetings. Prior to this, a contextual analysis is done that gives an overview of the case studies about organizational and team context. Semi-structured interviews are done to collect data how participants describe their own leadership behaviors and their experiences and perceptions regarding team functioning. To measure team effectiveness, a baseline score is established and at the end of each meeting, participants are requested to fill in a questionnaire about their team effectiveness perception up till that moment based on interactions and activities during and outside the meeting.

1.3. Research Questions

The shift from the traditional top-down to bottom-up management has a significant impact on the role of the project leader and presents the question how shared leadership behaviors influence the dynamics in PBCFDTs that affect team effectiveness and how that differs between teams operating under different project-delivery methods. In summary, there is a need for exploring the influences of shared leadership behaviors on team effectiveness with project-delivery method differences. More specifically, the following research questions need to be addressed:

Main Research Question:
What effects do shared leadership behaviors have on team effectiveness in Project-Based Cross-Functional Design Teams under different project-delivery methods in the Dutch construction industry?

Research Sub-questions:

1. What leadership behaviors can be recognized and how does it contribute to the development of team functioning in Project-Based Cross-Functional Design Teams?
2. How does team effectiveness of a Project-Based Cross-Functional Design Team with a Bouwteam project-delivery method compare to an integrated project-delivery method?

By doing so, this research study makes the following contributions: 1) it enriches our understanding on the relationship between shared leadership and team effectiveness while adding to the leadership and project management literature; 2) it serves as a suggestive guide for project managers, project leaders, and team members to improving best practices to enhance team effectiveness; and 3) it provides a more inclusive examination of shared leadership behaviors and team effectiveness by means of an ethnography.

2
Literature Review

This chapter will draw the relevant key concepts and theories from the literature on the topics of shared leadership, leadership behaviors, Project-Based Cross-Functional Design Teams, leaders versus followers, project-delivery methods and contracts, and team effectiveness, that form the conceptual framework which serves as the structure for the research study.

2.1. Shared Leadership

Traditional top-down leadership has been developed over the years to aid project managers to achieve organizational goals and objectives (Yang et al., 2011). Nevertheless, over the years the concept of shared leadership has gained increasing attention and researchers have grasped the pivotal role and its association with various benefits for team effectiveness (Wu & Cormican, 2021), team and individual learning (Liu et al., 2014), and autonomy and satisfaction (Robert & You, 2017). D'Innocenzo et al. (2016) describe this leadership as when two or more members of a working team assume leadership roles and assert influence, while Bergman et al. (2012) and Pearce (2004) define shared leadership as when two or more individuals engage in the leadership of the team to influence the members to maximize team effectiveness. Additionally, Syed (2017) has formulated a new definition based on the author's thesis findings which defines shared leadership as multiple dynamic leadership behaviors to maximize team effectiveness. Recent empirical studies by Nicolaides et al. (2014) and Sousa and Van Dierendonck (2016) amongst others demonstrated the importance of shared leadership and a study by Katzenbach and Smith (1993) showed that teams practicing shared leadership had a higher team performance. As opposed to the static nature of traditional top-down leadership, shared leadership is characterized by dynamic processes in which temporal dimensions play a significant role (Wang et al., 2014). This is further supported by Pearce and Conger (2003) whereby the authors describe the dynamic interactive influences distributed among team members that facilitate decentralized decision-making, promote collaboration and creative problem-solving, and allow for leveraging different knowledge domains.

2.2. Leadership Behaviors

Fleishman et al. (1991) identified 65 classification systems of leadership behaviors and concluded that these behaviors can be distinguished into task-focused behaviors and person-focused behaviors. Person-focused behaviors are especially important to ensure team effectiveness (Fiore et al., 2010). According to Salas et al. (1992), task-focused behaviors on the one hand emphasize collecting task information and understanding task requirement and operating procedures. On the other hand, person-focused behaviors draw attention to facilitating behavioral interactions, cognitive structures and attitudes in order to achieve team efficiency. Within these two categories of leadership behaviors, a set of sub-behaviors can be derived (Burke et al., 2006):

Task-focused behaviors:

- Transactional;
- Initiating structure;
- Boundary spanning.

Person-focused behaviors:

- Transformational;
- Consideration;
- Empowerment;
- Motivation.

2.2.1. Transactional

This type of leadership behavior has a focus on task accomplishment, reward contingencies and exchange relationships (Burke et al., 2006). The three main characteristics of this leadership behavior are contingent reward, active management by exception and passive management by exception. Contingent reward relates to rewarding an individual for their performance and task accomplishments. Active management by exception is a characteristic in which leaders engage in actively controlling and monitoring activities and outcomes. Passive management by exception on the other hand is a more reactive approach in which leaders only intervene and take corrective actions in case errors or issues occur.

2.2.2. Initiating structure

Similar to transactional behavior, initiating structure has a strong focus on task accomplishment. Additionally, the purpose of this behavior is to achieve increasing efficiency and coordination of team members (Bergman et al., 2012). Leaders that exhibit initiating structure behavior are focused on minimizing role ambiguity and conflict. They are structured, purpose-oriented with the goal of ensuring that members have a clear sense of direction and are fully aware what is expected from them (Burke et al., 2006). This is in line with the definition of initiating structure by Fleishman and Harris (1962) that describe behaviors of establishing structured ways of task accomplishment while adhering to performance standards, and imposing clear expectations of the team members. Pearce et al. (2003) have indicated that initiating structure comprises of two dimensions: director behaviors and autocratic behaviors. The former encompasses initiating and overseeing activities, task assignment, clear communication, clear expectations of task accomplishment. The latter concerns making unilateral decisions, in other words making decisions without the agreement of team members (Schriesheim et al., 1976).

2.2.3. Boundary spanning

Boundary spanning helps breaking through the invisible barrier between the internal organization and the external stakeholders. It ensures functioning beyond internal organization by collaborating with external stakeholders and reality checks, which ensures that the needs of the internal and external parties are understood (Bergman et al., 2012). Additionally, it is of great importance that deliverables and decisions adhere to criteria and meet approval of the external parties. Behaviors indicative of boundary spanning are resource management, networking communication, scanning the environment, creating and maintaining situational awareness by acquiring resources and information for the team for effective problem-solving (Burke et al., 2006).

2.2.4. Transformational

Transformational leadership behavior is a balanced approach that facilitates complex problem-solving, while guiding, promoting and developing self-leadership capabilities to address future problems (Burke et al., 2006). This leadership behavior consists of four aspects (Abu-Mahfouz, 2023): 1) idealized influence; 2) inspirational motivation; 3) intellectual stimulation; and 4) individualized consideration. Idealized influence is described as the appeal and capability of a leader to be a role model, while guiding and prioritizing team member's needs and values. Moreover, the leader is purpose-driven and their charisma gives a sense of achievement. Inspirational motivation is about creating solidarity by promoting excitement and having an eloquent vision that appeals to the team members that motivate them to achieve common goals. With intellectual stimulation, team members are stimulated to challenge themselves, be more inventive and innovative in creative problem-solving. Lastly, individualized consideration involves acting as a coach and considering each individual's capabilities, needs, values and their level of maturity in order to guide them further and grow their potential (Bi et al., 2012; Piccolo & Colquitt, 2006).

2.2.5. Consideration

Consideration behavior is exhibited by leaders who are relations-oriented and focus on maintaining close relationships and group cohesion (Bergman et al., 2012). Generally, there is an emphasis on mutual respect and trust by developing and maintaining a team's socio-psychological functioning (Burke et al., 2006). This is exemplified by friendliness, support, respect and concern for team member's emotional states and welfare (Bergman et al., 2012). Consideration behavior allows creating a safe environment for satisfying team member's need through conflict resolving, encouragement and ensuring that opinions are all heard, interpreted and respected (Burke et al., 2006).

2.2.6. Empowerment

Empowerment behaviors are person-oriented and have a strong focus on development, specifically development of self-management and self-leadership skills (Pearce et al., 2003). Behaviors representative of empowerment are coaching, monitoring, providing feedback, participation, facilitation and consultation (Burke et al., 2006). The authors indicate that these behaviors are facilitated through the promotion of team learning and adaptation. Building upon the descriptions from Pearce et al. (2003) and Burke et al. (2006), another definition and description of empowerment behavior is presented by Blanchard (Nauman et al., 2010). The author describes empowerment as disregarding the conventional hierarchical structure which changes the role of the leader and gives team members more freedom, autonomy and authority to make decisions.

Sims et al. (2009) view leaders that display empowerment behavior as the ones that leads others to lead themselves. There is a strong emphasis on developing the self-leadership skills of team members that in turn will contribute to organizational goals and objectives, which is in line with the description by Pearce et al. (2003). The foundation of empowerment behavior is for the leader to guide through encouraging initiative, self-responsibility, self-confidence, self-goal setting, positive opportunity thinking and critical self-problem solving (Sims et al., 2009). As opposed to transactional behavior, the leader assumes a different role in which the leader transfers the initiative and responsibility to the team members by letting them take the reigns and promotes to being proactive.

2.2.7. Motivation

Motivation behavior is characterized by promoting individual effort through verbal encouragement, active consideration, and providing positive comment about one's capabilities and performance (Burke et al., 2006). Similar to transactional behavior, there is an element included of reward contingency and recognition of performance. However, the underlying purpose is about satisfying and facilitating the needs and core values of team members.

2.2.8. Summary of Leadership Behaviors

Table 2.1 is a summary of the task-focused and person-focused behavior categories with their corresponding leadership behaviors. The third column of the table contains the characteristics of each of the leadership behaviors and are described by their representative behaviors.

Table 2.1: Summary of leadership behaviors

Category	Leadership behaviors	Characteristics	Representative behaviors
Task-focused	Transactional	Active management Passive management Exchange relationships Reward contingencies	Actively controlling and monitoring activities and outcomes. Passive interventions and corrective actions.
	Initiating structure	Clarity Conflict minimization Coordination & Structure Directive Efficiency Purpose-oriented Role unambiguity	Clear communication. Coordination and structuring task accomplishment. Imposing clear directions and expectations. Initiating, overseeing, and organizing roles and tasks. Unilateral decision-making.
	Boundary spanning	Adherence to criteria External approval Monitoring & Networking Organizational transparency Reality check Resource management	Acquiring resources and information. Collaboration with external stakeholders. Scanning the environment and network communication. Understanding needs.
Person-focused	Transformational	Complex problem-solving Idealized influence Individualized consideration Inspirational motivation Intellectual stimulation	Being a charismatic and purpose-driven role model. Being a coach, while prioritizing capabilities, needs, values, level of maturity. Creating solidarity by promoting an eloquent vision for achieving a common goal. Stimulating to being inventive and innovative in creative problem-solving.
	Consideration	Active listening Conflict management Consensus-building Encouragement Facilitation Group cohesion Needs assessment Openness Team satisfaction	Facilitate discussion. Open communication. Providing constructive feedback. Showing support, respect, trust and empathy for emotional states. Understanding and responding.
	Empowerment	Developing Self-leadership skills Distributed autonomy and authority Guidance Proactivity Shared responsibility Team learning and adaptation	Coaching, monitoring, providing feedback, participation, facilitation, consultation. Encourage initiative, self-responsibility, self-confidence, self-goal setting, positive opportunity thinking, critical self-problem solving. Promoting proactive behavior. Sharing initiative and responsibility.
	Motivation	Facilitation of needs and core values Individual effort Recognition Reward contingencies	Express appreciation and recognition. Positive feedback about capabilities and performance. Public acknowledgement.

2.3. Project-Based Cross-Functional Design Teams

The construction industry is characterized by teams that are project-based. This type of team is referred to as a Project-Based Cross-Functional Design Team (PBCFDT) according to Koolwijk et al. (2020) which shall be referred to as engineering design team for convenience. The authors define a PBCFDT as a team that consists of highly specialized professionals from different functional fields of expertise to design a structure within a defined time frame. These individuals all have different backgrounds and come from specialized disciplines ranging from design, engineering and contracting to share their expertise and to collaborate (Briscoe & Dainty, 2005; Salas et al., 2000). Keyton (2017) describes collaboration as the interaction in which individuals or a team work together to achieve a common shared goal, activity or deliverable. However, working in a diverse cross-functional team presents the challenge of facilitating integration of different knowledge domains to co-generate a design solution (Lovelace et al., 2001). In order to practice successful collaboration, team members of a PBCFDT are required to adhere to cooperation, task-coordination and continuous information exchange (Shen et al., 2018).

2.4. Leaders versus Followers

A distinction between leaders and followers can be made in teams that exhibit leadership. A leader is generally described as an individual who influences others towards achieving a common goal (Avolio et al., 2009). However, the definition of a leader may vary depending on the theoretical perspective. A study by Zhang et al. (2012) defines proactive personality as an individual's tendency to act in order to influence their environment. Individuals with a high proactive personality, recognized as leaders, are characterized by taking actions, identifying opportunities, showing initiative, and persisting until meaningful changes take place with the purpose of improving the current situation. Subsequently, individuals with a low proactive personality, recognized as followers, do not change the status quo and tend to passively adapt to their environment while fulfilling their own tasks, failing to identify opportunities, showing little initiative, and not persisting. Table 2.2 summarizes the characteristics of a leader and follower.

Table 2.2: Characteristics of leaders and followers (Zhang et al., 2012)

Leader Proactive personality: An individual's tendency to act in order to influence their environment	Follower Reactive personality: An individual's tendency to passively adapt to their environment
Taking actions.	Fulfilling own tasks.
Identifying opportunities.	Failing to identify opportunities.
Showing initiative.	Showing little initiative.
Persisting until meaningful changes occur.	Not persisting for meaningful changes.
Improving status quo.	Not challenging status quo.

2.5. Project-Delivery Method and Contracts

Project-Delivery method and contracts are fundamentally different concepts but interrelated aspects in the field of project management within the construction industry. Each of these concepts represent various aspects of a construction project from initiation till completion and beyond. The main difference between these two concepts is that project-delivery method concerns the approach of organizing and executing the project, whereas contracts between involved parties dictate their relationship as well as the legal framework and obligations. This section describes the key characteristics of project-delivery methods and the contracts relevant for the two case studies.

2.5.1. Project-Delivery Method

Project-delivery method is the approach to organize, manage and execute a construction project from its initiation phase till completion phase (Koolwijk et al., 2018). Two of the most prevalent project-delivery methods are the traditional and integrated project-delivery method. The traditional project-delivery method is typically associated with the Design-Bid-Build (DBB) approach. This approach is characterized by its sequential process that is divided into a design phase and build/construction phase in which the selected contractor builds the project based on the complete design and specifications developed in the design phase.

A minor adjustment to the traditional project-delivery method is the early involvement of the contractor in the early project phases such as as the design and planning phases (Wondimu et al., 2016). This is often referred to as a Bouwteam. The rationale for this approach is to leverage the contractor's expertise that allows for better integration of construction knowledge into the design process that benefits the project in terms of identifying and addressing potential issues at the front-end of a project. Within this project setting, the scope and responsibilities of the contractor to effectively contribute to the project outcomes include: providing expertise, collaborating in design, risk management, constructability reviews, schedule management, and quality assurance.

An integrated project-delivery method on the other hand is focused on integrating the design and construction process in the early project stages. This approach is usually associated with the Design & Build approach in which the activities related to both the design and execution are allocated to one party, often the contractor.

2.5.2. Contracts

The delivery of a construction project can be accomplished through various forms of contracts. Project-delivery method and contracts are used interchangeably every so often. However, a contract is part of the project-delivery method and it defines the legal framework and obligations between involved parties in the project. Each of the contract forms are characterized by different interrelations between team members of an engineering design team (Koolwijk et al., 2020). According to Article 6:213 in the Dutch Civil Code, a contract is defined as: "an agreement in the meaning of this title is a multilateral juridical act whereby one or more parties enter into an obligation towards one or more other parties" (Wetboekplus, 2022). The main characteristic of a juridical act is that it is enforceable by law and an agreement is multilateral which means that one or more parties are required to agree (Chao-Duivis et al., 2013).

Additionally, with an obligation, one party is entitled to something from the other party that needs to comply which can be exemplified by a purchase or execution of activities. The commission contract (TNR 2011), the Building Contract (UAC 2012) and Integrated Contracts (UAC-IC 2005), relevant to the case studies, are widely applied and have become the standard in construction projects in the Netherlands (voor Bouwrecht, 2020).

The New Rules 2011

The New Rules 2011 (TNR 2011) are general conditions for an agreement and is defined by law as a commission contract between the client and a consultant, architect and/or consulting engineer (Chao-Duivis et al., 2013). In contrast to a contract of employment in which works lead to tangible deliverables and products, a service is provided to create intangible products in a commission contract. For the provision of a design, the client has contractual relationship with consultants, architect and consulting engineers, while the parties providing the design in turn have a functional relationship with the contractor. These relationships are referred to as the classic triangle in the literature that is characteristic to the traditional building process (Figure 2.1).

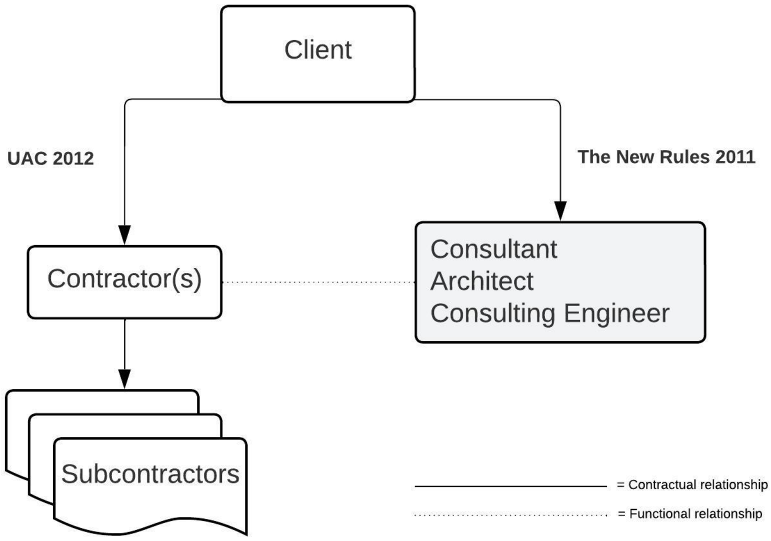

Figure 2.1: Schematic diagram of TNR 2011 and a UAC 2012 contract (Chao-Duivis et al., 2013)

UAC 2012

UAC 2012, officially known as Uniform Administrative Conditions for the Execution of Works and Technical Installation Works 2012 are based on the traditional relationship between a client and a contractor, which are general terms and conditions applied for building contracts (Chao-Duivis et al., 2013). The client and the contractor engage in a contractual relationship in which the contractor is in charge of only activities related to the execution of the construction project. For the design, the client engages in a contractual relationship with consultants, architects and consulting engineers. As a result of this relational structure, there are separate contracts between each involved participant and the client leading to the former to striving organizational interest, as shown in figure 2.1 (Pesek et al., 2019). Diverging goals and interests of each participant inhibits team collaboration and integration of activities and knowledge domains (Baiden & Price, 2011).

UAC-IC 2005

Another contractual approach in delivering construction projects is integrated contracts. Integrated contracts are officially referred to as Uniform Administrative Conditions for Integrated Contracts 2005 and are often better known as Design & Construct contracts (Figure 2.2). In contrast to UAC 2012, the client and the participant are engaged in an integrated relationship, and activities related to both design and execution are allocated to one party which can be a contractor, architectural/engineering (A/E firm) or any other involved party (Chao-Duivis et al., 2013). Even though these processes are in the hands of a contractor, it is possible to outsource the design and/or construction to an A/E firm and subcontractors in case the main contractor does not possess the necessary knowledge and expertise. However, the most common case is an integrated contract between the client and a design builder, in which the latter arranges a team of various design and execution experts jointly into a PBCFDT (Koolwijk et al., 2020). All participants are expected to collaborate closely with one another, to align and integrate activities and knowledge domains in order to develop a design and to execute the project (Jobidon et al., 2019).

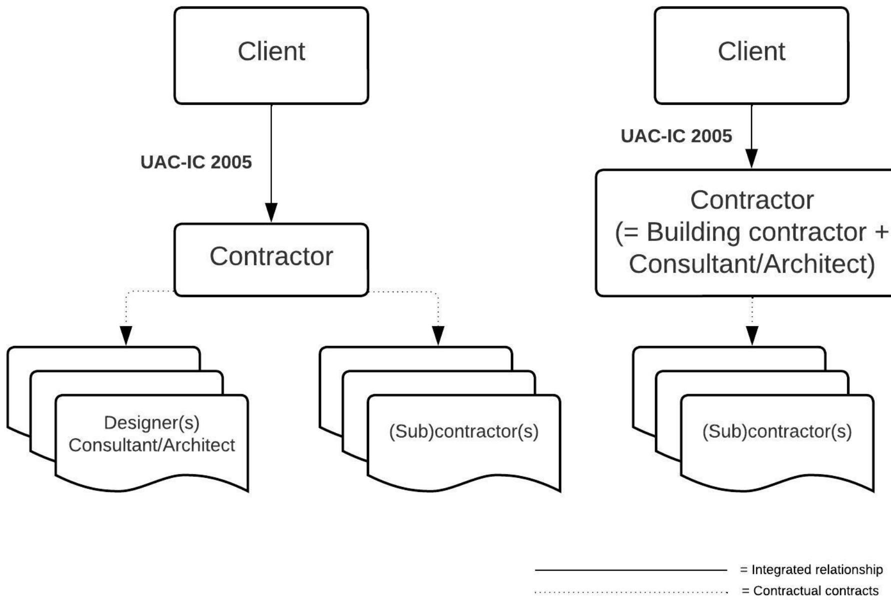

Figure 2.2: Schematic diagram of a UAC-IC 2005 contract (Chao-Duivis et al., 2013)

2.6. Input-Mediator-Outcome (IMO) Team Effectiveness Framework

A Team Effectiveness Framework was developed by McGrath in 1964 better known as the Input-Process-Outcome (IPO) framework to study team effectiveness (Figure 2.3). The inputs comprise of individual team member characteristics, team-level factors, and organizational and contextual factors (Mathieu et al., 2008). These inputs influence team processes which relate to interactions between team members with regard to task accomplishment and are often considered interdependent acts that result in outcomes. The outcomes include team performance affective reactions of the team members. Throughout the years, the proposed concept of IPO has been valuable in studying team effectiveness. Nevertheless, many researchers have discovered aspects that have been overlooked that resulted in limitations and shortcomings of the IPO framework. Cohen and Bailey (1997) have identified that the context and environmental factors play an important role as drivers of team inputs. This is exemplified by depicting that individuals are nested in teams and teams in turn are nested in an organization which is part of an environment. This is referred to as the multi-level models by Klein and Kozlowski (2000). Furthermore, it has been identified that IPO models fail to distinguish various processes and outcomes. Marks et al. (2001) differentiated between team processes that involves a member's action and other mediators such as cognitive, motivational or affective states. This was later referred to as emergent states that includes psychological safety, trust, cohesion and satisfaction (Bergman et al., 2012). Emergent states develop during team interactions and are variables that describe a team and shape the dynamics. Another aspect that the IPO models fail to address is the aspect of time which plays a significant role in team functioning.

Input-Process-Outcome (IPO) Team Effectiveness Framework

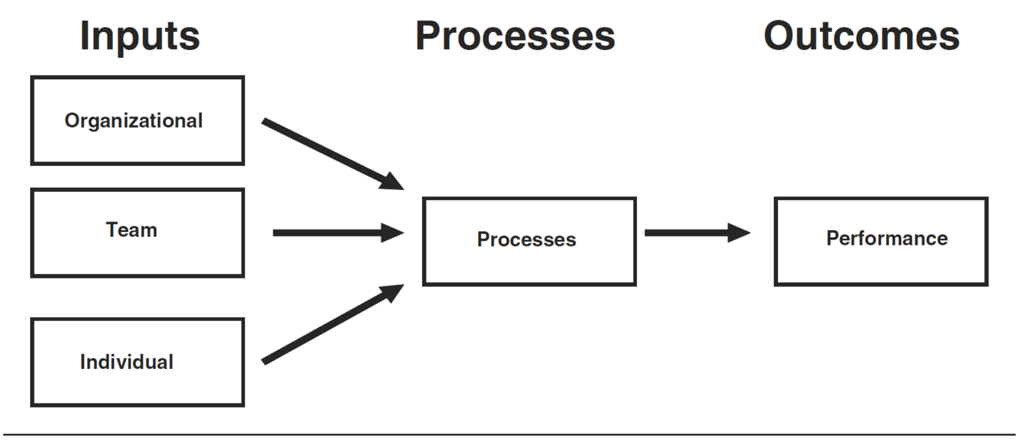

Figure 2.3: Input-Process-Outcome (IPO) Team Effectiveness Framework (Mathieu et al., 2008)

As a result, Ilgen et al. (2005) developed the IPO model into the Input-Mediator-Outcome (IMO) which is depicted in figure 2.4. Shared leadership and team effectiveness occur within a broader complex system in which various internal and external factors interact. Taking this into consideration in this study allows inclusion of other resulting factors to develop theories. The aspect of time is incorporated in the IMO model through the developmental model and episodic approach. The developmental model addresses the changes over time from the input-mediator phase (forming stage) through the mediator-outcome phase (functioning stage) as the team matures, while indicating influences from various factors (Kozlowsik et al., 1999). On the other hand, episodic approaches indicate that there is a feedback mechanism in a cyclical manner in which team members execute different processes at different times (McGrath, 1984). The solid lines from the outcomes back to the mediators suggest feedback of large significance, while the dashed lines from the mediators back to the input suggest feedback of low to moderate significance. The rationale for this statement is that the influences of mediators or outcomes are less likely to be immediate on members, team composition and organizational structure.

Input-Mediator-Outcome (IMO) Team Effectiveness Framework

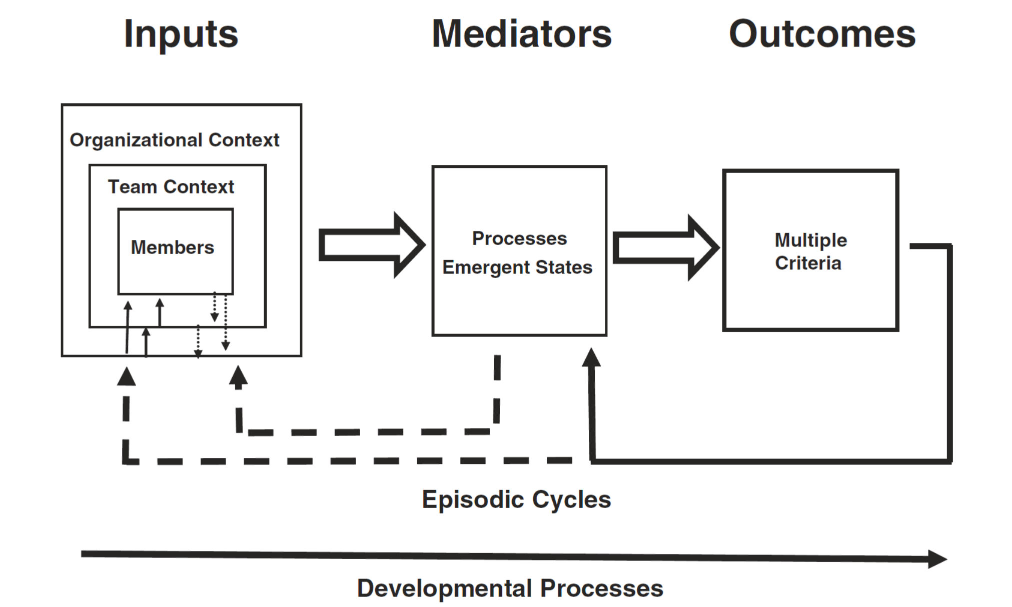

Figure 2.4: Input-Mediator-Outcome (IMO) Team Effectiveness Framework (Mathieu et al., 2008)

2.7. Team Effectiveness

In the literature, Team Effectiveness and Team Performance are at times used interchangeably to indicate the capacity of a team to accomplish its goals and objectives which leads to improved outcomes such as team member satisfaction and deliverables (Cooke & Hilton, 2015). Guzzo and Dickson (1996) describe that team effectiveness is indicated by team outputs, intra-group consequences and the capability to work effectively in the future. However, Cohen and Bailey (1997) proposed and distinguished between three fundamental dimensions of team effectiveness: 1) performance effectiveness; 2) attitudinal outcomes; and 3) behavioral outcomes. Depending on the organizational-, team-, or individual context, these dimensions may not be of equal significance. First, performance effectiveness are related to efficiency, productivity and quality. Second, attitudinal outcomes include team member satisfaction, commitment and trust. Third, behavioral outcomes encompasses communication and leadership behaviors. Team effectiveness outcomes are produced through team processes and emergent states that can be described as mediators or team functioning (Cooke & Hilton, 2015). These mediators and outcomes are also influenced by team composition, which are attributes of individual members of a team (Marks et al., 2001). The authors advocate taking a view on team composition as a complex mixture of individual attributes of team members that include knowledge, skills, and abilities (KSA), personality and other attributes such as goal- and teamwork orientation. Goal orientation encompasses the individual's approach to achieve certain tasks and activities, while teamwork orientation concerns an individual's tendency to work as a fellow team member in contrast to working individually. Besides, team composition is regarded as dynamic as team members can move on and off during different phases of the project. The dynamics are also influenced by individuals taking part in multiple teams and working on a variety of projects simultaneously (Mathieu et al., 2008).

2.7.1. Team Processes

Team processes are interactions between team members and are interdependent acts that create team effectiveness outcomes (Mathieu et al., 2008). Team processes can be categorized into cognitive-, affective-, and behavioral processes (Cooke & Hilton, 2015). The focus in this research is team behavioral processes for which Marks et al. (2001) developed a classification that concentrates on three sub-processes: 1) transition processes, which concerns planning and goal specification; 2) action processes, that entails communication and coordination; and 3) interpersonal processes, related to conflict management and consensus-building. The latter process is especially important for team effectiveness and has been a research topic in a study by Bergman et al. (2012). Intragroup conflict consists of socio-emotional conflict and task conflict. Socio-emotional conflict relates to incompatibilities between team members and is of high influence on productivity, satisfaction and decision-making. Task conflict involves disagreement about the task or activity and affects decision-quality and performance. The root cause of conflicts is associated with misperception by team members. In a team with individuals from different expertise, it is aimed to integrate different knowledge domains. Hence, individuals may perceive different ideas from others as personal criticism or rejection. Consensus-building is about coming to an agreement with regard to tasks and activities. This is especially important in engineering design teams with different expertise to co-generate a solution. The core of consensus-building is for all team members to reach a final decision that is in the best interest of the organization, in which all individual viewpoints have been considered and accepted by all.

2.7.2. Emergent States

Emergent states are regarded as an umbrella term for cognitive-, motivational-, and affective states, that are developed during team interactions and are variables describing a team altogether and an individual's feelings and attitudes (Marks et al., 2001). Moreover, emergent states shape the dynamics between team members. A study by Bergman et al. (2012) looked into emergent states such as, intragroup trust, cohesion and team member satisfaction. Trust is built through exhibiting behaviors to show an individual's trustworthiness and is facilitated by repeated interaction between team members. The established trust only strengthens further by showing one's willingness to share responsibility and power, and by signalling confidence in other's values, perspectives and opinions. Cohesion is the unity of a team throughout a project in which team members feel connected and work towards a common goal and is associated with interaction and socialization. Team member satisfaction relates to an individual's affective reactions to leadership, experiences with team members and team processes.

2.8. Conceptual Framework

Collectively, the key concepts, definitions and theories discussed in this chapter result in a conceptual framework that guides this research which is depicted in figure 2.5. The IMO model is adopted and serves as the core concept. The inputs on the left-hand side comprise of individual-, team- and organizational contextual factors that all influence one another. Individuals possess unique knowledge, expertise, individual characteristics and leadership behaviors. These individuals are nested in engineering design teams that are characterized by diversity, interdependence and expertise connection. The engineering design teams are in turn operating within an organization in which the organizational context is influenced by the project-delivery method. In this study on shared leadership and team effectiveness, the mediators are team behavioral processes and emergent states. The outcome is team effectiveness that is categorized into performance effectiveness, attitudinal outcomes and behavioral outcomes. Between the inputs, mediators and outcomes, there is a cyclic feedback loop that takes into account the temporal aspect.

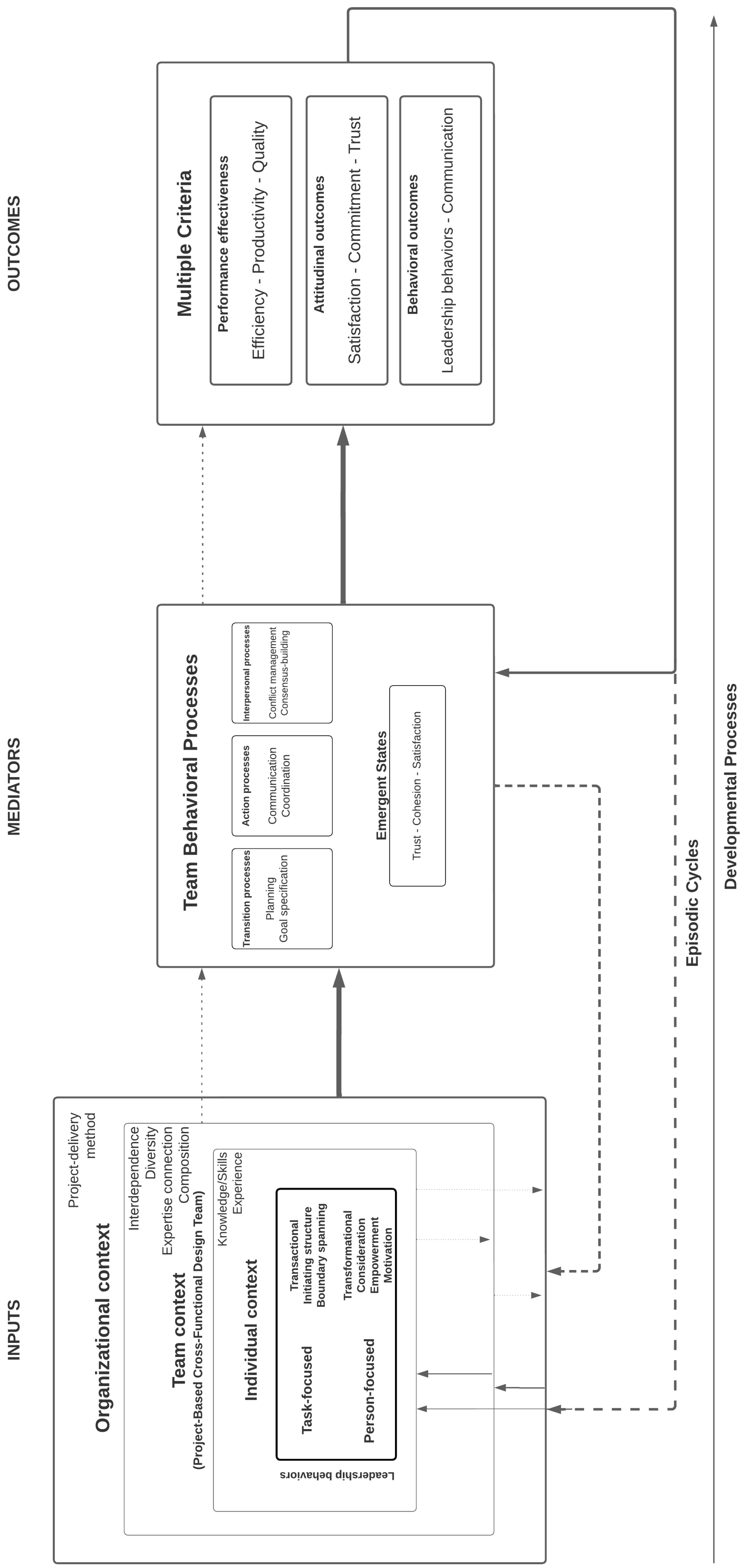

Figure 2.5: Conceptual Framework (Illustration by author)

3 Methodology

This chapter will begin by revisiting the research aim, the research question and its underlying research philosophy. The methodology, being the research approach, research design including sampling method, data collection methods and data analysis methods will then be discussed.

3.1. Research Aim and Approach

The study aimed to identify the effects of shared leadership behaviors on team effectiveness in two Project-Based Cross-Functional Design Teams in the Dutch construction sector, given that the Main Station Schiphol Center 50/10 kV project is being delivered through a Bouwteam and the Main Station Schiphol South-East 150/20 kV through an integrated project-delivery method. The objectives of this research were on the one hand to explore the concepts of shared leadership and team effectiveness, and on the other hand to clarify patterns and the relationship between shared leadership, team effectiveness and project-delivery method. Consequently, the research question guided the literature review and choices for the methodology, and was defined as:

What effects do shared leadership behaviors have on team effectiveness in Project-Based Cross-Functional Design Teams under different project-delivery methods in the Dutch construction industry?

3.1.1. Research Philosophy

For a researcher it is of great significance to determine the methodology of the research and the selection of the appropriate research methods (Alharahsheh & Pius, 2020). The focus of the study was to observe shared leadership behaviors and its resulting dynamics in cross-functional communication between team members and what effects it had on team effectiveness. Interpretivism integrates human interest in a study and has a strong emphasis on understanding and interpreting human behaviors through a subjective point of view (Dudovskiy, n.d.). The philosophy of interpretivism involves qualitative methods such as collecting data by means of textual analysis, interviews and observations to explore a phenomena. Therefore, the research philosophy that this study adopted was interpretivism that aligned with the research aim, research question, and literature review.

3.1.2. Mixed Methods Research

As noted earlier, the research objectives were to explore the concepts of shared leadership and team effectiveness, and to clarify patterns and the relationship between shared leadership and team effectiveness. The exploratory part of the study implied the use of qualitative research methods which involved collecting and analyzing non-numerical data and concerns understanding and interpreting a group's or individual's behavior, attitudes, experiences and interactions (Pathak et al., 2013). This approach is typically based on interviews, observations and analysis of textual data, which were relevant to this study. The explanatory part of the study implied the use of quantitative research methods which involved collecting and analyzing numerical data through questionnaires.

The research aim and question, and literature review suggested that qualitative and quantitative data individually will not provide a sufficient answer to the research question. A more complete deliverable was achieved through integration of qualitative and quantitative parts of the study (Guetterman et al., 2015). Methodologists have stressed the significance and advocated for the integration of qualitative and quantitative data in mixed method research studies. However, from a great number of reviews on published studies, it appeared that in mixed methods research there was no integration of qualitative and quantitative data. In this regard, the most appropriate approach for this study was mixed methods research without disregarding integration of qualitative and quantitative data. Mixed methods research is an approach that incorporates collecting and analyzing both qualitative and quantitative data and its integration within a research project. The intention of integration is to gain a more comprehensive understanding of the research problem and to leverage the strengths of each method while addressing their respective limitations.

As stated in the previous paragraph, the research study is partly qualitative which necessitated consideration of the four quality criterion proposed by Guba to attain a trustworthy study (Shenton, 2004):

1. Credibility: Is one of most important factors in establishing trustworthiness and concerns truthfulness and accuracy of a study;
2. Transferability: The extent to which findings can be utilized and applied to different contexts and settings;
3. Dependability: The extent to which the study with the exact same methodology can be used to repeat the study to obtain similar results;
4. Confirmability: Objectivity of the research findings.

The trustworthiness of the research study can be enhanced by adhering to these four quality criteria. For each of the quality criterion, strategies were employed. The four quality criteria and their respective employed strategies are summarized in table 3.1.

Table 3.1: Guba's Four Criteria and Strategies for Trustworthiness (Shenton, 2004)

Quality criterion	Strategies employed by researcher
Credibility	Adopt Established Research Methods
	Development of Early Familiarity with Culture of Participating Organisations
	Triangulation via Different Methods
	Ensure Honesty in Informants
	Debriefing Sessions with Supervisors
	Thick Description of Phenomenon under Scrutiny
Transferability	Provision of background data to establish context of study and detailed description of phenomenon in question to allow comparison to be made
Dependability	In-depth methodological description to allow study to be repeated
Confirmability	Triangulation to reduce effect of investigator bias
	Admission of researcher's beliefs and assumptions
	Recognition of shortcomings in study's methods and their potential effects
	In-depth methodological description to allow integrity of research results to be scrutinized

3.2. Research Design

On the basis of the research aim and question, research philosophy and research approach, a research design was composed to guide the research project throughout the phases by outlining the steps and procedures to be taken in order to address the research questions. Based on the mixed methods research approach, the study was set up as a basic convergent design, that concerns collection and analysis of both qualitative and quantitative data simultaneously, with thereafter analysis of the integrated data (Guetterman et al., 2015). Moreover, features of a comparative case study were added that turned the basic design into an advanced design. A case study design is a research strategy aimed to investigate a phenomenon in its real-life context (Yin, 2009). The rationale for a comparative case study design was to study two engineering design teams in detail in its natural setting rather than a controlled setting through observations, interviews and questionnaires. Moreover, it was aimed to study the engineering design teams under the conditions specific to their respective project-delivery method context to eventually identify patterns, commonalities and differences. Each of the engineering design teams worked on a unique, but similar construction project under a different project-delivery method. According to Yin (2017), a case study can be designed to be descriptive, exploratory and explanatory. An appropriate selection in alignment with the research aim and question was made for the comparative case study to be designed as both exploratory and explanatory. On the one hand, it was aimed to explore and gain insights into the concepts of shared leadership and team effectiveness in engineering design teams operating under different project-delivery methods as this topic is somewhat under researched and data collection is challenging. On the other hand, it was aimed enrich the current understanding and to clarify patterns and the relationship between shared leadership and team effectiveness by explaining why or how certain phenomena occur or do not occur (Yin, 2017).

3.2.1. Sampling Method

The underpinning of a solid case study is sampling as one is not able to study every individual at every place doing everything (Miles & Huberman, 1994). A sample was selected based on self-selection sampling which is a subcategory of non-probability sampling even though it is often not relevant in case studies. The rationale for this sampling method was because the study relied on the willingness of participants to take part in the research. The study conducted semi-structured interviews, questionnaires and observations that collected data from individuals in which consent is an absolute prerequisite. Therefore, an informed consent letter was handed out with all the relevant information such as the scope of the research study and explicit consent points. In order to adhere to the credibility criterion proposed by Shenton (2004), individuals were given the opportunity to willingly participate in the study and the right to withdraw at any moment in time without revealing any particular reason.

3.2.2. Case Selection

Case study selection for small samples is associated with challenges according to Gerring and McDermott (2007), in which it is a difficult task to identify a truly representative case, with variation on relevant dimensions regularly being overlooked. Cases have mostly been selected from practical considerations without the methodological justification. Therefore, it is essential to consider purposeful case study selection. Seawright and Gerring (2008) proposed seven case selection procedures, each facilitating a different strategy appropriate for the type of research. Shared leadership is a concept that is inherently diverse in characteristics, hence the adoption of the diverse case selection technique proposed by Seawright and Gerring (2008). Diverse case involves cases in which the population of interest displays various characteristics, and the aim of this technique is to explore the diversity of experiences, perspectives, communication and coordination of the teams. The following key characteristics of the diverse case were considered for the selection of the two cases, which contributed to enhancing trustworthiness of a qualitative study that was in alignment with Guba's Four Criteria (Shenton, 2004):

1. Variability: Regarding characteristics and contexts. This allowed for identifying patterns, commonalities and differences and contributed to comprehensive understanding;

2. In-depth Exploration: Allowed for exploration of a wide range of aspects to uncover unique insights;

3. Comparative Analysis: Allowed for comparison between cases to identify patterns, similarities and differences that contributed to richer and more inclusive findings;

4. Enhanced Generalizability: Identifying various aspects allowed for the findings to be applied to different contexts and settings.

In the work of Syed (2017), the author adopted criteria for the selection of the cases, with additional criteria for this specific study:

- The cases must have similar project deliverables;
- The engineering design team should exist of various stakeholders (internal and external) with different backgrounds of expertise;
- The engineering design team must have a project leader;
- The project teams must consist of nearly identical team members;
- Each project must be operated under a different project-delivery method;
- A minimum of 4 to 6 team meetings must be observed.

With the diverse case selection technique and these criteria in mind, a selection was made for two cases with similar project deliverables, but designed and executed under a different project-delivery method. Case 1 is the 50/10kV Main Station Schiphol Center, operating under a Bouwteam project-delivery method and case 2 is the 150/20kV Main Station Schiphol South-East, operating under an integrated project-delivery method. The similarity of the two construction projects on various aspects allowed for enhanced comparison between engineering design teams operating with project-delivery method differences, while adhering to the research aim and question, and literature review. Table 3.2 shows the similarities in team composition of the team members that were willing to participate in the study.

Table 3.2: Team composition 50/10kV vs 150/20kV

	50/10kV Project	150/20kV Project
Advisor Electrical Engineering	X	
Architect	X	X
Assistant Project Manager	X	X
Custom Requirements Specifier	X	X
Lead Engineer Civil and Environment	X	X
Lead Engineer Demolition and Installation	X	
Lead Engineer Installation Technology	X	X
Lead Engineer Installation Technology 150kV		X
Lead Engineer Preparatory work	X	
Lead Engineer Structural/Building / Project Leader B*	X	X
Operational Installation Manager	X	
Project Leader	X	X
Project Manager	X	X
Project Manager C	X	
Structural Engineer	X	
System Integrator		X

*Same individual with different role in each project

3.2.3. Data Collection Methods

This research study utilized four different methods for the collection of qualitative and quantitative data across three months. Qualitative data was collected from a context analysis, semi-structured interviews and participatory observations, while quantitative data was collected from questionnaires. First, a context analysis was done prior to the research. Second, observations were done in which questionnaires were completed after every meeting. Third, semi-structured interviews were conducted parallel to the observations.

Context Analysis

The first method of data collection was through a context analysis. The purpose was to get familiar with the two cases and to gain a better understanding of the organizational- and team context. Moreover, familiarity with the organizational culture of the participants was developed (Shenton, 2004). The context analysis was structured as follows: 1) Project description, that gave a brief overview about the organizational context; 2) Organizational structure, that concerned team context and encompassed the involved team members and stakeholders and; 3) the project meeting structure, that related to the different types of meetings and its frequency.

Semi-structured Interviews

The second method was conducting semi-structured interviews that contributed to exploring the individual context by becoming acquainted with the team members. This was done by identifying their backgrounds, the perception of their role in steering, as well as their experiences of team processes, team collaboration and atmosphere (Appendix A). The interview questions were based on the leadership behaviors (Table 2.1) and a few questions were adopted from the interview protocol by Syed (2017).

Participatory Observations

The third method was ethnography or better known as participant observations in which the researcher immersed himself in the engineering design teams to be familiar with the project and the working culture and common practices (Shenton, 2004). The purpose of participant observations was to observe leaders and followers, and to document which team member initiates a particular topic and who subsequently responds to that, which is based on the definition of a leader and follower from table 2.2, as well as identifying exhibited leadership behaviors. For each of the cases, five observations were done during project team meetings. An adaptation of the observation checklist from a study by Jon (2019), originally developed by Wijnstra (2016), was used for conducting the participant observations (Appendix B.1). During the observations, verbal communication was audio-recorded and for each time stamp the individual that initiated a topic (leader) and the individual that responded to that (follower) were captured with the checklist. A leader is indicated with green and a follower is indicated with orange. Thereafter, the leadership behaviors of each team member were examined by analyzing and comparing the checklist with the audio recordings to determine the leaders and followers.

Questionnaires

The last method was a questionnaire to collect quantitative data in order to measure team effectiveness. Before the first observation, participants were requested to fill in the questionnaire on the basis of how they have experienced team effectiveness up to this moment (at that time) in order to establish a baseline score. At the end of each meeting, participants were requested to fill in a questionnaire about their perception of team effectiveness based on interactions and activities during the meeting and outside the meetings. Koolwijk et al. (2020) adopted a questionnaire which was developed and tested in several other studies to measure teamwork and team effectiveness (Appendix C). The questionnaire includes measures of no blame culture, teamwork, team effectiveness, and control variables goal clarity and attainability, team competences and relationship duration. Seven items adapted from Van Den Bossche et al. (2006) and Pearce and Sims (2002) were used to measure team effectiveness. From those seven items, five items were used to measure output, quality, and change effectiveness (Pearce & Sims, 2002). The remaining two items measured satisfaction of the team (Van Den Bossche et al., 2006). The same questionnaire with only the team effectiveness items was used for this research as it aligned with the literature review. Each item is scored between 1 to 4 with a lower score indicating higher team effectiveness.

3.2.4. Data Analysis Methods

Qualitative data collected from observations was analyzed with the aid of software ATLAS.ti. It is a qualitative research tool that assists researchers in coding and analyzing transcripts amongst others. The specific applications of ATLAS.ti relevant to this research were coding and annotation. This involved coding, annotating, categorizing and labelling the audio transcripts from the observations in order to identify patterns, commonalities and differences. Grounded upon the theories and key concepts from the literature review and the course of the two case studies, the following categories of codes were determined and used for the qualitative analysis with a complete summary in Appendix D.1:

- Roles: These codes were derived from the context analysis and semi-structured interviews
- Leadership behaviors: These codes concerned characteristics and representative behaviors of the relevant leadership behaviors (Table 2.1)
- Team processes: Originate from team effectiveness theory that include action processes, interpersonal processes, and transition processes
- Team Effectiveness questionnaire topics: These questionnaire topics were incorporated as individual codes
- Other codes: These codes were developed during the observation period as each meeting addressed different topics or had a different meeting structure.

Debriefing sessions with the thesis supervisors were organized to share the researchers analysis and interpretation of the collected data. This is in compliance with the quality criteria to enhance credibility of a research study (Shenton, 2004). Additionally, as this research study was facilitated by Royal HaskoningDHV as an internship, it was logical to have debriefing sessions with the internship supervisor to review the methodology, analysis and interpretations for feedback.

Qualitative analysis aimed to: 1) Determine which individuals were leaders or followers; 2) Identify leadership behaviors when steering the conversation and; 3) Identify patterns in how certain topics were communicated. Quantitative analysis was done to measure team effectiveness. For each meeting, the average score and standard deviation of the team effectiveness questionnaire were calculated across all team members. Individual averages and standard deviations were calculated as well as weekly differences by subtracting the scores of each meeting from the baseline scores to see the changes over time. Subsequently, the average score of each meeting was compared with one another and with the baseline score.

Qualitative and quantitative data were brought together in order to establish and clarify the relationship between shared leadership behaviors and team effectiveness. The use of visual joint displays facilitated integration and representation of qualitative and quantitative data in mixed method studies (Guetterman et al., 2015). The author indicates that joint displays are visual means that draws out new insights and inferences, which otherwise would be to a lesser extent if the researcher would analyze qualitative and quantitative results separately. To present the integrated analysis and to draw new insights and inferences , a side-by-side joint display was created that displayed exhibited leadership behaviors and its frequencies, the average team effectiveness scores per observation, and the Person Task-Ratio (PT-Ratio). This integration approach was based on a study by Shaw et al. (2013). After integration, the results of each case study were compared with each other to identify patterns, commonalities, and differences. Figure 3.1 summarizes the methodology for this research.

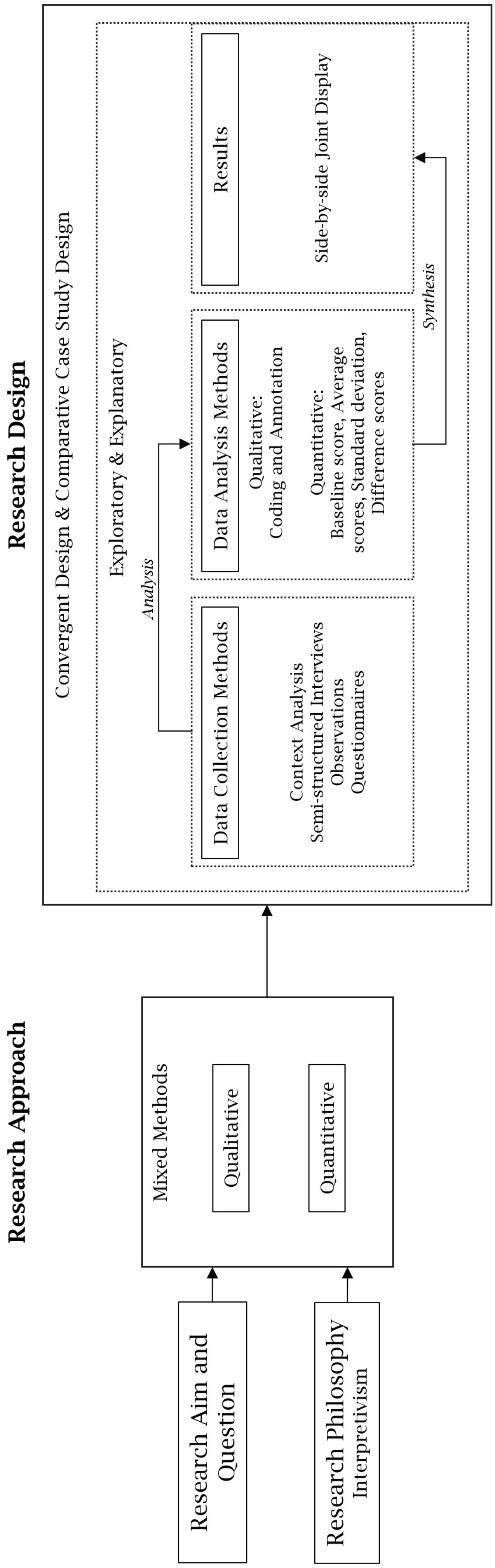

Figure 3.1: Summary of the methodology

3.3. Thesis Outline

Figure 3.2 depicts the thesis outline and summarizes the steps taken for this research study. Personal motivation and the works by Syed (2017) and Jon (2019) were the drivers for this research topic. Extensive literature review resulted in the problem statement and the relevant theories. On these bases, the methodology was designed for the two cases, including the research approach and design. The intended results of this research study were on the one hand contribution to the knowledge of shared leadership as it was partly explanatory. On exploratory spectrum, the research was intended to develop strategies and recommendations for project managers and project leaders in the construction industry to enhance team effectiveness.

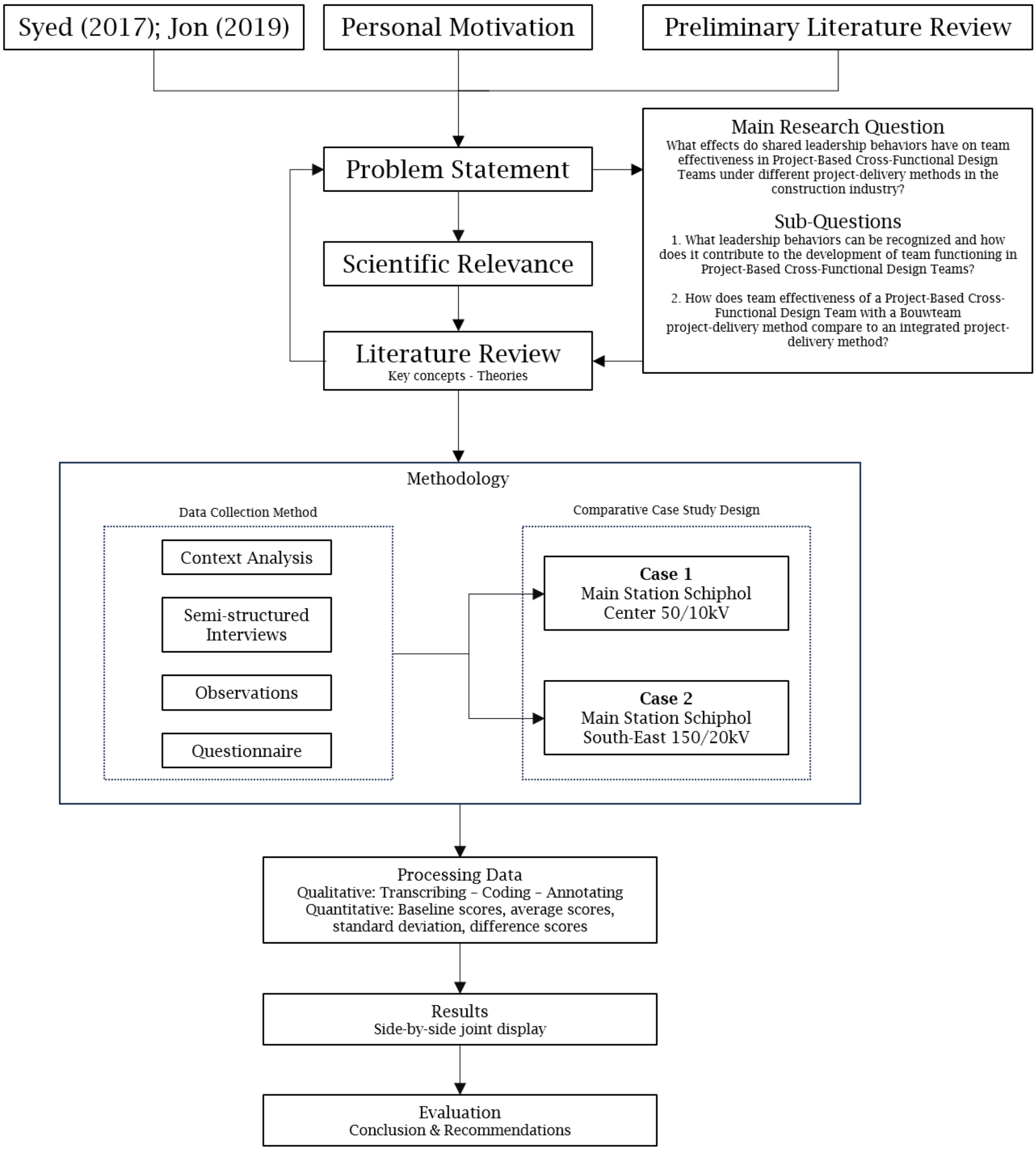

Figure 3.2: Thesis outline

4

Case 1 - Main Station Schiphol Center 50/10kV

This chapter will begin by introducing Case 1 - Main Station Schiphol Center 50/10kV, which entails the project overview, its context, organizational structure and project meeting structure. Thereafter, for each of the observations, general information and agenda topics are listed, a summary of the project meeting is reported, and an overview is given of the collected quantitative and qualitative data.

4.1. Project Overview

This section introduces case 1 by providing background and contextual information about the Main Station Schiphol Center 50/10kV project. Next, the organizational context of the project is described and presented through an organizational structure. Lastly, the structure of project meetings is given to indicate the different types of project meetings and its relevance for this research. All factual information regarding the project and its structure are provided by the Royal HaskoningDHV internship supervisor.

4.1.1. Project Description

The current 50/10kV high-voltage substation is approaching the end of its lifespan, which necessitates the construction of a new high-voltage substation at Schiphol Center, specifically located between Schiphol Boulevard and Westelijke Randweg ("Schiphol Tomorrow | New high-voltage substation at Schiphol", n.d.). In addition to the substation reaching the end of its lifespan, the current station is on the verge of reaching maximum capacity, while the energy demand at Schiphol is continuously growing due to electrification. Subsequently, Schiphol has set ambitions to have all of its buildings at the airport to be independent of gas by transitioning from the gas grid to electric equipment by the year 2030. These ambitions originate from the Paris Agreement and the Dutch climate goals to comply with the calls for a minimum reduction of 55% of greenhouse gas emissions by 2030 and to be climate-neutral by 2050, which entails net-zero greenhouse gas emissions (van Infrastructuur en Waterstaat, 2023).

During the summer of 2023, Schiphol and Liander signed a cooperation agreement for the construction and management of the new high-voltage substation, which is part of the Masterplan Power Grid (MPG) 2060, in order to meet the energy demand, and to guarantee the energy supply and increased grid capacity for the future. The high-voltage substation consists of a 50 kV station and a 10 kV station, of which the ownership belongs to the clients. The design of the substation is rather unconventional due its hill-like design and domed roof that will be green to blend in with the environment. The domed roof with green components in particular introduces complex problems and challenges that demands integration of different knowledge domains for innovative problem-solving.

In order for the design to be resilient to future changes, the clients requested for solutions that take into consideration potential future expansions of the 50 kV station and possibilities for the replacement of the station after the end of its lifespan. This entails that there is sufficient space to install additional 50 kV equipment next to the equipment that will be in operation in 2027. Moreover, the 10 kV station must comply with all sustainability requirements of Schiphol in relation to design, construction and lifespan. The sustainability requirements include energy efficiency and circular design.

After the preliminary design phase, it was decided to procure the 50/10kV project through the traditional process or better known as the UAC 2012 within a Bouwteam. The project is currently in the Technical Design phase. The construction is planned to be initiated in 2024 and it is expected that in 2027 the newly-built high-voltage 50/10kV main station is ready for operation to supply electricity to the terminal, offices and other buildings. Figure 4.1 depicts the timeline of the key project milestones.

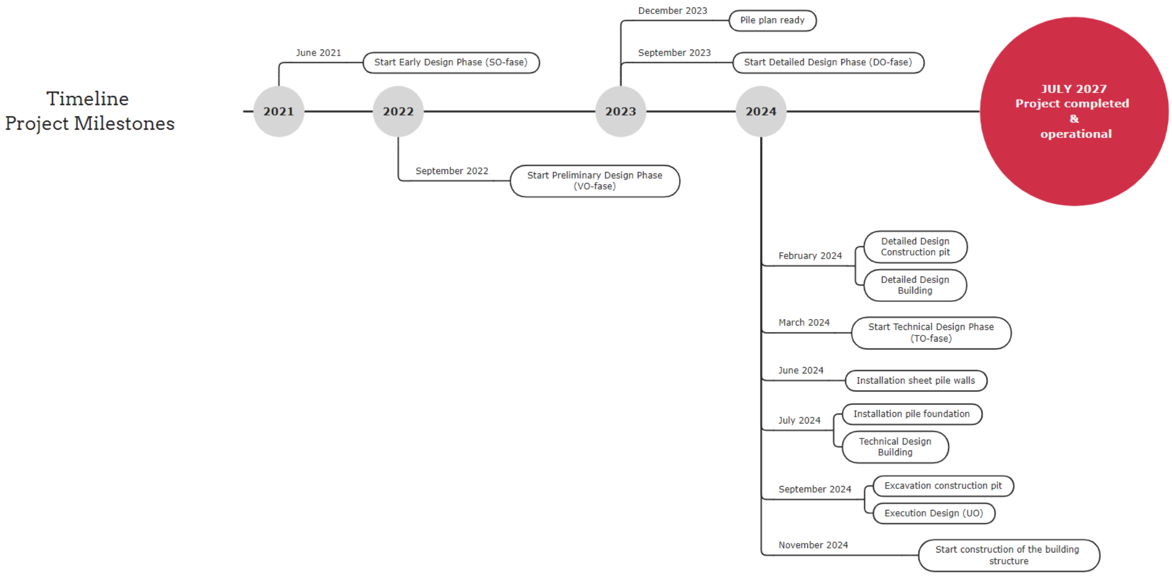

Figure 4.1: Timeline Project Milestones 50/10kV

4.1.2. Organizational Structure

During the Detailed Design phase (DO-fase), it was recognized that the current set-up was inadequate to proceed with the project. Subsequently, the organization had to be restructured and the transition was made from the conventional organizational structure to a new layered structure. Figure 4.2 depicts the organizational structure of the 50/10kV project which is as follows:

- Steering Committee;
- Advisory Committee;
- Project Management Team;
- Engineering Design Team;
- BIM Team;
- Systems Engineering Team.

It is beyond the scope of this research study to explore the entire organization. The subjects of interest, in line with the research question and literature research, are the team members of the engineering design team (10 members are observed), that can be defined as the population in statistical terms. For the design phase, the relationship between the clients and the design parties are governed by TNR 2011. One of the design parties is also the contractor for this project and therefore there is an additional relationship in the execution phase between the clients and this party which is governed by the UAC 2012. In other words, the contractor is involved in the design of the project. Figure 4.3 depicts the simplified representation of the contractual relations between the clients, engineering design team, and contractor, which is the resulting combination of figure 2.1 and figure 4.2.

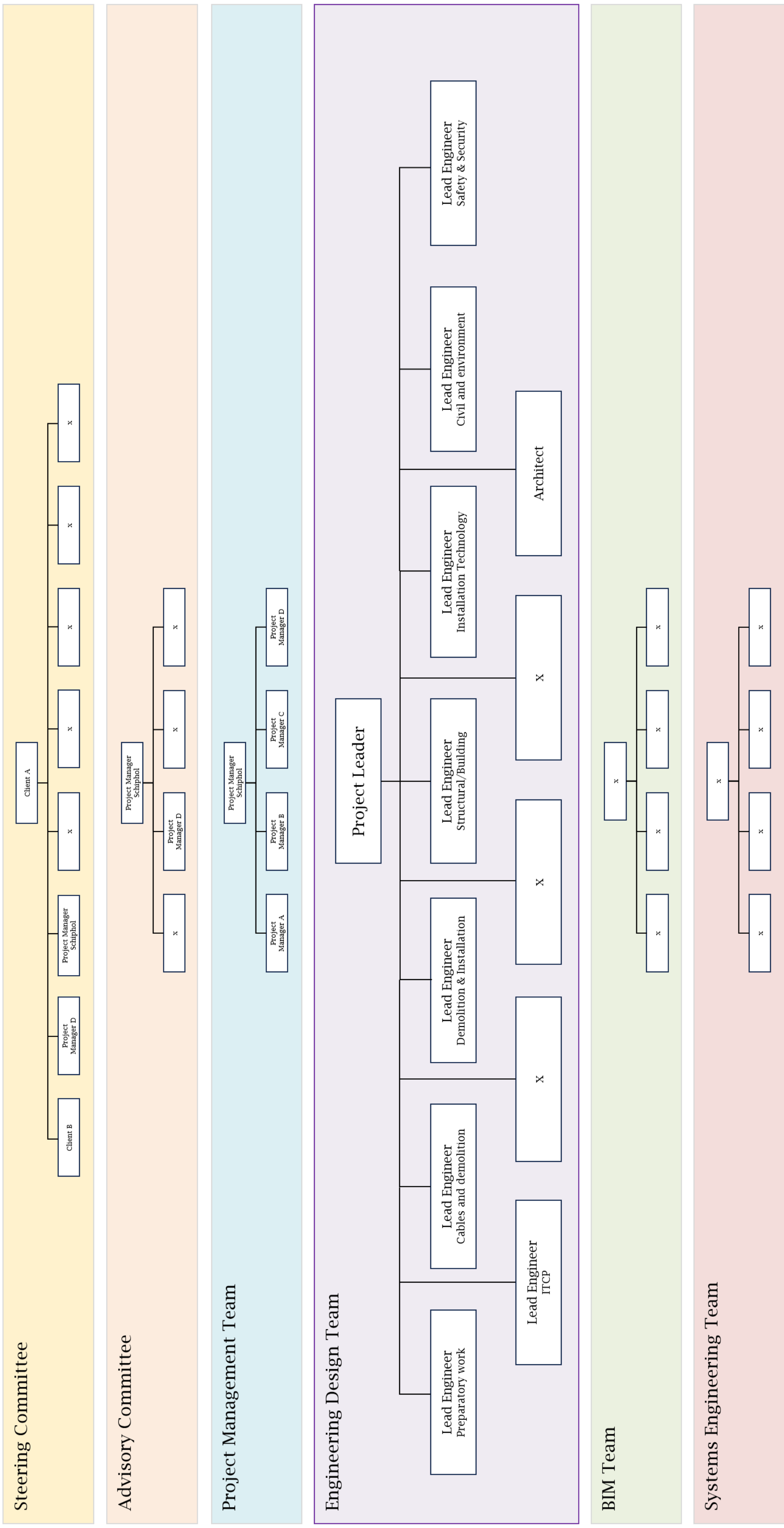

Figure 4.2: Project Organization 50/10kV (Based on Project Management Plan)

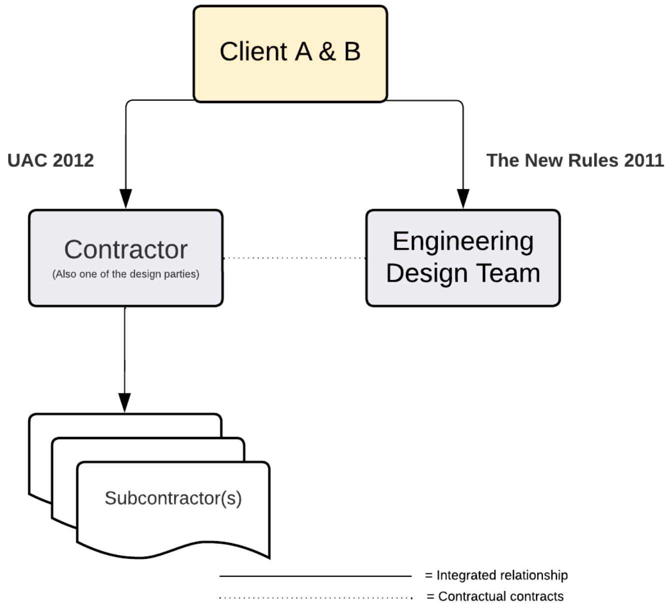

Figure 4.3: Contractual relations of the 50/10kV project (own illustration)

As can be seen in figure 4.2, there are several project managers in different organizational layers, each having a different area of focus. The project leader of the engineering design team is involved with managing the integral design of the project. Within the engineering design team, there are lead engineers from different organizations that are responsible for a certain work package, with the exception of the architect. The team members involved in the observed project meetings are as follows (excluding lead engineers that did not participate in the study):

- Advisor Electrical Engineering;
- Architect;
- Lead Engineer Civil and Environment;
- Lead Engineer Demolition and Installation;
- Lead Engineer Installation Technology;
- Lead Engineer Preparatory work;
- Lead Engineer Structural/Building;
- Project Leader;
- Project Manager C;
- Structural Engineer.

4.1.3. Project Meeting Structure

Table 4.1 illustrates the different types of project meetings and its frequency. Project meetings of the engineering design team and the work package coordination, indicated with bold letters, are observed that are in accordance with the research question and literature review, while the other project meetings are beyond the scope of this research study. The objective of an engineering design team meeting is to discuss and coordinate topics about the design across all lead engineers and the architect on a more generic level, while during a work package coordination meeting, designers and advisors of a few specific work packages discuss topics on a more profound level to coordinate tasks and activities as some work packages have close interfaces with one another.

An excel sheet is utilized as a standard procedure to guide and structure all the project meetings. The excel sheet contains several tabs related to the agendas, actions, decision-making, progress, attendees, and work packages. Special attention is drawn to the general agenda topics that is iterative and specific agenda topics that may differ every meeting. The specific agenda topics, or better known as actions, are summarized in an action list that contains: item number, what work package it belongs to, subject, task description, individual responsible for undertaking the corresponding task/activity/action, agreed and actual deadline of the action, and the status of the action. New agenda topics and actions are noted during the meeting.

Table 4.1: Project Meeting Structure 50/10kV

Meeting	Frequency
Progress Meeting	Monthly
Project Management Meeting	Weekly
Engineering Design Team	Weekly
Work Package Coordination Meeting	Bi-Weekly
Steering Committee Meeting	Quarterly
Advisory Committee Meeting	Bi-Monthly
BIM Meeting	Weekly

4.2. Observation 1

General
Date: January 25, 2024
Type of meeting: Work Package Coordination
Duration: 57 minutes
Attendees:

- Advisor Electrical Engineering;
- Lead Engineer Demolition and Installation;
- Lead Engineer Installation Technology;
- Lead Engineer Preparatory work;
- Lead Engineer Structural/Building;
- Structural Engineer.

Agenda

- Discussion with fire department;
- Response time;
- Fire resistance;
- Coating;
- Coordination position of cables and EPS;
- Baseline measurement;
- Communication and documentation;
- Procedure Excel and Relatics (Responsible individual);
- SMART Program of Requirements;
- Overarching Program of Requirements document.

Summary of the project meeting
The meeting was about different aspects of the projects. Special attention was drawn to the topics of the fire department, response time and fire resistance. Discussions were held with the fire department about the response time and actions in case of a fire in the main stations as well as whether the fire department will arrive to extinguish the fire. As of now, there is no clarity and detail concerning the fire department accessing high, medium or voltage areas, and the response time of 120 minutes. This needs to be verified with a representative of Schiphol as this person had several meetings with the fire department. Additional documents will be provided to indicate the fire resistance and heat development in the steel elements in case of a fire. Another important topic of discussion is the choice for the type of coating. In the Detailed Design Phase it is indicated that there is a solution which will be further specified and elaborated in the Technical Design Phase. A topic that has been a challenge for a long time is the coordination of the exact position of the cables and the EPS as well as its technical details. Team members are working hard on this interface. Attention was drawn to the importance of clear communication and documentation for continuous progress and to prevent asymmetric information. This was exemplified by improving the procedure of excel and relatics, in which the objective was to make the requirements smart in order to do the check properly, and to attach a responsible person to each requirement for transparency. Lastly, the objective was to compose an overarching Program of Requirements document that contains a management summary of around 10 pages of every discipline elaborating the design choices as well as its rationale and how interfaces were dealt with. There was a need for this document to properly communicate the specifications and progress of the project with the involved parties.

Collected data
All clarifications of the collected quantitative and qualitative data in the form of tables and figures in observation 1 are equivalent for all following observations as well as the observations for the 150/20kV project to prevent unnecessary repetition.

With respect to quantitative data collection, the Team Effectiveness questionnaires were collected after every meeting from the 10 participating members. The questionnaire has 7 items in which each item can be assigned a score from 1 to 4, hence the total score can range from 7 to 28. A lower score indicates a higher team effectiveness and vice versa. Thereafter, the scores per individual team member were calculated as well as the average and standard deviation across all team members. Team members that were absent during the meeting are indicated with N/A (Not Applicable). The quantitative data and calculated values are depicted in table 4.2 and table 4.3. Scores of all observations for both projects can be found in Appendix E and Appendix F.

Table 4.2: Baseline Team Effectiveness scores 50/10kV

Baseline Team Effectiveness scores										
Team member	1	2	3	4	5	6	7	8	9	10
Score	20	17	19	13	18	14.5	21	12	N/A	17
Average score	16.83									
Standard deviation	3.10									

Table 4.3: Observation 1 Team Effectiveness scores 50/10kV

Observation 1 Team Effectiveness scores (25-01-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	18	N/A	N/A	18	17	N/A	18	N/A	N/A	21
Average score	18.40									
Standard deviation	1.52									

In relation to qualitative data collection, the observations of the meetings were recorded. Thereafter the recordings were transcribed with the assistance of Amberscript (machine-made transcription version). The resulting transcripts were coded and annotated with ATLAS.ti. Then co-occurrence analysis was performed to obtain frequency tables, bar charts, and sankey diagrams.

Figure 4.4 depicts a frequency table that shows the relationship between the role of a team member and the exhibited shared leadership behaviour. The table indicates the frequency of engagement in shared leadership and the frequency of a particular shared leadership behaviour. Figure 4.5 on the other hand depicts the relationship between shared leadership behaviours and the Team Effectiveness questionnaire topics. The table shows the frequency of the displayed shared leadership behaviours and the frequency of the related team effectiveness questionnaire topics.

A bar chart is another approach to represent the data. Figure 4.6 presents a bar chart of the role versus shared leadership, in which immediately can be seen which shared leadership behaviours were exhibited the most by the team members. Figure 4.7 displays which type of shared leadership behaviour, task-focused or person-focused (red and green respectively), has been exhibited the most on each team effectiveness questionnaire item.

Another approach in visually representing the frequency table is the sankey diagram. Figure 4.8 depicts the flow from each of the team members to their exhibited shared leadership behaviours. Figure 4.9 in turn shows the flow from the exhibited shared leadership behaviours to the related team effectiveness questionnaire topics. Sankey diagrams provide a clear and intuitive visualization of flows between variables and allows for comparison of flow magnitudes.

	Boundary Spanning 56	Consideration 36	Empowerment 13	Initiating Structure 66	Motivation 5	Transactional 1	Transformational 4
Advisor Electrical Engineering 0							
Architect 0							
Lead Engineer Civil and Environment 0							
Lead Engineer Demolition and Installation 1	1	1		1			
Lead Engineer Installation Technology 30	21	15	7	24	2	1	3
Lead Engineer Preparatory Work 15	10	4	3	13			
Lead Engineer Structural/Building 34	24	16	3	28	3		1
Project Leader 0							
Project Manager C 0							
Structural Engineer 0							

Figure 4.4: Observation 1 Frequency Table - Role vs Shared Leadership

	1. Overall performance 0	2. Overall satisfaction 5	3. Quality effectiveness 54	4. Planning effectiveness (on-time) 24	5. Planning effectiveness (effective use of time) 16	6. Change effectiveness (problem handling) 24	7. Change effectiveness (coping with changes) 21
Boundary Spanning 56		3	40	20	9	18	18
Consideration 36		5	21	8	6	11	4
Empowerment 13		2	9	7	3	5	4
Initiating Structure 66		4	43	20	15	20	19
Motivation 5		1	4	3	1	3	1
Transactional 1			1			1	
Transformational 4			3	1		1	1

Figure 4.5: Observation 1 Frequency Table - Shared Leadership vs Team Effectiveness

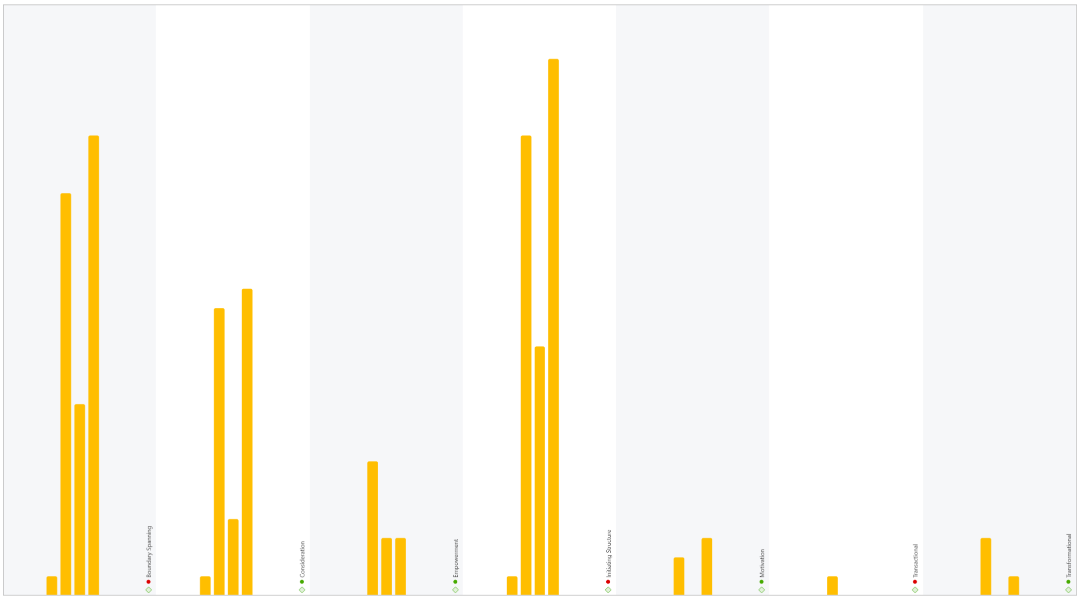

Figure 4.6: Observation 1 Bar Chart - Role vs Shared Leadership

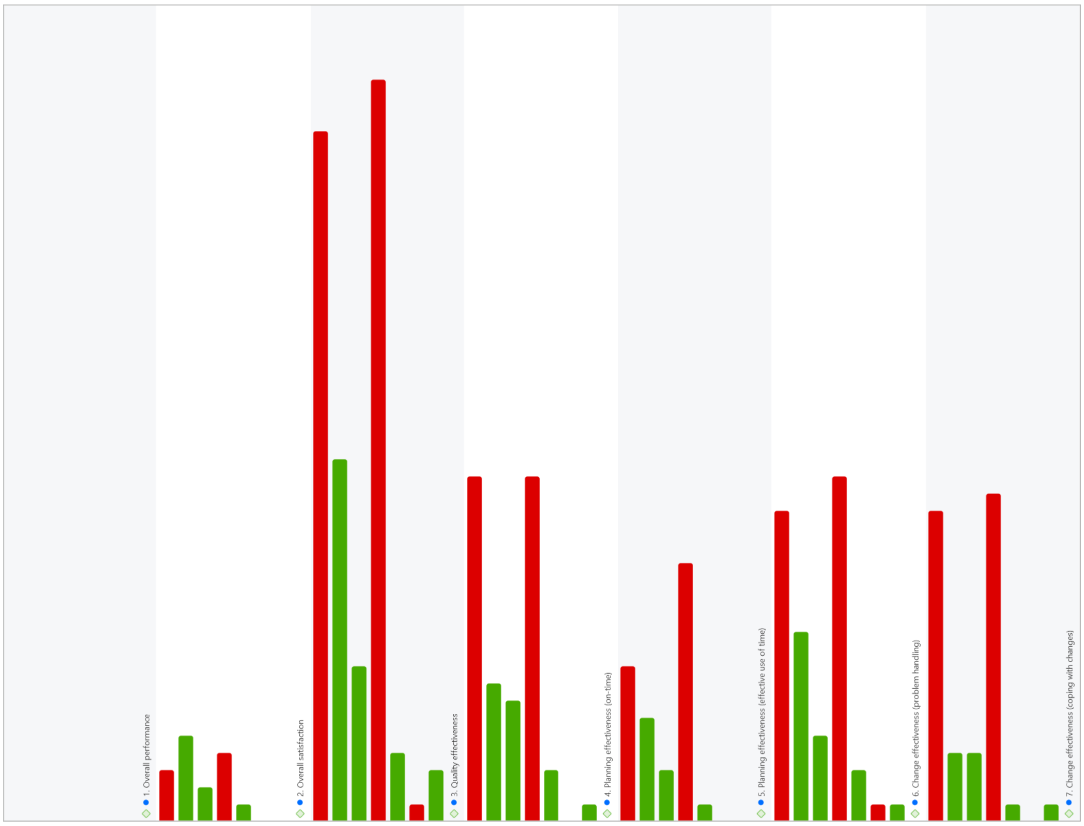

Figure 4.7: Observation 1 Bar Chart - Shared Leadership vs Team Effectiveness

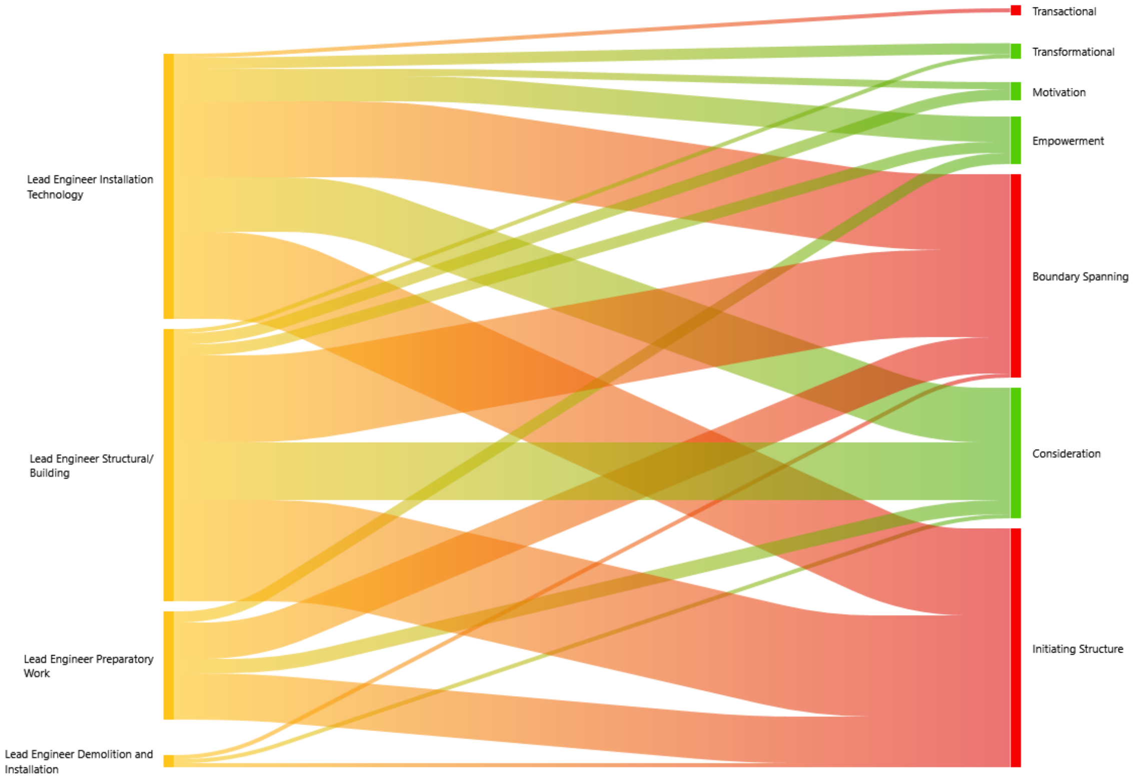

Figure 4.8: Observation 1 Sankey Diagram - Role vs Shared Leadership

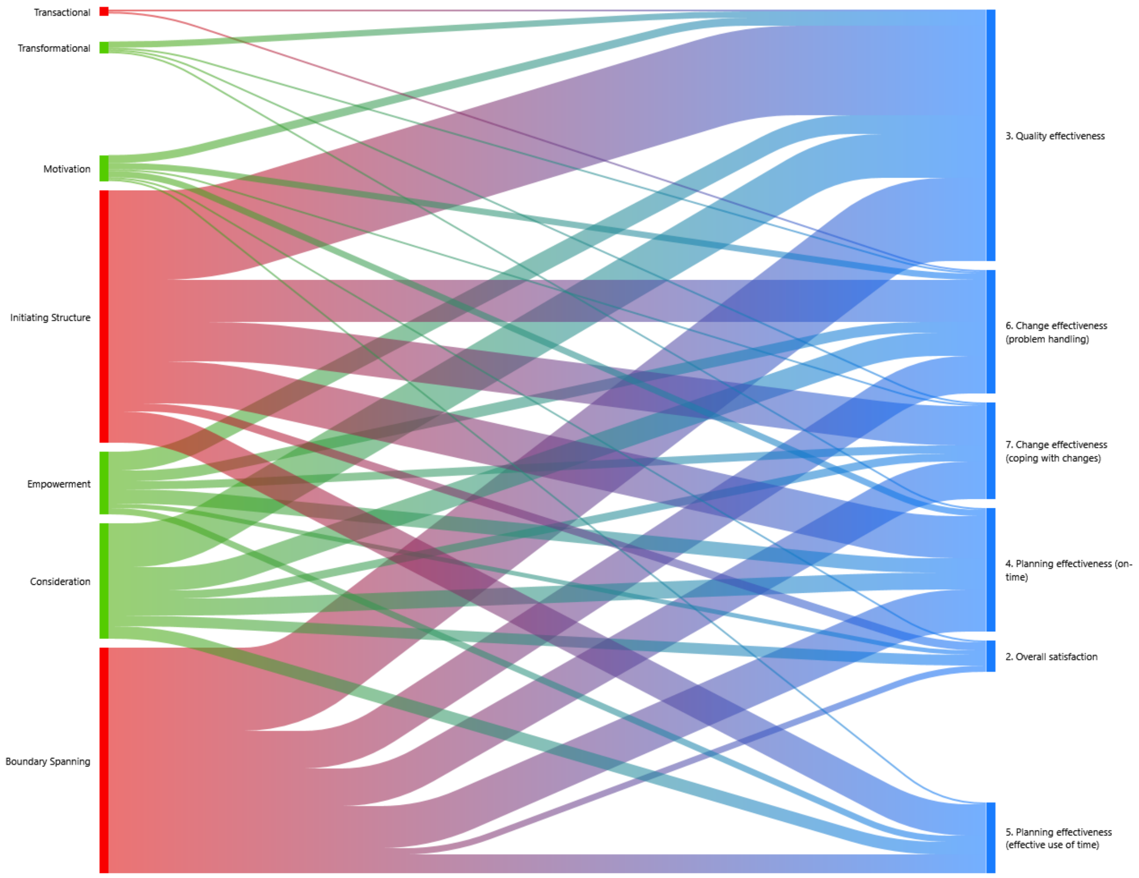

Figure 4.9: Observation 1 Sankey Diagram - Shared Leadership vs Team Effectiveness

4.3. Observation 2

General
Type of meeting: Engineering Design Team
Date: February 1, 2024
Duration: 1 hour and 16 minutes
Attendees:

- Lead Engineer Civil and Environment;
- Lead Engineer Demolition and Installation;
- Lead Engineer Installation Technology;
- Lead Engineer Preparatory work;
- Lead Engineer Structural/Building;
- Project Leader;
- Project Manager C.

Agenda

- Needs diagram;
- Detailed Design presentation;
- Pile plan;
- Interface EPS - cables;
- Accessibility;
- Conduit pipes;
- Interface construction pit - cables;
- Incomplete information sharing;
- Updating risk register;

Summary of the project meeting
There were 15 topics on the agenda to be discussed in this meeting, that were not of equal importance or did not require much time and effort. The meeting was about different aspects of the project. The needs diagram was discussed and there was a need for planning a brainstorm session with the team members for developing a solution, as well as to ascertain that everyone made the appropriate design choices based on the identical and most recent information, thereby preventing information asymmetry. An important topic for this meeting was identifying risks and updating the risk register, especially regarding the conduit pipes, cable calculations and the interfaces between Expanded Polystyrene (EPS) and the cables, and the interface between the construction pit and the cables. This was the result of the discussion with an external architectural firm about possible developments and changes to the tunnel, in particular shortening the tunnel. However, the essence and conclusion was to proceed with the current design/plan, in which changes and other influences must be submitted formally before the aforementioned adjustments take place. Attention was also drawn to the aspect of safety, wherein different stakeholders are involved each having their own requirements. Therefore, it was stressed that conflicting interests and requirements must be reported in order to guarantee management of risks.

Collected data

Table 4.4: Observation 2 Team Effectiveness scores 50/10kV

Observation 2 Team Effectiveness scores (01-02-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	16	10	17	N/A	N/A	N/A	17.5	14	N/A	15
Average score	14.92									
Standard deviation	2.73									

		Boundary Spanning 78	Consideration 65	Empowerment 30	Initiating Structure 124	Motivation 12	Transactional 11	Transformational 12
Advisor Electrical Engineering	0							
Architect	0							
Lead Engineer Civil and Environment	3	2			3			
Lead Engineer Demolition and Installation	9	3	3	1	9			
Lead Engineer Installation Technology	40	25	18	12	34	3	3	5
Lead Engineer Preparatory Work	11	6	4	1	8			1
Lead Engineer Structural/Building	10	6	4	1	10			
Project Leader	76	33	36	15	58	9	8	6
Project Manager C	7	4	2		5			
Structural Engineer	0							

Figure 4.10: Observation 2 Frequency Table - Role vs Shared Leadership

		1. Overall performance 0	2. Overall satisfaction 14	3. Quality effectiveness 40	4. Planning effectiveness (on-time) 17	5. Planning effectiveness (effective use of time) 23	6. Change effectiveness (problem handling) 40	7. Change effectiveness (coping with changes) 25
Boundary Spanning	78		5	23	8	8	27	18
Consideration	65		14	14	4	13	22	11
Empowerment	30		7	14	9	7	13	7
Initiating Structure	124		12	35	16	22	34	20
Motivation	12		4	3	1	5	6	1
Transactional	11		1	1	2	5	2	2
Transformational	12		2	6	3	2	8	2

Figure 4.11: Observation 2 Frequency Table - Shared Leadership vs Team Effectiveness

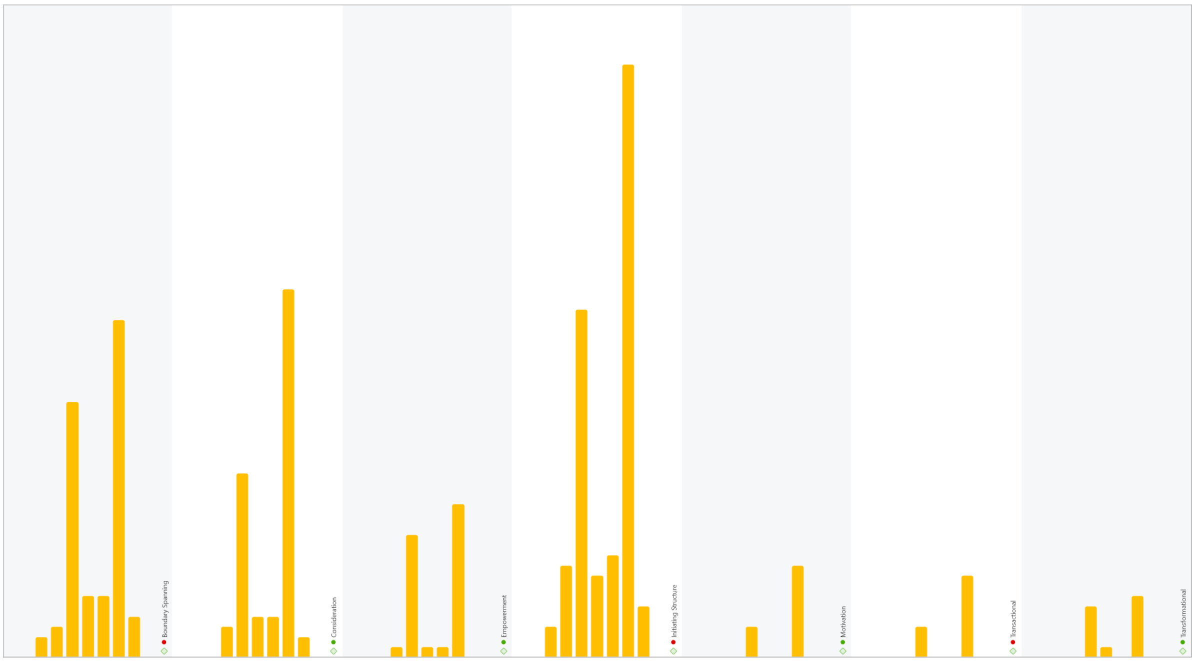

Figure 4.12: Observation 2 Bar Chart - Role vs Shared Leadership

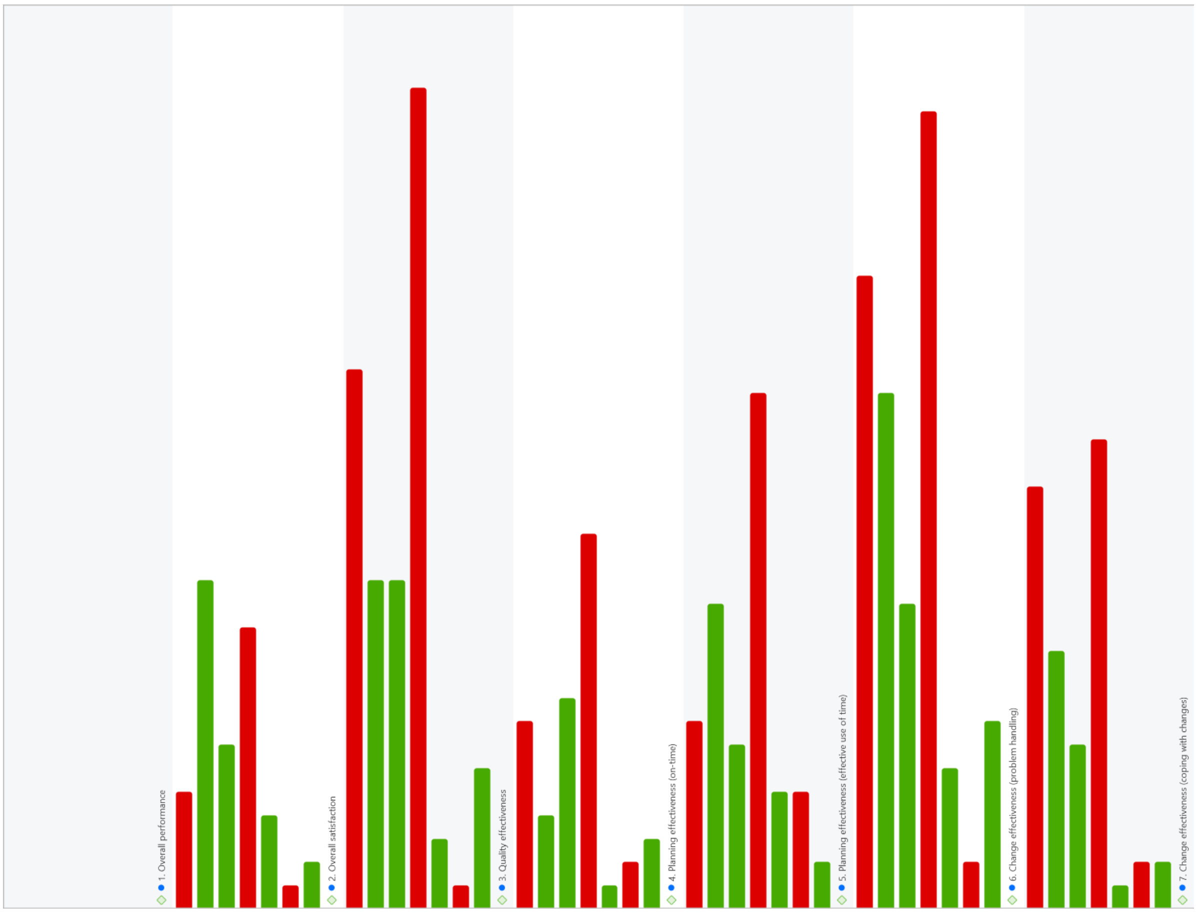

Figure 4.13: Observation 2 Bar Chart - Shared Leadership vs Team Effectiveness

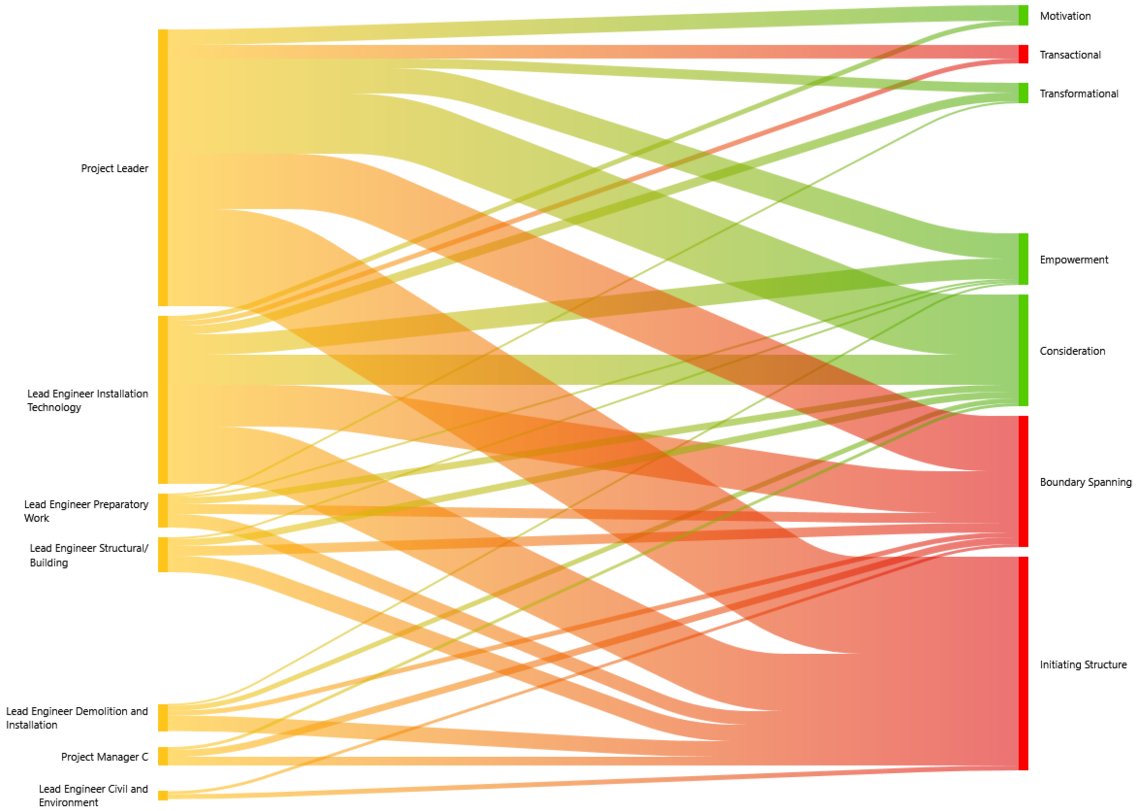

Figure 4.14: Observation 2 Sankey Diagram - Role vs Shared Leadership

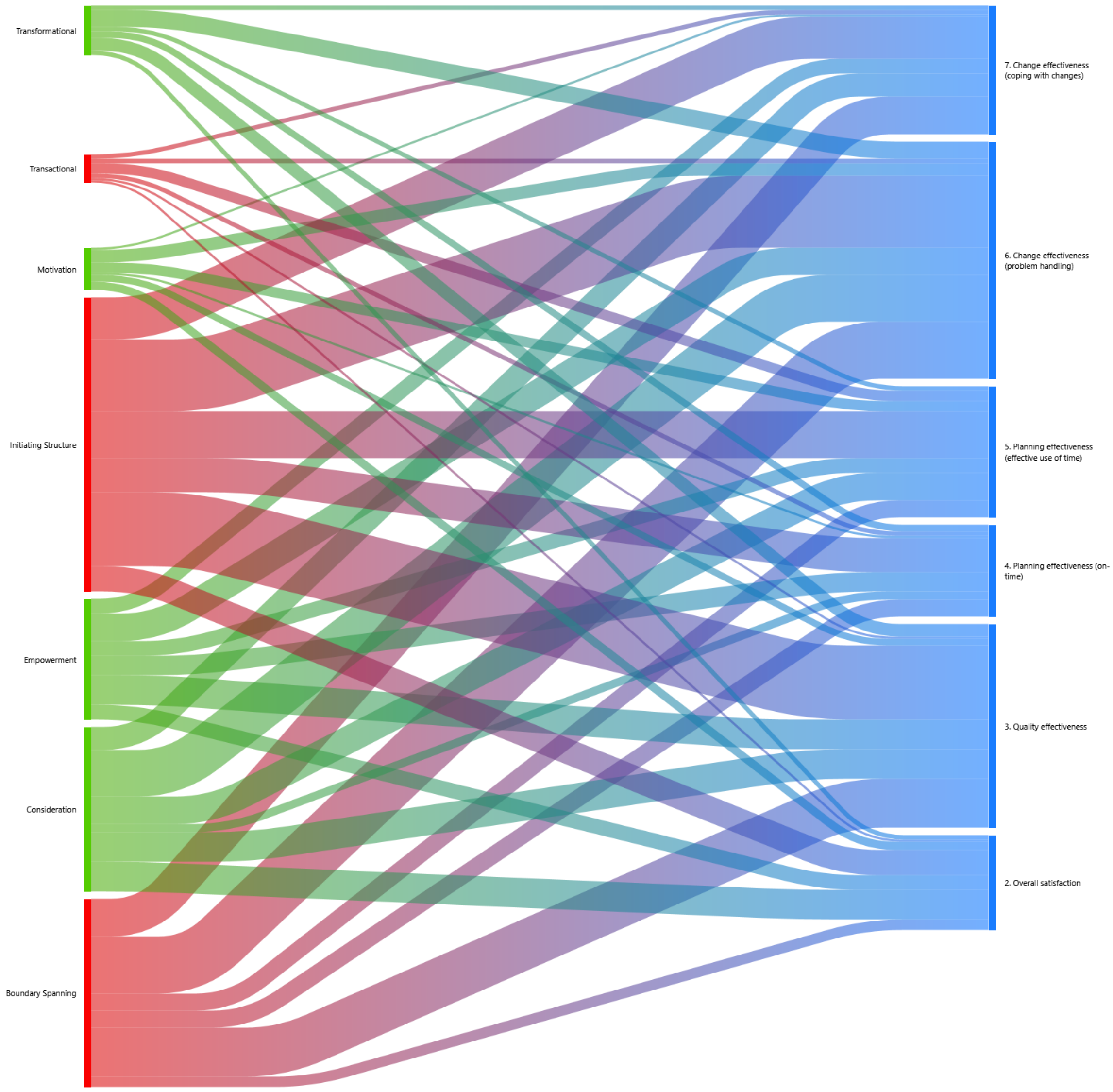

Figure 4.15: Observation 2 Sankey Diagram - Shared Leadership vs Team Effectiveness

4.4. Observation 3

General
Date: February 8, 2024
Type of meeting: Engineering Design Team
Duration: 1 hour and 36 minutes
Attendees:

- Architect;
- Lead Engineer Civil and Environment;
- Lead Engineer Demolition and Installation;
- Lead Engineer Installation Technology;
- Project Leader;
- Structural Engineer.

Agenda

- Presentation Advisor Electrical Engineering;
- Presentation Lead Engineer Installation Technology;
- 50kV;
- 10kV;
- Verification process.

Summary of the project meeting
This Engineering Design Team meeting had a different structure that slightly deviated from the conventional weekly meetings. The main purpose of this meeting/presentation was for team members to provide insight into their current progress with regard to the project. Progress was shown through a presentation including schemes, drawings and by explaining rationale behind design choices and addressing possible issues. Three main topics of this meeting/presentation were about the 50kV, 10kV and the verification process. The Project Leader presented the work and progress of the Advisor Electrical Engineering as this individual was not able to attend this meeting. The contents of this presentation emphasized the technical aspects of the project. Next, Lead Engineer Installation Technology presented his work and progress through the Detailed Design document (DO document). The remaining time of the meeting emphasized the importance and coordination of the verification process. The explanation on the verification document DO has been written and should be shared amongst the designers of work package 5 to review the work and design approach. A crucial objective for the verification process is to add the missing requirements and to make the requirements SMART. This will be a helpful tool to go through the verification process. The requirements are available on SharePoint and the purpose of working with the requirements list is not to measure whether it is correct or not, but to evaluate how the requirements were addressed. It is important to note one requirement per line in the excel document, in which each discipline will respond to their respective topics and field of expertise. Finally, the Project Leader concluded the meeting with expressing the need to arrange follow-up procedures regarding deadlines, task coordination and structure, and general overview with the rationale that the team is entering a new phase that requires much more time and effort. Special attention is drawn to streamlining scheduling and planning such that there are no team members that have no tasks to fulfill during certain periods of time.

Collected data

Table 4.5: Observation 3 Team Effectiveness scores 50/10kV

Observation 3 Team Effectiveness scores (08-02-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	N/A	N/A	17	N/A	15	18	17	18	N/A	14
Average score					16.50					
Standard deviation					1.64					

		Boundary Spanning 52	Consideration 39	Empowerment 13	Initiating Structure 54	Motivation 6	Transactional 0	Transformational 1
Advisor Electrical Engineering	0							
Architect	3	2	1		3			
Lead Engineer Civil and Environment	0							
Lead Engineer Demolition and Installation	9	9	3		8			
Lead Engineer Installation Technology	14	12	11	5	14	3		1
Lead Engineer Preparatory Work	0							
Lead Engineer Structural/Building	0							
Project Leader	31	27	25	9	28	3		
Project Manager C	0							
Structural Engineer	5	5	2		5			

Figure 4.16: Observation 3 Frequency Table - Role vs Shared Leadership

		1. Overall performance 53	2. Overall satisfaction 56	3. Quality effectiveness 43	4. Planning effectiveness (on-time) 5	5. Planning effectiveness (effective use of time) 5	6. Change effectiveness (problem handling) 19	7. Change effectiveness (coping with changes) 6
Boundary Spanning	52	48	51	39	5	4	17	4
Consideration	39	35	38	31	1	3	17	5
Empowerment	13	10	12	9		1	4	1
Initiating Structure	54	50	53	43	5	6	17	5
Motivation	6	4	6	3		1	3	1
Transactional	0							
Transformational	1	1	1	1			1	1

Figure 4.17: Observation 3 Frequency Table - Shared Leadership vs Team Effectiveness

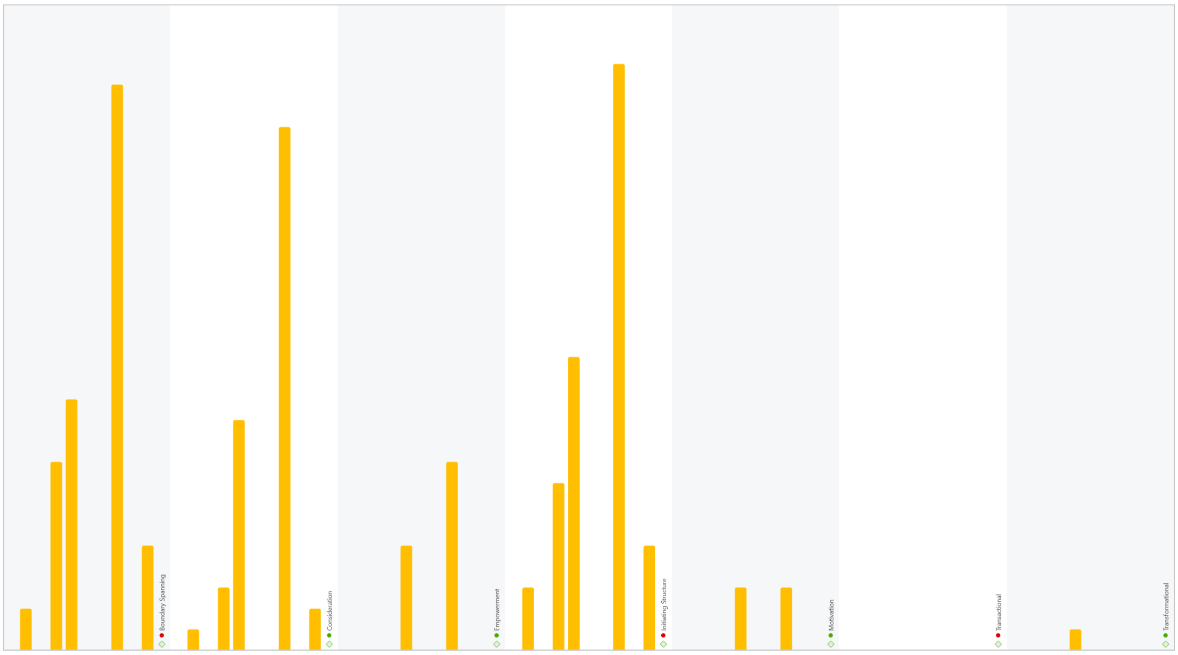

Figure 4.18: Observation 3 Bar Chart - Role vs Shared Leadership

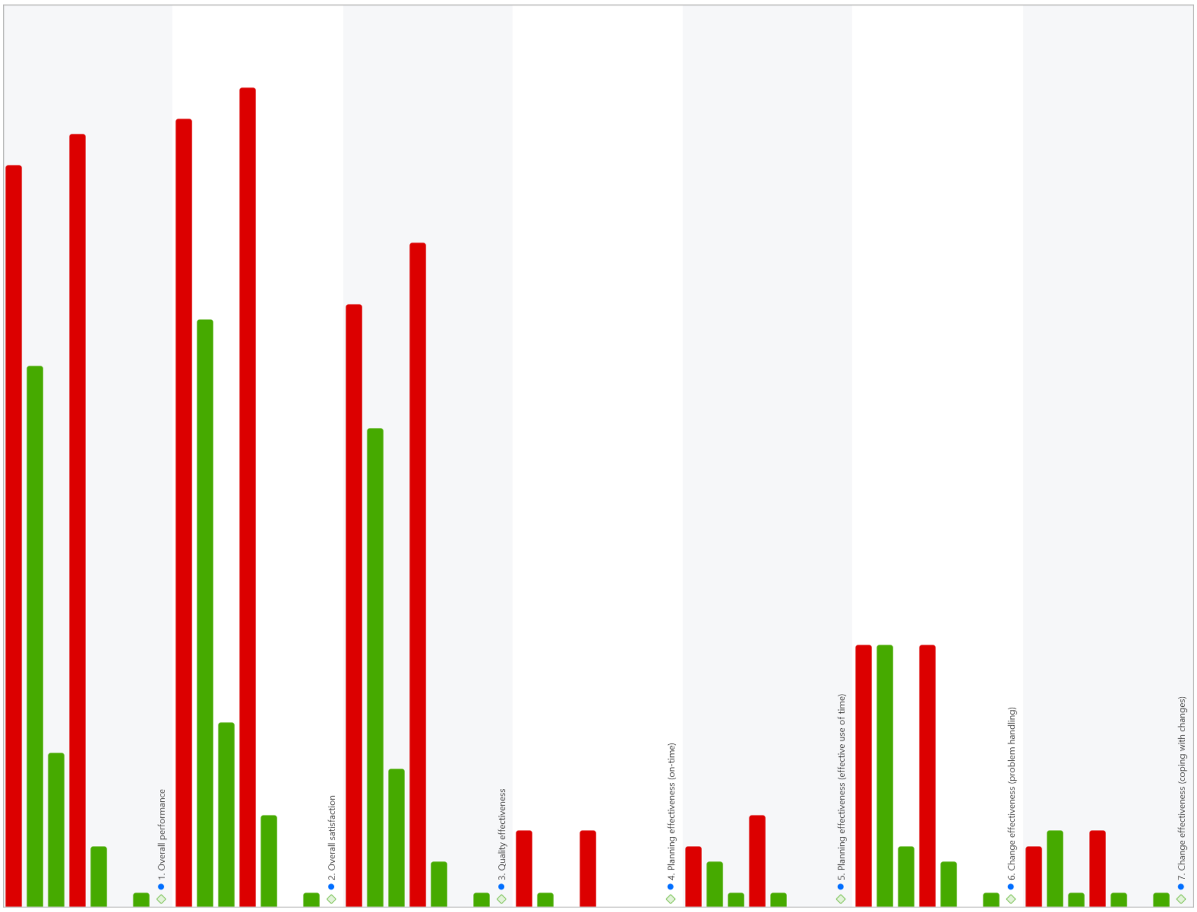

Figure 4.19: Observation 3 Bar Chart - Shared Leadership vs Team Effectiveness

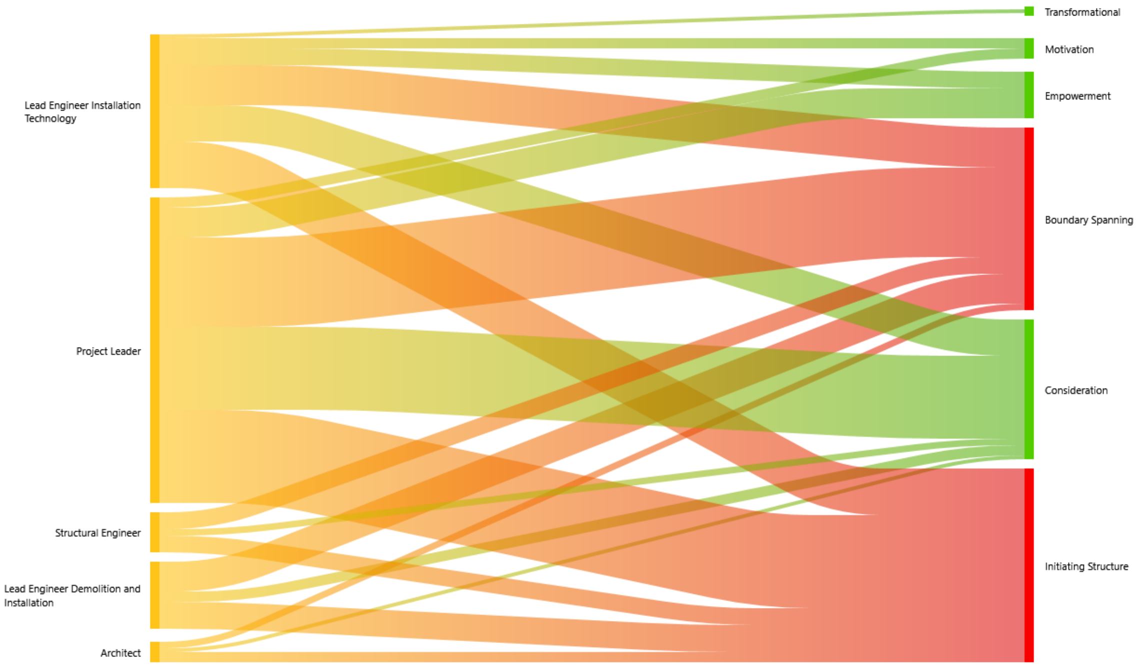

Figure 4.20: Observation 3 Sankey Diagram - Role vs Shared Leadership

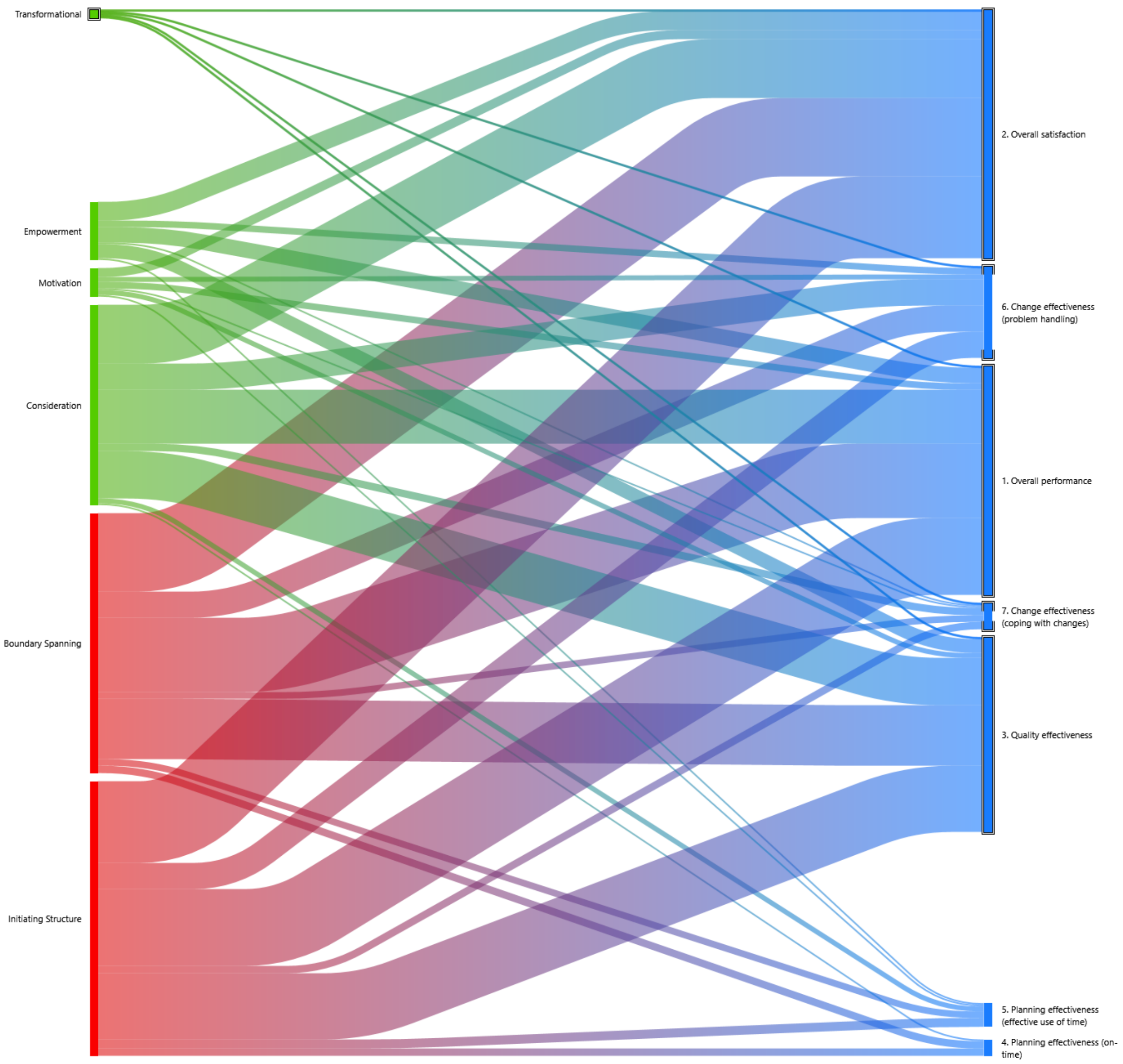

Figure 4.21: Observation 3 Sankey Diagram - Shared Leadership vs Team Effectiveness

4.5. Observation 4

General
Date: March 7, 2024
Type of meeting: Work Package Coordination
Duration: 1 hour and 53 minutes
Attendees:

- Architect;
- Lead Engineer Demolition and Installation;
- Lead Engineer Preparatory work;
- Project Leader;
- Structural Engineer;

Agenda

- Systems Engineering;
- Project Planning;
- Meeting structure and procedures;
- Architect's progress.

Summary of the project meeting
A team member from Systems Engineering was the chair for this Work Package Coordination meeting, temporarily replacing Lead Engineer Structural/Building. The chair and an individual from BAM are involved with Systems Engineering and will participate from now on to support the Engineering Design Team. It was clarified that the members from Systems Engineering will support through documenting any changes in the set of requirements, whether it be adjustments or additions, as well as facilitating with regard to the requirements being processed by the proper individual, involved parties or even the client. The purpose of this support and facilitation is to take away some concerns from the Engineering Design Team as well as ensuring that they do not exceed the deadlines and can focus on designing to comply with the wishes of the client: that the design and requirements are traceable and verifiable.

The Project Leader took over and went through the most recent project planning information collectively with the team members and stated that the team is transitioning from the Detailed Design phase to the Technical Design phase. The Project Leader emphasized that it is of great significance that the planning displayed on the screen must comply with the overall planning on the wall. A few important milestones were discussed and it was determined that the team shall start with the technical design including processing feedback, even though the detailed design has not been approved yet. No adjustments will be made to the detailed design and focus shall be on the technical design. The detailed design will be delivered to the client which will turn into a formal phase document.

From the team there was a need for a new meeting- and procedure structure, that includes more frequent meetings that last about a day part rather than just two hours. Furthermore, there is need that every discipline should attend the meetings as team members were missing each other to discuss important matters. This is especially important in this phase if the team wants to stay on schedule as coordination happened too late in the Detailed Design phase. Therefore, based on this needs assessment the Project Leader proposed to organize the meetings at the Royal HaskoningDHV office in Amersfoort with the rationale that it provides more space, tools and is more convenient to commute for most of the team members. It was emphasized by the Project Leader that the meetings will follow an improved structure by collectively discussing models instead of only drawings, discussing per themes, and that members of every discipline gather to come up with solutions for problems. The needs assessment had a strong focus on solving problems together as a team, while disregarding individual problem-solving.

The last part of the meeting revolved around the Architect showing his work and drawings to go through collectively to provide insight into the current progress and addressing potential issues. An important topic discussed was how the change of the resistance from 60 minutes to 120 minutes would be documented. One option was to change it in the Program of Requirements or to add an overarching requirement that states the requirement of 120 minutes. This change might be in conflict with requirements from other parties, however it is a requirement from the client which has greater authority. At the end of meeting the Architect expressed (several times) his gratitude towards the team that he is very content that time was taken for a needs assessment, facilitation of concerns and needs, and reorganizing the meeting structure and procedure for the upcoming period. The other team members agreed and were also satisfied with the outcomes of this meeting.

Collected data

Table 4.6: Observation 4 Team Effectiveness scores 50/10kV

Observation 4 Team Effectiveness scores (07-03-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	18	N/A	N/A	N/A	16	X*	N/A	11	N/A	12
Average score					14.25					
Standard deviation					3.30					

*Present but researcher did not receive the questionnaire

	Boundary Spanning 122	Consideration 74	Empowerment 38	Initiating Structure 137	Motivation 15	Transactional 5	Transformational 4
Advisor Electrical Engineering 0							
Architect 61	51	31	20	59	7		
Lead Engineer Civil and Environment 0							
Lead Engineer Demolition and Installati... 29	23	8	2	27	1		
Lead Engineer Installation Technology 0							
Lead Engineer Preparatory Work 3	3	2	1	3			
Lead Engineer Structural/Building 0							
Project Leader 47	43	33	15	45	8	5	4
Project Manager C 0							
Structural Engineer 4	2			3			

Figure 4.22: Observation 4 Frequency Table - Role vs Shared Leadership

	1. Overall performance 135	2. Overall satisfaction 139	3. Quality effectiveness 87	4. Planning effectiveness (on-time) 14	5. Planning effectiveness (effective use of time) 24	6. Change effectiveness (problem handling) 46	7. Change effectiveness (coping with changes) 30
Boundary Spanning 122	117	119	78	13	19	39	25
Consideration 74	70	74	46	6	18	26	14
Empowerment 38	36	38	24	5	9	20	9
Initiating Structure 137	131	134	85	13	24	46	30
Motivation 15	11	14	7	2	3	4	2
Transactional 5	5	5	3		3	1	1
Transformational 4	4	4	3	3	3	2	1

Figure 4.23: Observation 4 Frequency Table - Shared Leadership vs Team Effectiveness

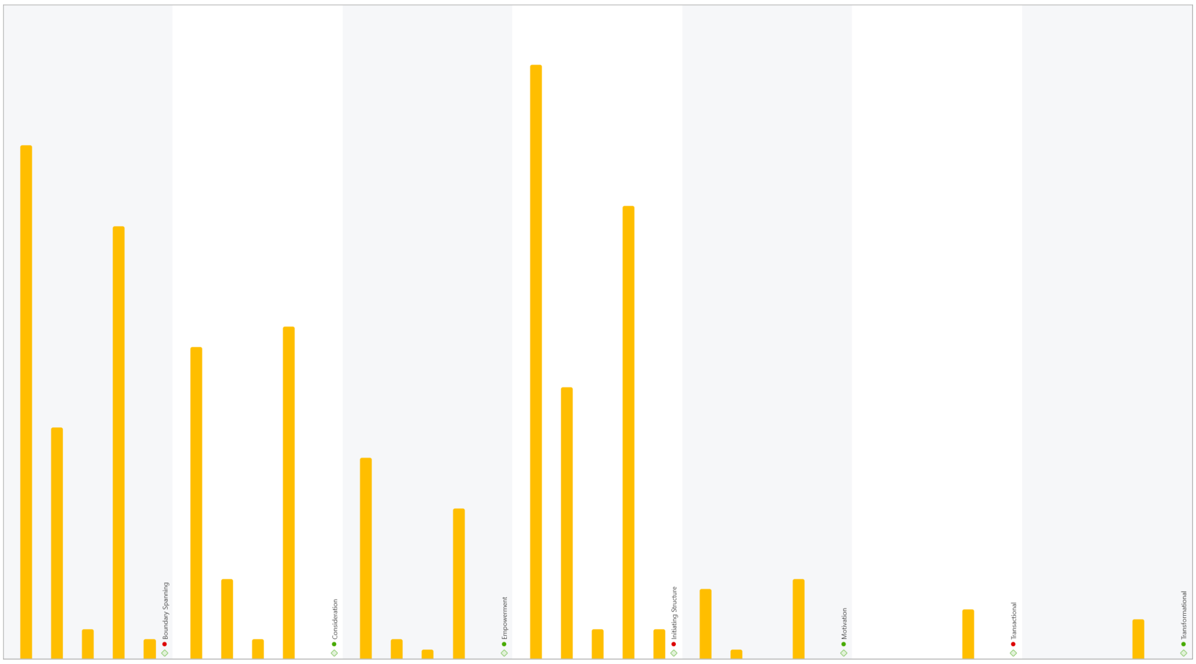

Figure 4.24: Observation 4 Bar Chart - Role vs Shared Leadership

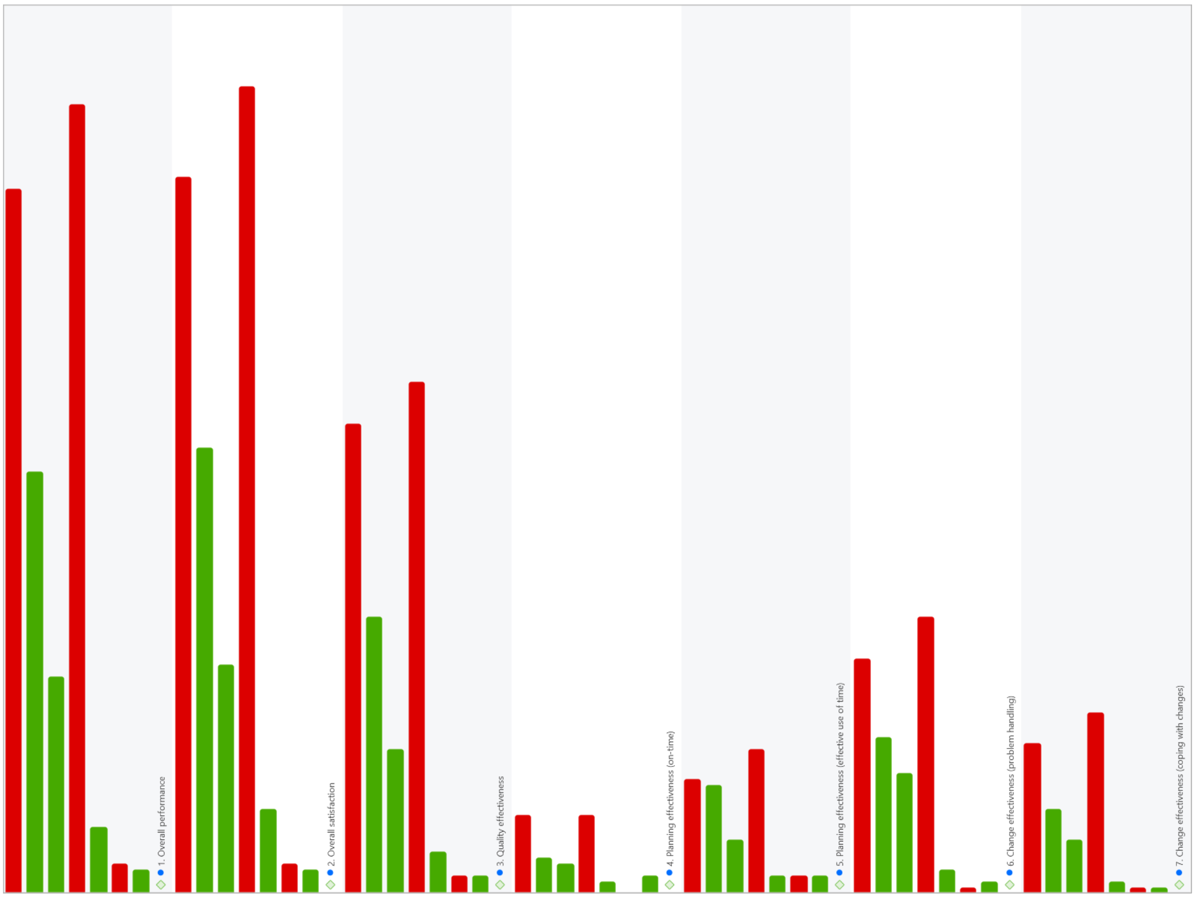

Figure 4.25: Observation 4 Bar Chart - Shared Leadership vs Team Effectiveness

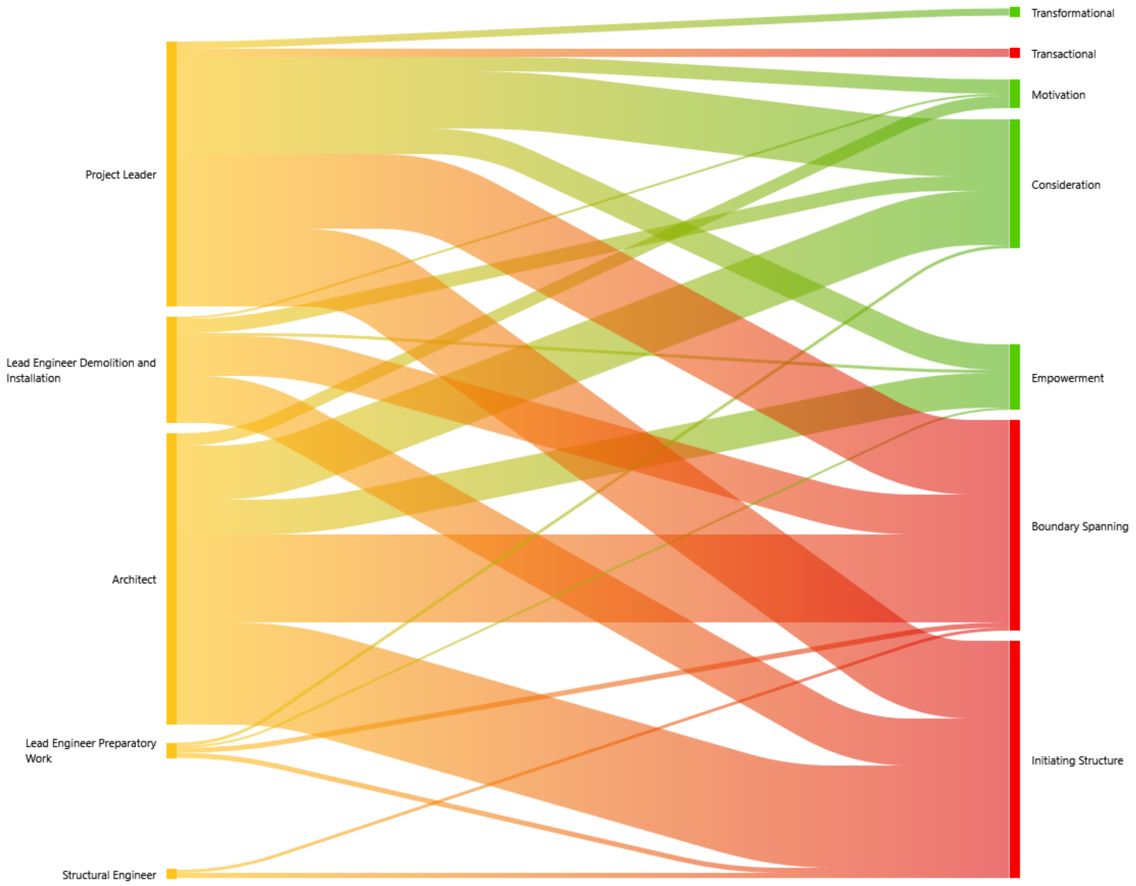

Figure 4.26: Observation 4 Sankey Diagram - Role vs Shared Leadership

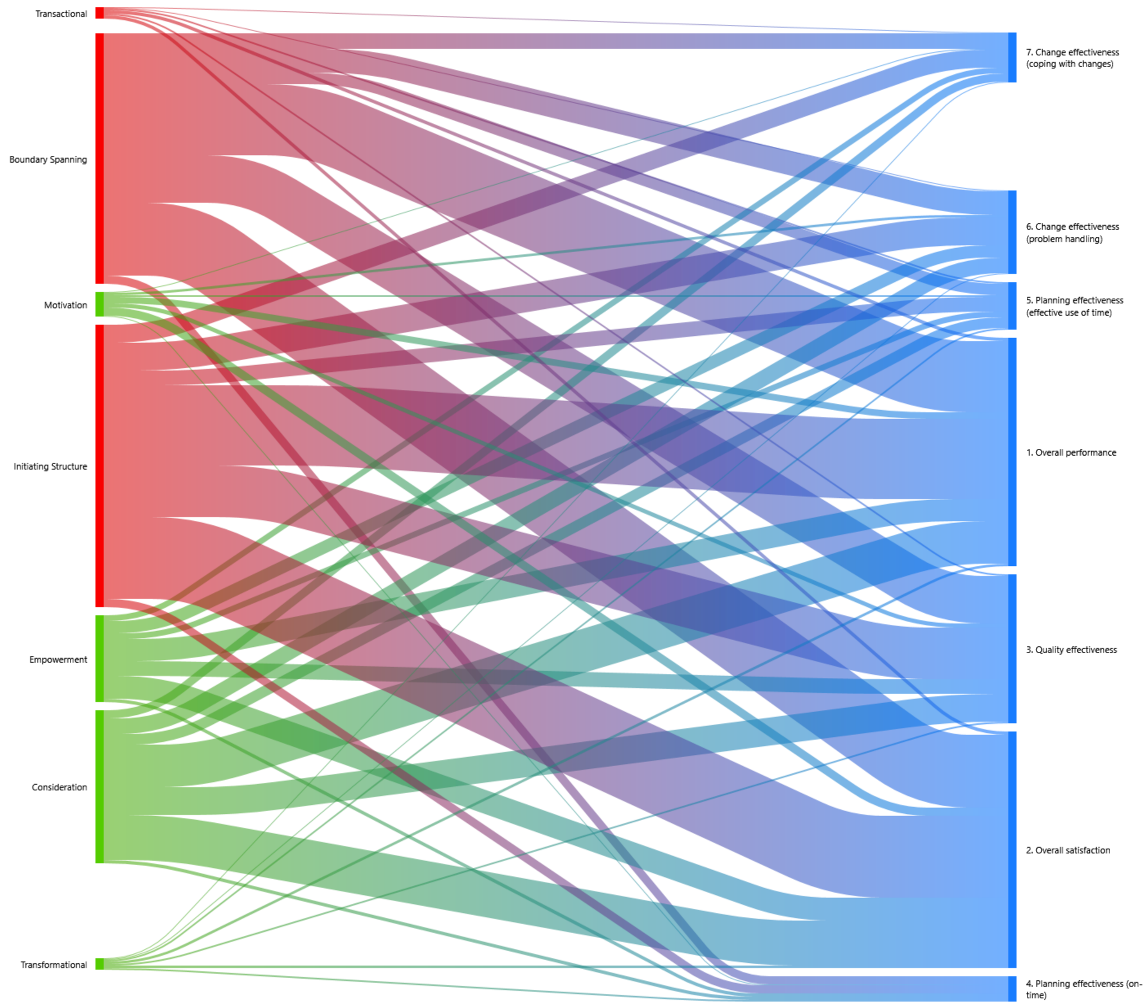

Figure 4.27: Observation 4 Sankey Diagram - Shared Leadership vs Team Effectiveness

4.6. Observation 5

General
Date: March 14, 2024
Type of meeting: Engineering Design Team
Duration: 51 minutes
Attendees:

- Architect;
- Lead Engineer Civil and Environment;
- Lead Engineer Installation Technology;
- Lead Engineer Preparatory work;
- Project Leader;
- Project Manager C;

Agenda

- Interface EPS - cables;
- Access facility ;
- Dome hole - Pigeons and safety;
- Provision drawings conduit pipes;
- Incomplete information sharing;
- Settlement road - subway tunnel;
- Notes and drawings 50kV and subway tunnel;

Summary of the project meeting
The online meeting was about different aspects of the project and topics that have been addressed in earlier Engineering Design Team meetings as well as Work Package meetings. There are improvements with regard to working towards a solution of the interface between the EPS and cables. Discussions are on-going with the relevant party that deals with the access of the facility. The team is currently looking into implementing a net in the hole of the dome to address conduction of lightning. Conduit pipes have been addressed regarding its impact on the metro which has been passed to the project manager of Schiphol to inform about the interfaces. An important topic addressed by the architect was about the necessity of better communication about shared information and drawings, specifically about its completeness and correctness. It was exemplified by drawings that have been uploaded and shared, but some elements were missing or removed. These pieces of information, such as the loads and other necessary information, were important for the architect and his team to proceed with their tasks and activities, as there were moments they could not continue their work. The risk of inadequate communication is that team members could have proceeded with the missing and incorrect information, that ultimately would have affected the progress of the project.

After the meeting had ended, Lead Engineer Installation Technology joined the meeting and had some topics to share that was discussed in the Work Package meeting. The first matter was about the loads on the 10kV cables and the EPS, and its resulting two variants that need to be compared and worked out. The other matter was about the ventilation system in which the importance of good ventilation was emphasized to prevent issues. This raised the question what solution is appropriate with respect to the type of ventilation. It was suggested to refrain from utilizing mechanical ventilation because of the risk of failure, and there was a preference for natural ventilation. However, the final solution must be properly underpinned. The meeting ended with a reminder that a meeting is organized with several disciplines to address the table construction and other technical topics.

Collected data

Table 4.7: Observation 5 Team Effectiveness scores 50/10kV

Observation 5 Team Effectiveness scores (14-03-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	17	13	N/A	N/A	N/A	15.5	17	14	N/A	N/A
Average score	15.30									
Standard deviation	1.79									

*Present but researcher did not receive the questionnaire

	Boundary Spanning 43	Consideration 32	Empowerment 8	Initiating Structure 29	Motivation 7	Transactional 1	Transformational 5
Advisor Electrical Engineering 0							
Architect 2	2	1	1	1			
Lead Engineer Civil and Environment 0							
Lead Engineer Demolition and Installation 0							
Lead Engineer Installation Technology 12	10	7	3	8	1		
Lead Engineer Preparatory Work 9	8	2		4			
Lead Engineer Structural/Building 0							
Project Leader 27	21	22	4	17	6	1	5
Project Manager C 2	2						
Structural Engineer 0							

Figure 4.28: Observation 5 Frequency Table - Role vs Shared Leadership

	1. Overall performance 35	2. Overall satisfaction 21	3. Quality effectiveness 38	4. Planning effectiveness (on-time) 9	5. Planning effectiveness (effective use of time) 13	6. Change effectiveness (problem handling) 20	7. Change effectiveness (coping with changes) 28
Boundary Spanning 43	28	18	31	7	9	18	23
Consideration 32	24	15	27	5	10	16	22
Empowerment 8	8	6	8	3	4	7	6
Initiating Structure 29	21	15	24	7	11	11	16
Motivation 7	6	5	7	1	3	5	4
Transactional 1	1		1			1	1
Transformational 5	5	4	5	2	3	3	4

Figure 4.29: Observation 5 Frequency Table - Shared Leadership vs Team Effectiveness

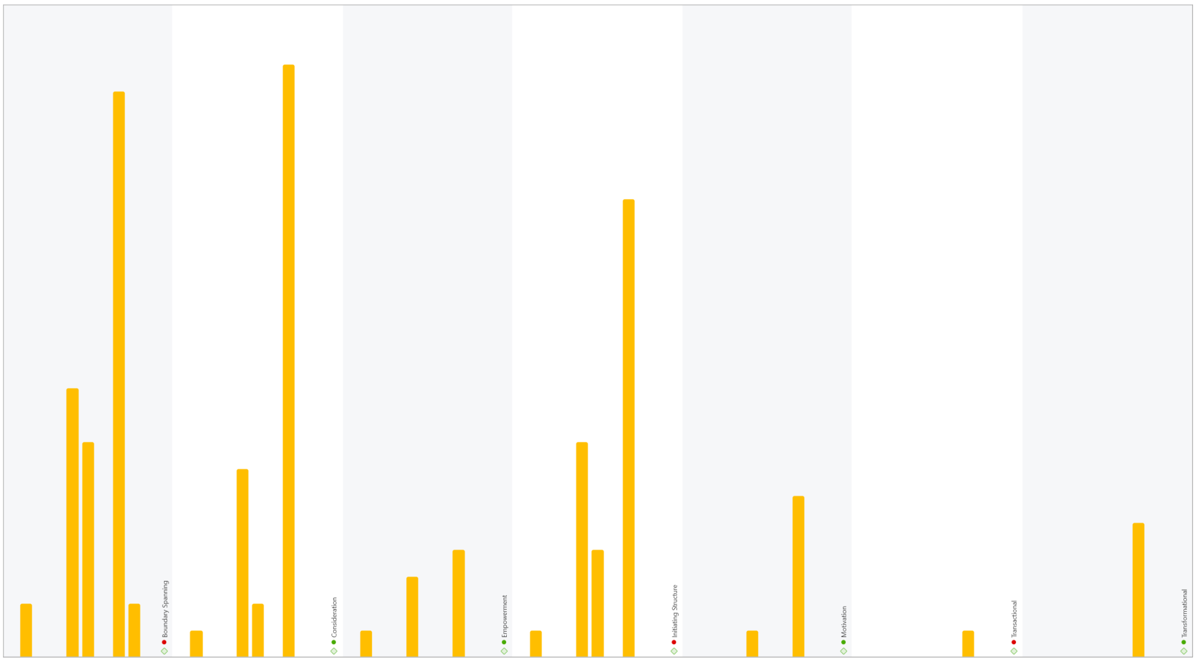

Figure 4.30: Observation 5 Bar Chart - Role vs Shared Leadership

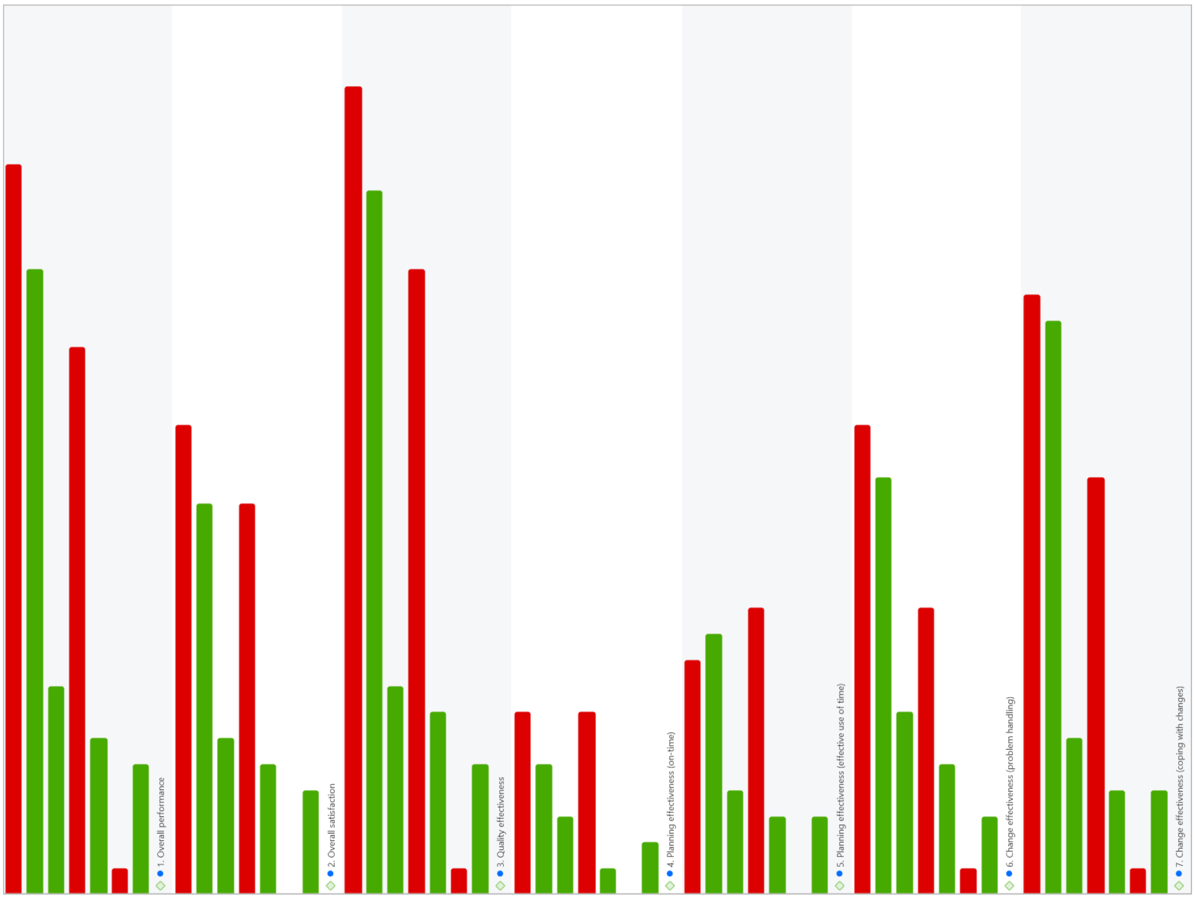

Figure 4.31: Observation 5 Bar Chart - Shared Leadership vs Team Effectiveness

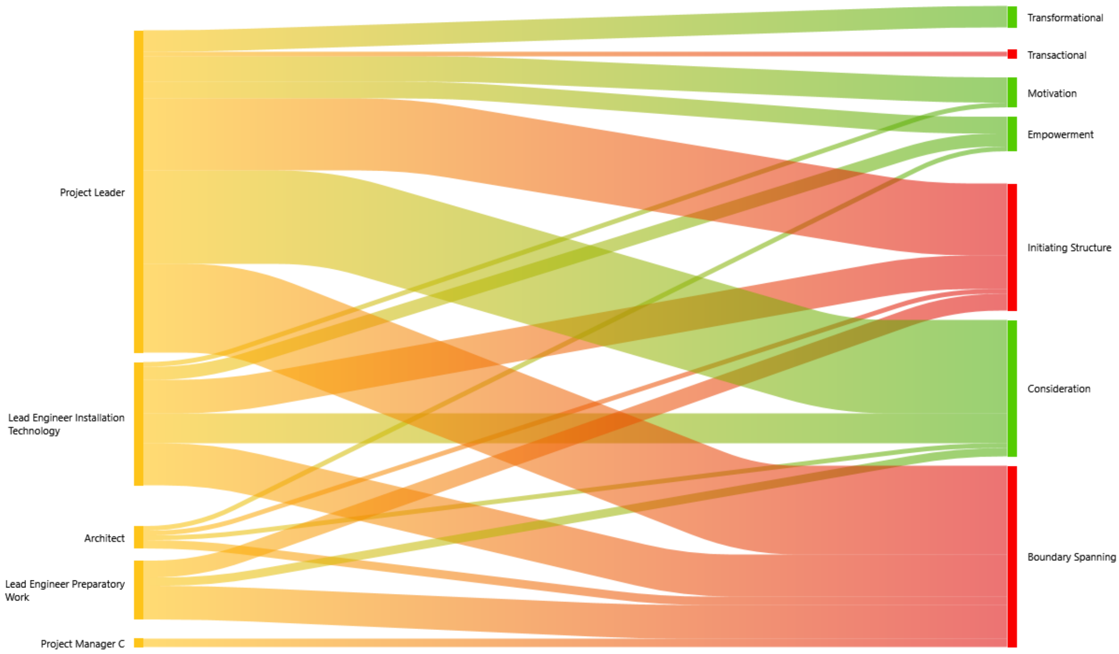

Figure 4.32: Observation 5 Sankey Diagram - Role vs Shared Leadership

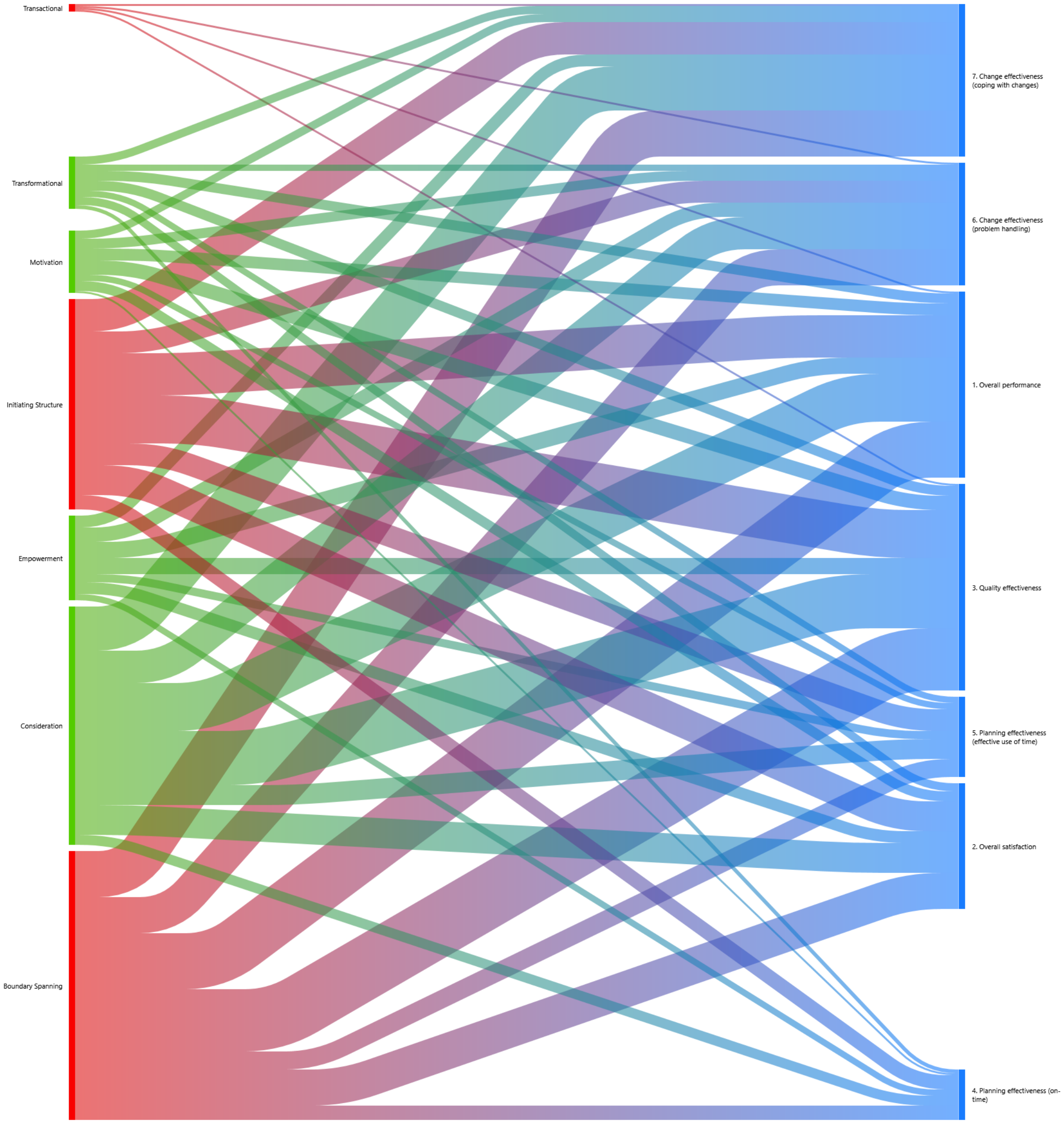

Figure 4.33: Observation 5 Sankey Diagram - Shared Leadership vs Team Effectiveness

4.7. Summary of the Observations

Table 4.8: Summary of the average Team Effectiveness scores and standard deviations 50/10kV

Summary Team Effectiveness scores 50/10kV						
Observation	Baseline	1	2	3	4	5
Average score	16.83	18.40	14.92	16.50	14.25	15.30
Standard deviation	3.10	1.52	2.73	1.64	3.30	1.79

Table 4.9: Summary individual Team Effectiveness average scores, standard deviations, and difference scores 50/10kV

Summary individual Team Effectiveness 50/10kV										
Team member	1	2	3	4	5	6	7	8	9	10
Average score	17.80	13.33	17.67	15.50	16.50	16.00	18.10	13.80	N/A	15.80
Standard deviation	1.48	3.51	1.15	3.54	1.29	1.80	1.67	2.68	N/A	3.42
Δ1	2	N/A	N/A	-5	1	N/A	3	N/A	N/A	-4
Δ2	4	7	2	N/A	2	N/A	3.5	-2	N/A	2
Δ3	**3**	**6**	2	N/A	3	-3.5	4	-6	N/A	3
Δ4	2	**5**	**2**	N/A	2	**-2.25**	**4**	1	N/A	5
Δ5	3	4	**2**	N/A	N/A	-1	4	-2	N/A	N/A

Bold values are extrapolated values

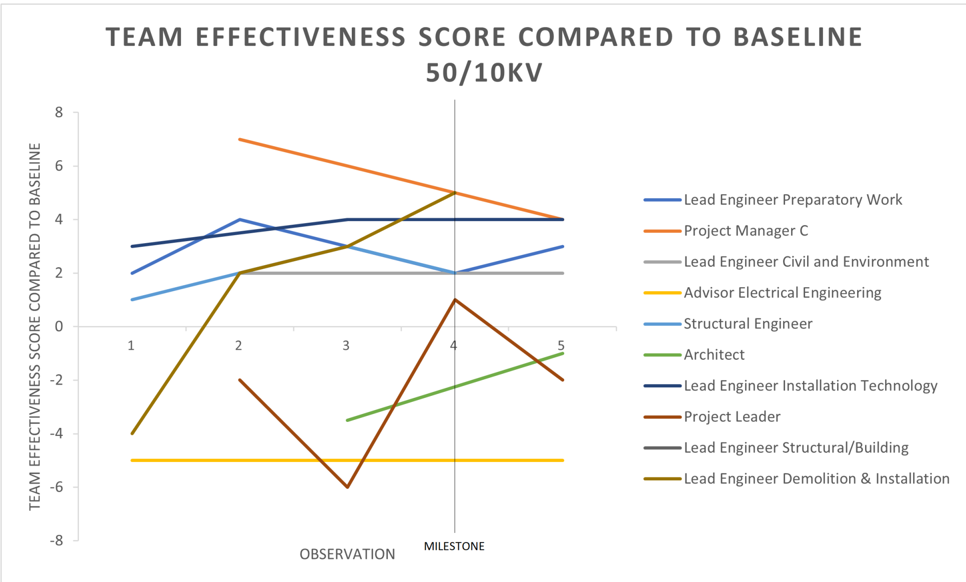

Figure 4.34: Summary Difference Scores 50/10kV

	Boundary Spanning 351	Consideration 246	Empowerment 102	Initiating Structure 410	Motivation 45	Transactional 18	Transformational 26
Advisor Electrical Engineering 0							
Architect 66	55	33	21	63	7		
Lead Engineer Civil and Environment 3	2			3			
Lead Engineer Demolition and Installation 48	36	15	3	45	1		
Lead Engineer Installation Technology 96	68	51	27	80	9	4	9
Lead Engineer Preparatory Work 38	27	12	5	28			1
Lead Engineer Structural/Building 44	30	20	4	38	3		1
Project Leader 181	124	116	43	148	26	14	15
Project Manager C 9	6	2		5			
Structural Engineer 9	7	2		8			

Figure 4.35: Summary Observations Frequency Table - Role vs Shared Leadership

	1. Overall performance 223	2. Overall satisfaction 235	3. Quality effectiveness 262	4. Planning effectiveness (on-time) 69	5. Planning effectiveness (effective use of time) 81	6. Change effectiveness (problem handling) 149	7. Change effectiveness (coping with changes) 110
Boundary Spanning 351	193	196	211	53	49	119	88
Consideration 246	129	146	139	24	50	92	56
Empowerment 102	54	65	64	24	24	49	27
Initiating Structure 410	202	218	230	61	78	128	90
Motivation 45	21	30	24	7	13	21	9
Transactional 18	6	6	6	2	8	5	4
Transformational 26	10	11	18	9	8	15	9

Figure 4.36: Summary Observations Frequency Table - Shared Leadership vs Team Effectiveness

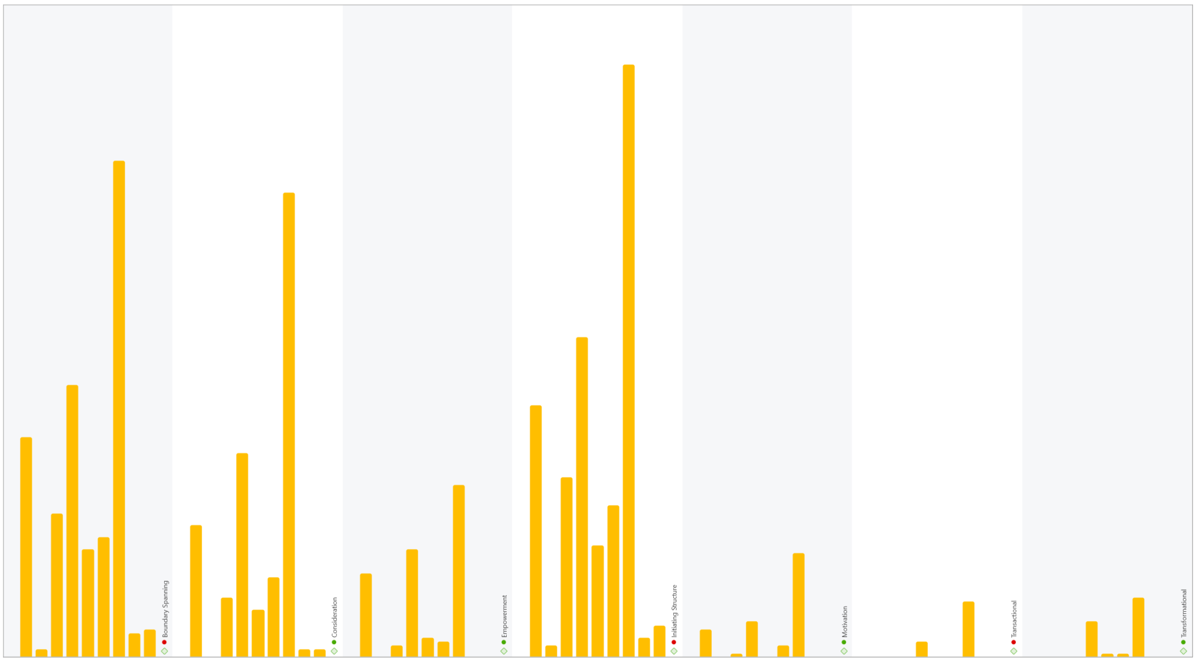

Figure 4.37: Summary Observations Bar Chart - Role vs Shared Leadership

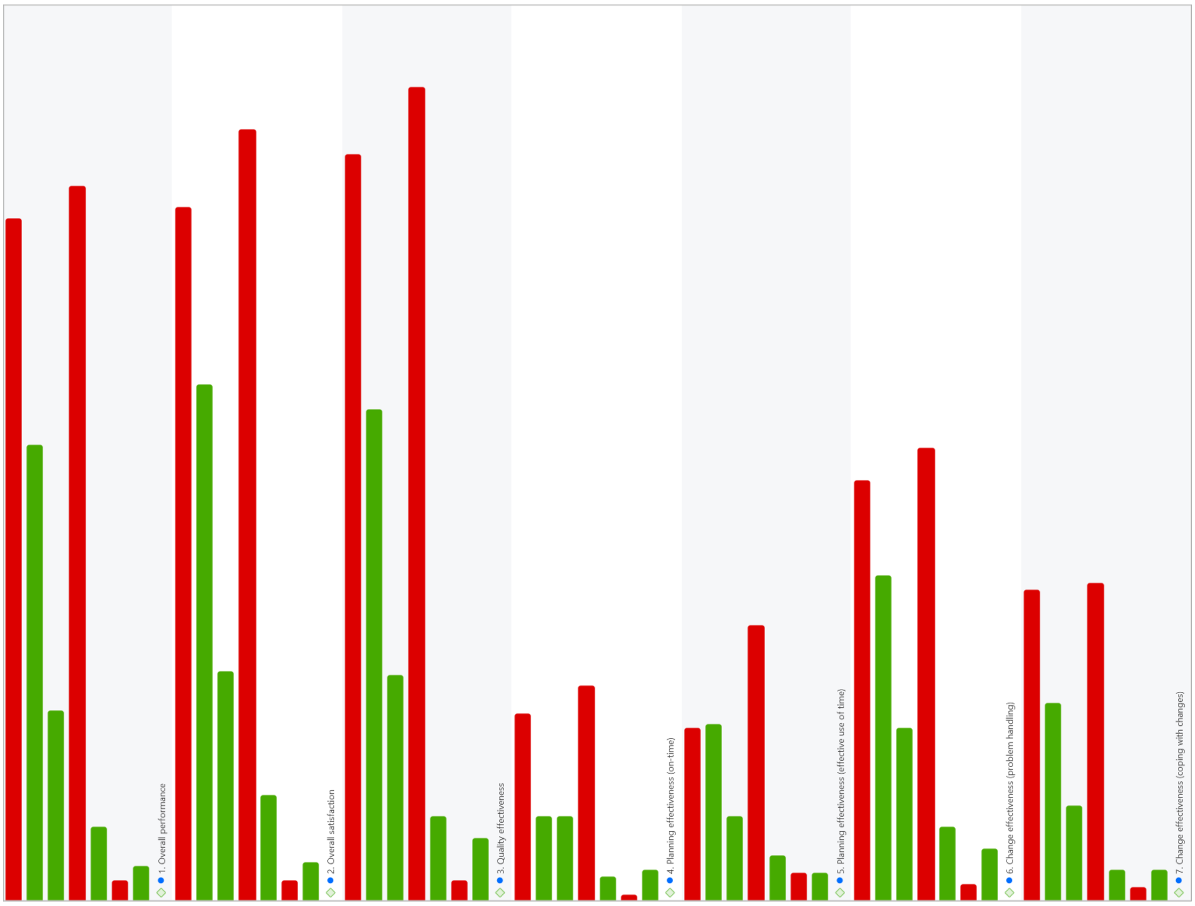

Figure 4.38: Summary Observations Bar Chart - Shared Leadership vs Team Effectiveness

Figure 4.39: Summary Observations Sankey Diagram - Role vs Shared Leadership

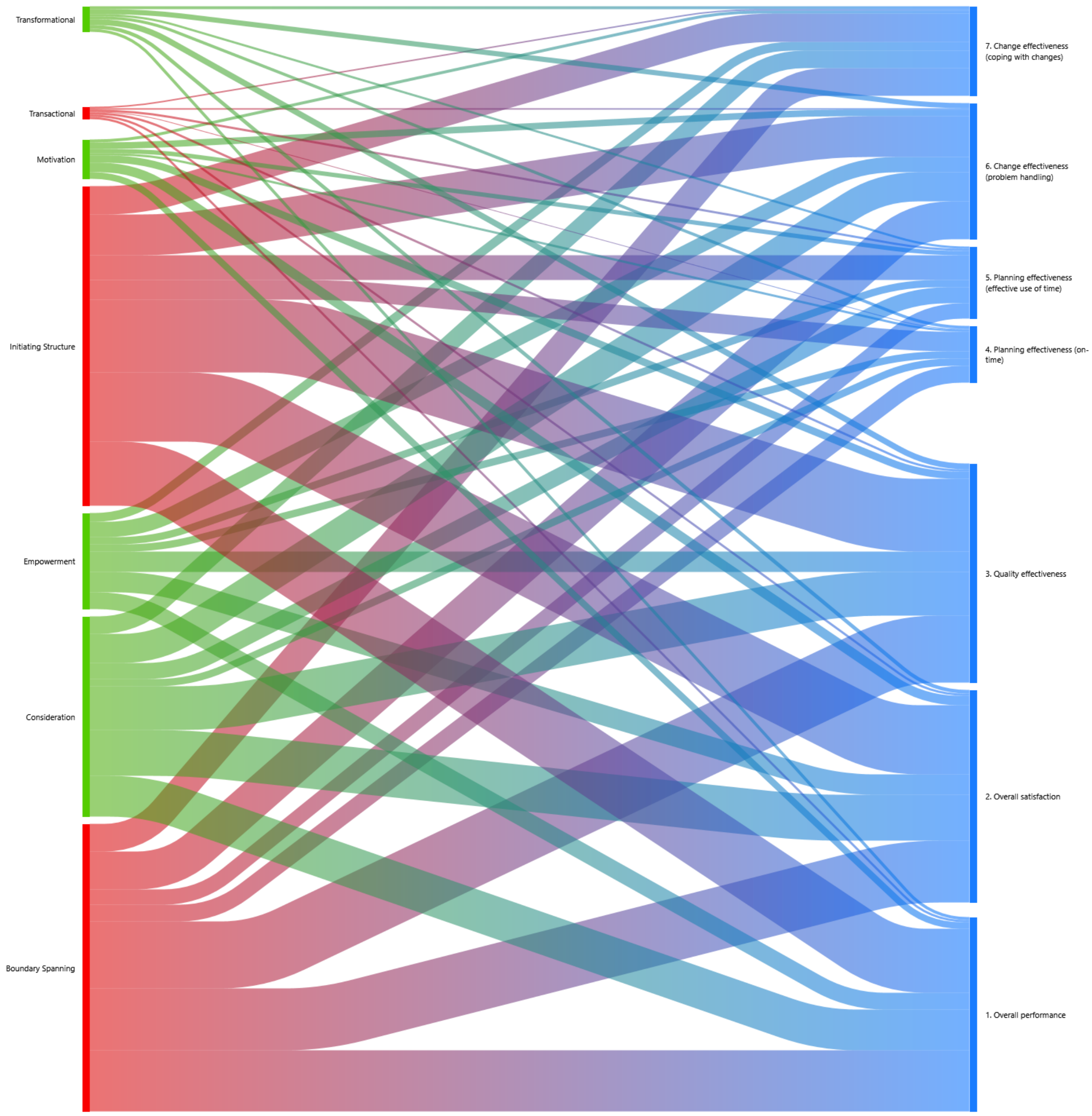

Figure 4.40: Summary Observations Sankey Diagram - Shared Leadership vs Team Effectiveness

5
Case 2 - Main Station Schiphol South-East 150/20kV

This chapter will begin by introducing Case 2 - Main Station Schiphol South-East 150/20kV, which entails the project overview, its context, organizational structure and project meeting structure. Thereafter, for each of the observations, general information and agenda topics are listed, a summary of the project meeting is reported, and an overview is given of the collected quantitative and qualitative data.

5.1. Project Overview

This section introduces case 2 by providing background and contextual information about the Main Station Schiphol South-East 150/20kV project. Next, the organizational context of the project is described and presented through an organizational structure. Lastly, the structure of project meetings is given. All factual information regarding the project and its structure are provided by the Royal HaskoningDHV internship supervisor.

5.1.1. Project Description

Schiphol B.V. (SNBV) has developed a vision to drastically reduce greenhouse gas emissions by 2030 and to become climate-neutral by 2050, in response to the Paris Agreement. Utilization of fossil fuels must be ceased and transition must be made to electrical energy in order to achieve these ambitions. One of the ambitions is exemplified through electrification of ground activities (i.e. electricity provision for still-standing airplanes and taxiing airplanes). As a result of electrification in general, the future demand for electricity will increase substantially and exceed the supply. Similar to Case 1 - Main Station Schiphol Center 50/10kV, the current energy infrastructure is reaching the end of its lifespan and its current capacity is insufficient to supply the projected future demand of 325 MVA. Subsequently, Schiphol B.V. has developed the Masterplan Power Grid 2060 in which it necessitates the need for a new high-voltage station that is officially referred to as Main Station Schiphol South-East 150/20kV that will provide 225 MVA and the remaining 100 MVA will be covered by Main Station Schiphol Center 50/10kV.

The 150/20kV station will be procured on the basis of a UAC-IC 2005 through an integrated project-delivery method in which the project is currently in the tender phase. The execution period is nearly three years from the moment of signing the contract and the total duration of the contract is around eight years including a period of five years regarding maintaining and operating the station. It is expected that the newly-built high-voltage 150/20kV substation will be operational in December 2026 to supply electricity for the regions of North-West, North and South-East, GH and Center. Figure 5.1 illustrates the intended timeline of the project.

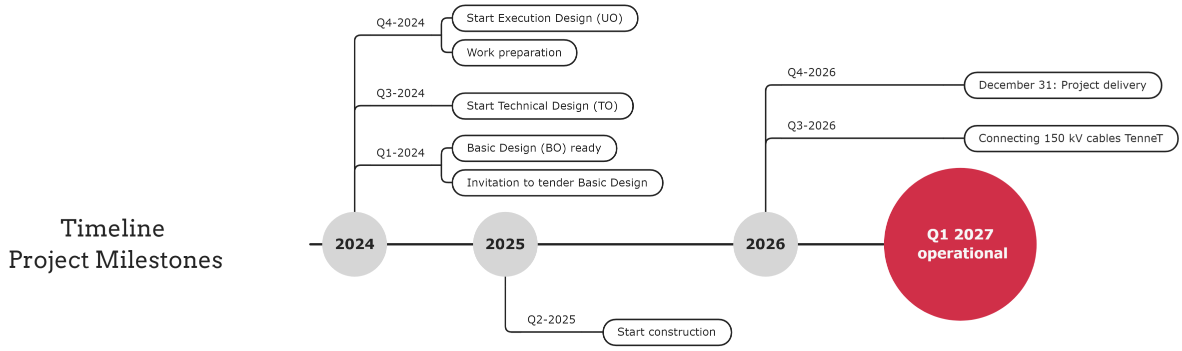

Figure 5.1: Timeline Project Milestones 150/20kV

5.1.2. Organizational Structure

The illustration of the organizational structure for the 150/20kV project is somewhat different from the 50/10kV project. As mentioned in the previous section, the project will be procured on the basis of a UAC-IC 2005 contract through an integrated project-delivery method and the project is currently in the tender phase, hence there is not yet an official awarding contractor. The client is Schiphol B.V. that employs different design and consulting parties. A number of team members involved in the 50/10kV project are also employed for the 150/20kV project. The relationship between the client and each of the design/consulting parties are governed by TNR 2011 contract. Figure 5.2 shows the contractual relations between the client, the engineering design team and the contractor.

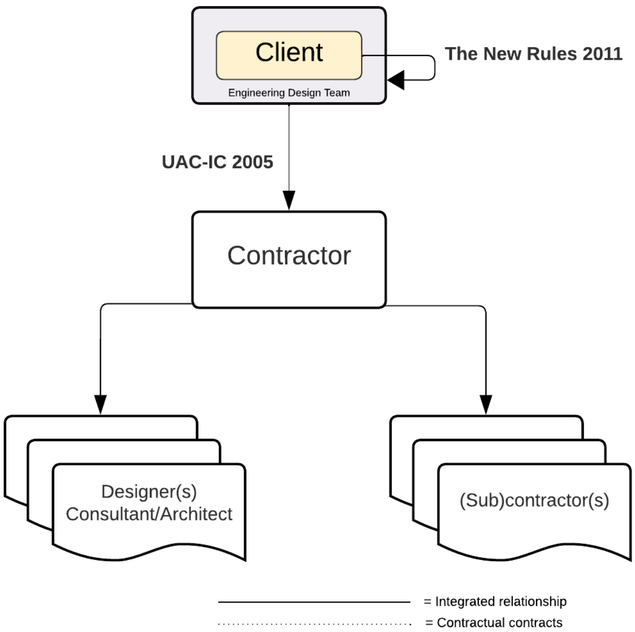

Figure 5.2: Contractual relations of the 150/20kV project (own illustration)

The rationale for employing these design and consulting parties is for them to create a Specification of Requirements (Vraagspecificatie) that consists of a general specification (VSA; Vraagspecificatie Algemeen), process specification (VSP; Vraagspecificatie Proces), and requirement specification (VSE; Vraagspecificatie Eisen).

The VSA is the general part of the specification of requirement agreement for the 150/20kV project. It serves as a general and introductory document to the project that provides a description of the project and insights into the ambitions and intentions of the client as well as the project context. Subsequently, based on the general specification, the contractor should be able to correctly interpret the requirements and come to appropriate design choices, taking into account the expectations and interests of the client and other stakeholders. The process specification and requirement specification documents are provided in addition to the general specification documents. The process specification and its annexes define requirements with regard to activity processes and document deliverables, while the requirement specification and its annexes define requirements concerning the physical results of the structure, or in other words, what must be built and delivered. Figure 5.3 summarizes the structure of the Specification of Requirements.

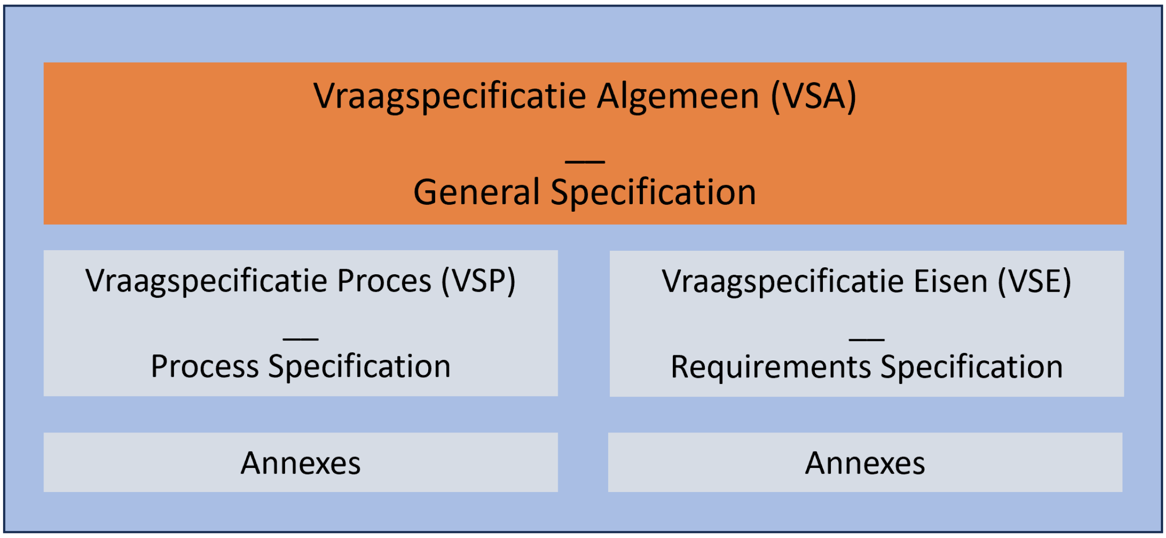

Figure 5.3: Structure of the Specification of Requirements (Vraagspecificatie)

In the 150/20kV project, there is a project manager from the client that is supported by an assistant project manager to oversee the tasks and activities. As mentioned earlier in the paragraph, a number of team members involved in the 50/10kV project are also employed for the 150/20kV project. However, there are additional team members such as a custom requirements specifier, lead engineer installation technology 150kV, operational installation manager, and a system integrator. A total of 10 team members that have given their consent to participate in this research study are listed below and an overview of the project organization of the 150/20kV project is summarized in figure 5.4.

- Architect;
- Assistant Project Manager;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Operational Installation Manager;
- Project Manager;
- Project Leader;
- Project Leader B;
- System Integrator.

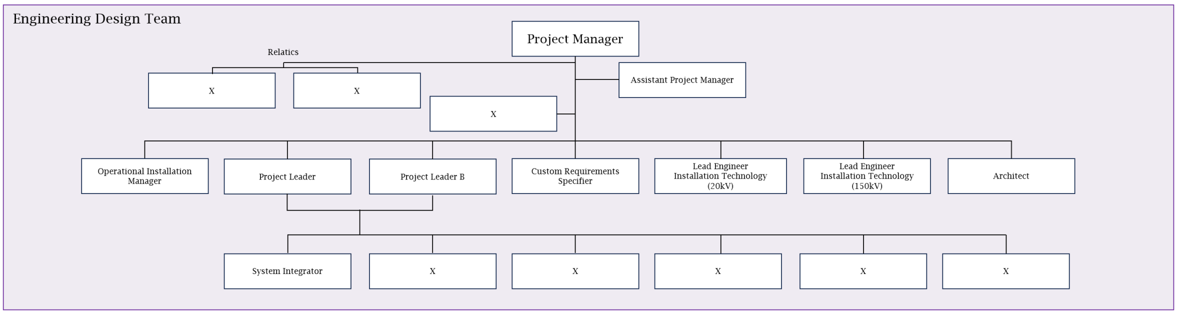

Figure 5.4: Project Organization 150/20kV

5.1.3. Project Meeting Structure

The type of meeting relevant for this research in accordance with the research question and literature review is the project meeting in which the action list is reviewed as it consists of members that form an engineering design team. All other meetings such as the internal meetings within the organization of the client are not considered. The action list review has the purpose of discussing tasks and activities and has a frequency of once a week. Similar to the 50/10kV project, the meetings are guided by an excel sheet that contains several tabs related to the agenda, actions, decision-making, progress and attendees. New agenda topics and actions are noted during the meeting. Further details have been discussed and can be found in subsection 4.1.3. Project Meeting Structure.

5.2. Observation 1

General
Date: January 23, 2024
Type of meeting: Engineering Design Team
Duration: 54 minutes
Attendees:

- Assistant Project Manager;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Operational Installation Manager;
- Project Leader;
- Project Leader B;
- System Integrator.

Agenda

- Status Specification of Requirements;
- Sustainability requirements;
- Work Package 1 - Construction site arrangements;
- Work Package 2 - Review VES cables;
- Work Package 3 - Checking for completeness based on the Program of Requirements;
- Work Package 4 - Conversion of tables;
- Work Package 5 - Review GGI (Gebouwgebonden Installaties);
- Work Package 7 - Business management requirements;
- Work Package 8 - ITCP amenities;
- Work Package 9 - Construction standards and discussion TenneT;
- Documents overview;
- Complementing Security requirements;
- Review Process Specification (VSP);
- Verification acceptance and assessment documents;
- Software systems and ownership software security;
- Ditches.

Summary of the project meeting

The first observation of the Engineering Design Team of the 150/20kV project started with the System Integrator informing about the current status of the Specification of Requirements. The general requirements are known and will be added to the general specification. The system integrator raised concerns about the clients sustainability requirements not being specific, which bears the risk of contractors being uncertain how to address those requirements as well as how to verify compliance. This needs to be addressed as the Engineering Design Team wants to stimulate the contractor to comply with the needs and requirements of the client. Security requirements has been a major topic for the past period that may have not received proper attention. As a result, there is an absence of clear understanding by some team members regarding security requirements. Therefore, a meeting on February 1 is planned specifically to address this topic and to dive into the details. Business management is another topic in which a clear understanding is lacking. The Project Leader proposed to have input for this topic the following week. Additionally, other issues were discussed with regard to insufficient ITCP deliverables, requirements that were not shared early, software systems and software security ownership, and ditch requirements while no ditches have been observed. The highlight of the meeting was the System Integrator specifying the following goals for next week: Consistent referencing, delivering requirements of each work package in table format, the System Integrator processing comments and checking for completeness based on the Program of Requirements, team members reviewing the chapters, and collectively going through the Process Specification to conclude final tasks and activities. A concern was raised by a team member that the team should keep overview and control to a certain extent to guarantee the final product.

Collected data

Table 5.1: Baseline Team Effectiveness scores 150/20kV

Baseline Team Effectiveness scores										
Team member	1	2	3	4	5	6	7	8	9	10
Score	16	17	16	16.5	19	9	12	11	11	17
Average score					14.45					
Standard deviation					3.37					

Table 5.2: Observation 1 Team Effectiveness scores 150/20kV

Observation 1 Team Effectiveness scores (23-01-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	16	17	16	N/A	18	14	12	12	N/A	16
Average score					15.13					
Standard deviation					2.23					

		Boundary Spanning 117	Consideration 60	Empowerment 14	Initiating Structure 86	Motivation 8	Transactional 3	Transformational 3
Advisor Electrical Engineering	0							
Architect	0							
Custom Requirements Specifier	8	8	2		2			
Lead Engineer Installation Technology	16	14	8	3	11		1	
Lead Engineer Installation Technology 150kV	11	9	2		5			
Operational Installation Manager	1	1	1					
Project Leader	25	15	12	4	14	6	2	2
Project Leader B	15	10	6	2	7			
Project Manager	0							
System Integrator	46	39	10	3	32	2		1

Figure 5.5: Observation 1 Frequency Table - Role vs Shared Leadership

		1. Overall performance 611	2. Overall satisfaction 599	3. Quality effectiveness 436	4. Planning effectiveness (on-time) 121	5. Planning effectiveness (effective use of time) 36	6. Change effectiveness (problem handling) 91	7. Change effectiveness (coping with changes) 46
Boundary Spanning	501	458	444	345	90	18	72	33
Consideration	272	245	248	179	39	10	50	20
Empowerment	84	81	82	66	16	7	18	8
Initiating Structure	477	451	438	330	85	30	74	39
Motivation	28	22	25	19	7	1	1	1
Transactional	19	19	19	7	1	1	5	1
Transformational	6	5	5	4	2	1	2	

Figure 5.6: Observation 1 Frequency Table - Shared Leadership vs Team Effectiveness

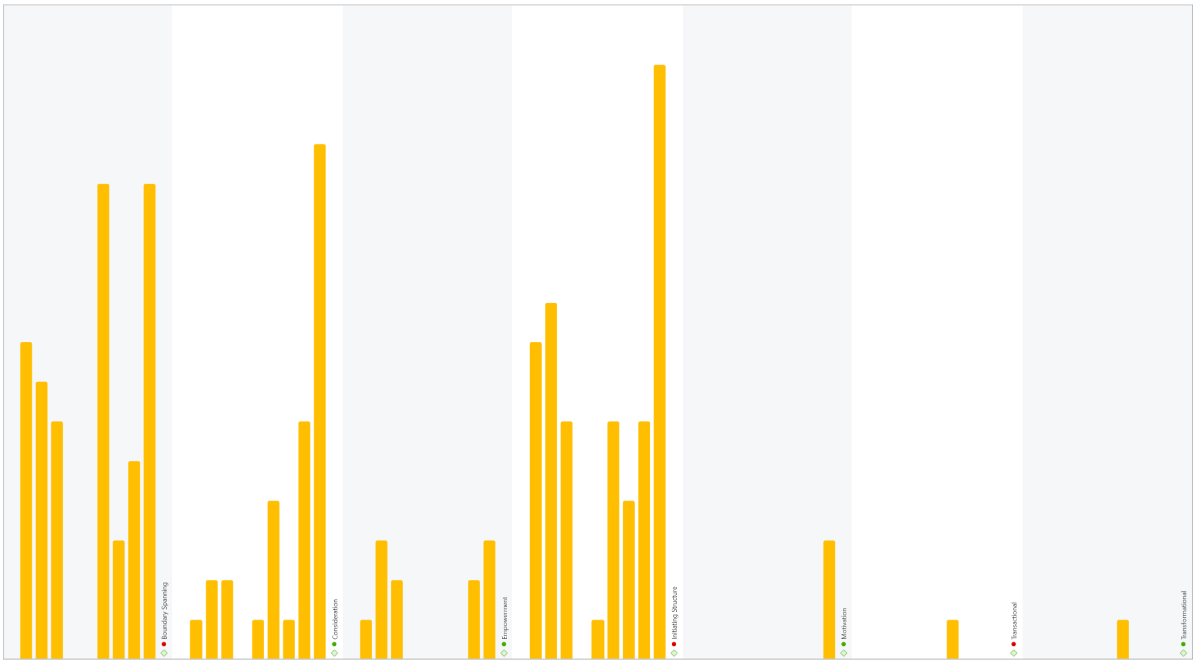

Figure 5.7: Observation 1 Bar Chart - Role vs Shared Leadership

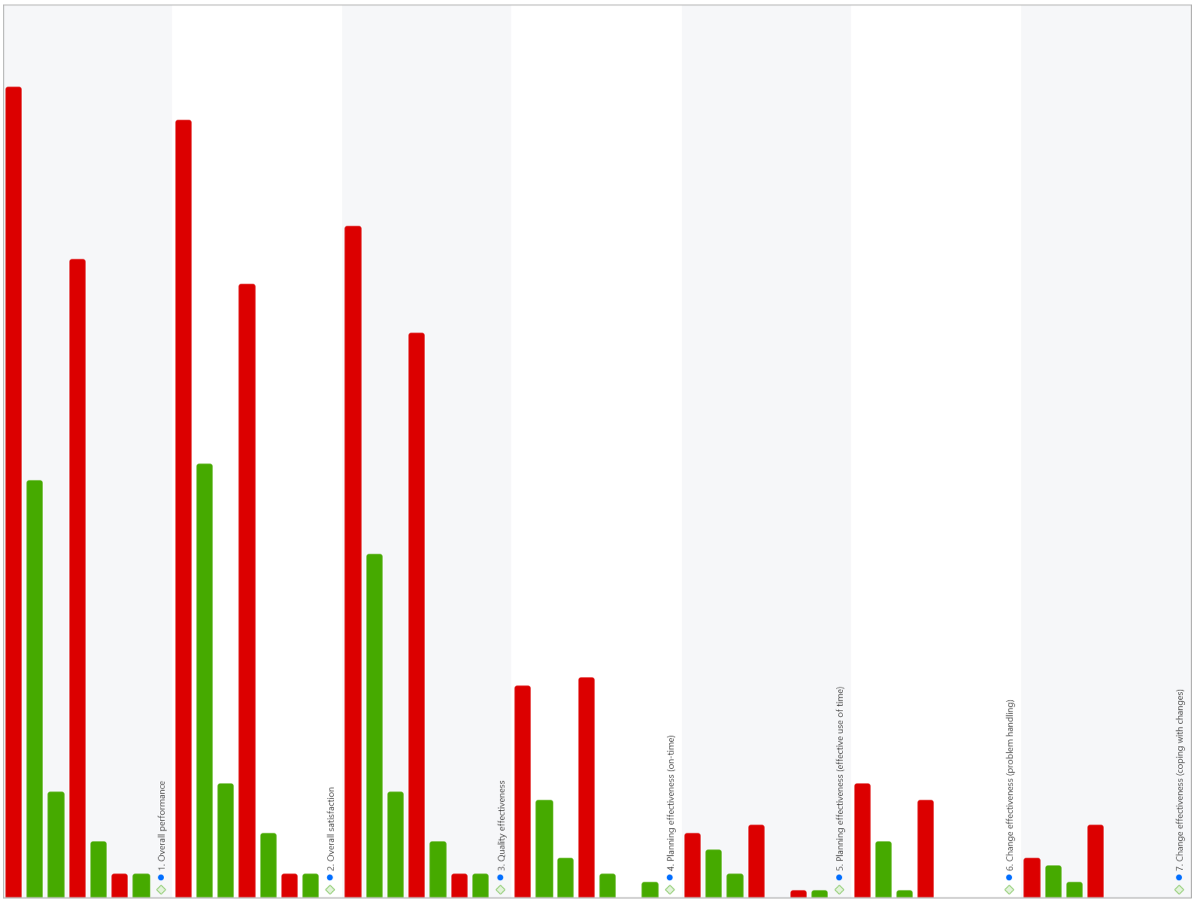

Figure 5.8: Observation 1 Bar Chart - Shared Leadership vs Team Effectiveness

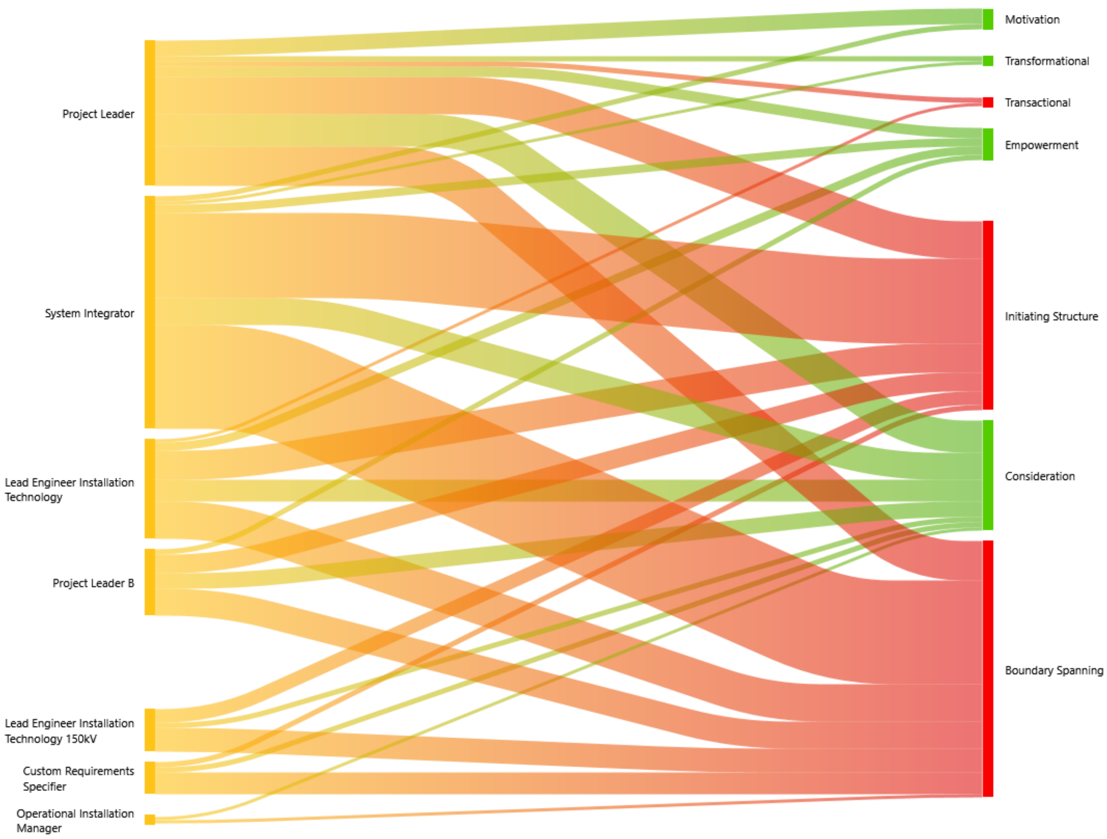

Figure 5.9: Observation 1 Sankey Diagram - Role vs Shared Leadership

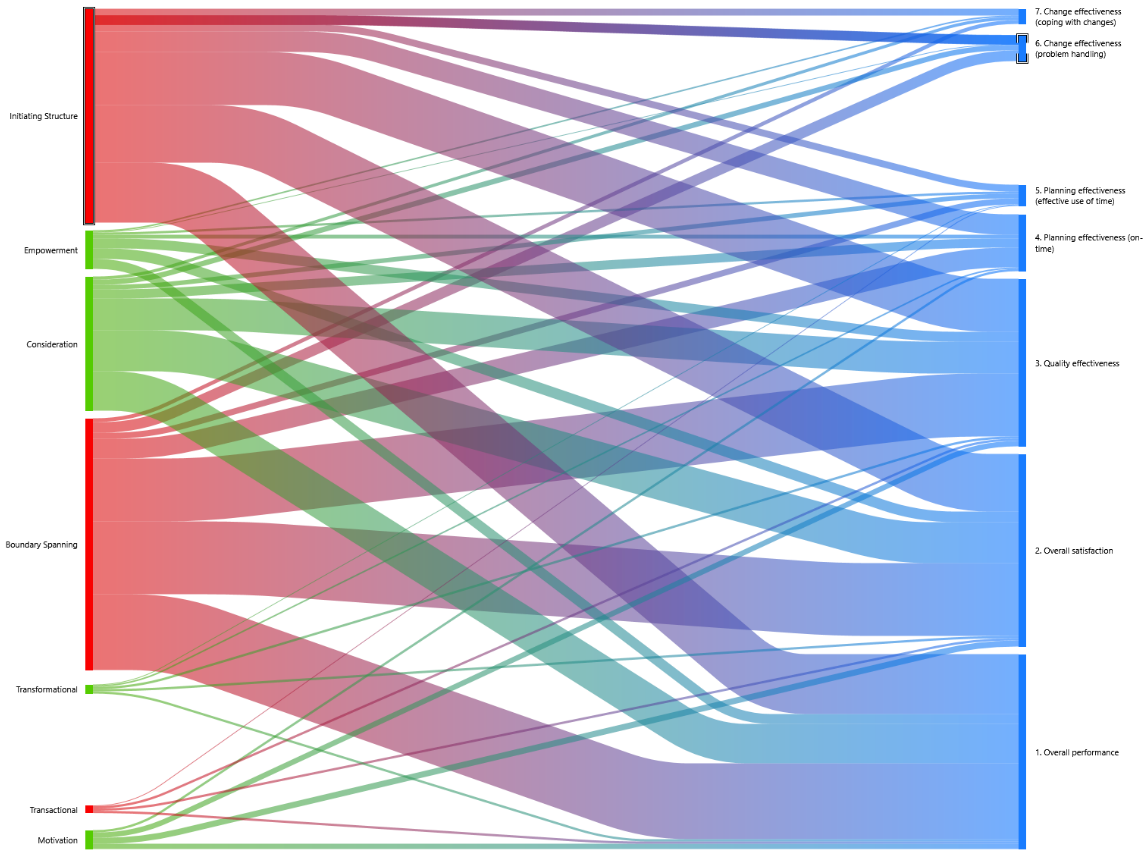

Figure 5.10: Observation 1 Sankey Diagram - Shared Leadership vs Team Effectiveness

5.3. Observation 2

General
Date: January 30, 2024
Type of meeting: Engineering Design Team
Duration: 57 minutes
Attendees:

- Assistant Project Manager;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Operational Installation Manager;
- Project Manager;
- Project Leader;
- Project Leader B;
- System Integrator.

Agenda

- Work Package 3 - Checking for completeness based on the Program of Requirements;
- Work Package 4 - Conversion of tables;
- Work Package 7 - Business management requirements;
- Work Package 8 - ITCP amenities;
- Work Package 9 - Construction standards and discussion TenneT;
- Documents overview;
- Complementing Security requirements;
- Verification acceptance and assessment documents.

Summary of the project meeting
The meeting structure for this meeting is slightly different as the focus is to review the Specification of Requirement document, hence the agenda topics are less important. The System Integrator started going through the Specification of Requirement and all the work packages and its corresponding chapters. It is partly table format and partly checklists which is starting to get more structured. Requirements from the Architect have been shared in which a few need adjustments and a few requirements need to be added. The chapter from the Lead Engineer Installation Technology was very structured and clear, which still needs to be converted to tables. An on-going task for the System Integrator is to do the completeness check on the basis of the Program of Requirements which will be reviewed by the Custom Requirements Specifier. Attention was drawn to the safety and security requirements concerning the possibility that the client may not want them, and providing requirements from past projects to put it in a requirement set as preparatory work. Moreover, the current requirements only specify what needs to be physically realized while other aspects are neglected, which need to be addressed. Concerns were raised about certain requirements not being specific for the contractor to address those, and the 9 infamous questions have not been answered yet and will be escalated to the higher-ups in case there is no progress after the planned meeting. For the operation and maintenance of the 150kV installation there are 3 options: outsource to TenneT, train own staff, or outsource to System Integrator (not the same SI of this project). The meeting ended with a necessity for adding documents and finishing final tasks as well as gathering requirements and reaching agreement with TenneT, business management and an involved individual representing another organization as their requirements may conflict with one another.

Collected data

Table 5.3: Observation 2 Team Effectiveness scores 150/20kV

Observation 2 Team Effectiveness scores (30-01-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	16	17	20	N/A	21	16	14	N/A	11	17
Average score	16.50									
Standard deviation	3.16									

		Boundary Spanning 54	Consideration 29	Empowerment 11	Initiating Structure 54	Motivation 3	Transactional 1	Transformational 1
Architect	0							
Assistant Project Manager	11	8	1	1	8			
Custom Requirements Specifier	13	7	2	3	9			
Lead Engineer Installation Technology	9	6	2	2	6			
Lead Engineer Installation Technology 150kV	0							
Operational Installation Manager	1		1		1			
Project Leader	14	12	4		6		1	1
Project Leader B	4	3	1		4			
Project Manager	11	5	6	2	6			
System Integrator	26	12	13	3	15	3		

Figure 5.11: Observation 2 Frequency Table - Role vs Shared Leadership

		1. Overall performance 67	2. Overall satisfaction 68	3. Quality effectiveness 45	4. Planning effectiveness (on-time) 8	5. Planning effectiveness (effective use of time) 7	6. Change effectiveness (problem handling) 6	7. Change effectiveness (coping with changes) 2
Boundary Spanning	54	41	42	33	4	4	4	1
Consideration	29	24	27	17	2	2	3	
Empowerment	11	9	9	7		1		
Initiating Structure	54	46	44	29	8	5	2	2
Motivation	3	2	3	2				
Transactional	1	1	1					
Transformational	1							

Figure 5.12: Observation 2 Frequency Table - Shared Leadership vs Team Effectiveness

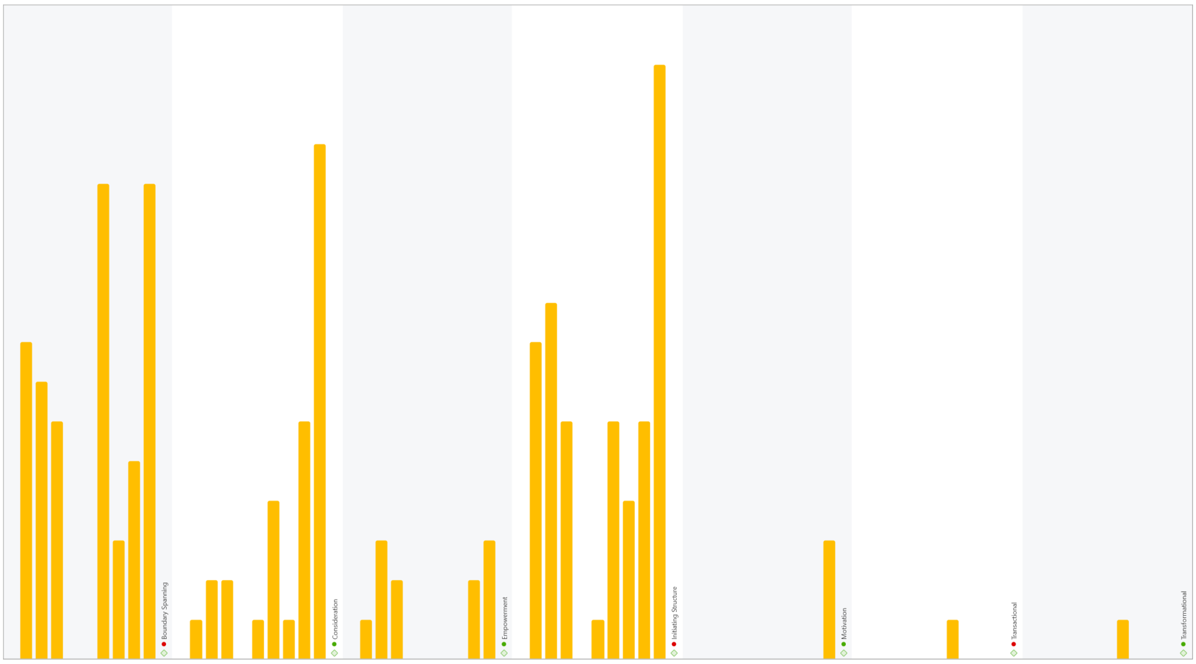

Figure 5.13: Observation 2 Bar Chart - Role vs Shared Leadership

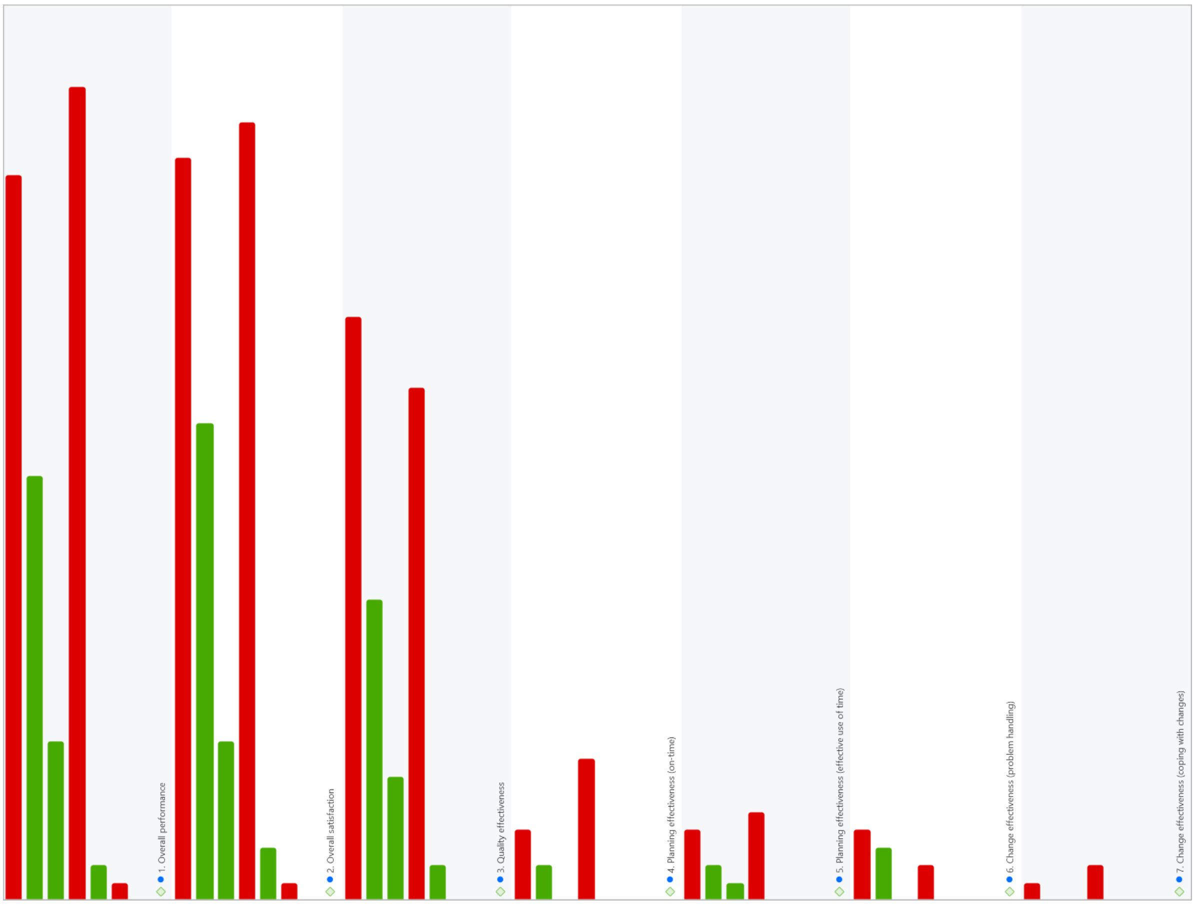

Figure 5.14: Observation 2 Bar Chart - Shared Leadership vs Team Effectiveness

Figure 5.15: Observation 2 Sankey Diagram - Role vs Shared Leadership

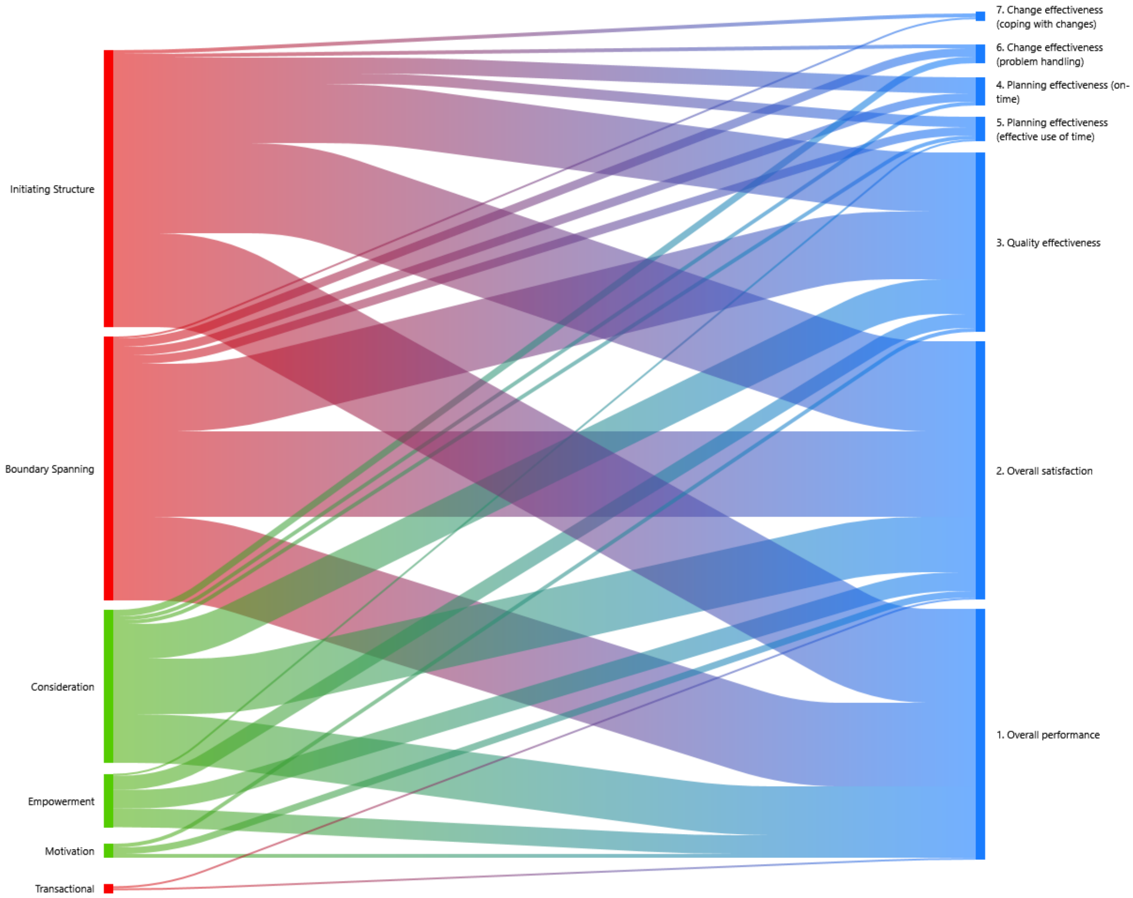

Figure 5.16: Observation 2 Sankey Diagram - Shared Leadership vs Team Effectiveness

5.4. Observation 3

General
Date: February 6, 2024
Type of meeting: Engineering Design Team
Duration: 47 minutes
Attendees:

- Architect;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Project Manager;
- Project Leader;
- System Integrator.

Agenda

- Permits 150kV;
- Status electrical supply;
- Work Package 3 - Ditches and vehicle access;
- Work Package 4 - Conversion of tables;
- Work Package 5 - Review GGI;
- Work Package 7 - Review;
- Work Package 8 - ITCP demarcation procedure;
- Work Package 9 - Construction standards and discussion TenneT;
- Planning follow-up procedures;
- Verification acceptance and assessment documents.

Summary of the project meeting
This meeting had a different chair as the Assistant Project Manager was absent. The role of the chair was temporarily taken over by the Assistant Project Manager's colleague. This meeting has the regular structure of going through the action list, in contrast to the previous meeting which had the focus on reviewing the Specification of Requirements document. It was agreed to have this document completed by January 31. The current progress is that ownership interfaces still needed be included, and ditches and vehicle access need to be specified. It is now clear how to address sustainability requirements. Questions were raised concerning how to move martens and which party will provide new homes for these animals. It could either be the contractor or a specialized company. These aspects must be included in the specification documents. An additional meeting is planned for next week to discuss the System Integrator's questions and remarks to the team members with regard to their deliverables. An important topic was the road access requirements about the border till which the contractor is allowed to build. The details are known but is has not yet been included in the documents. The contract document and Specification of Requirements document shall be delivered for the client to read for feedback and approval before finalization. There was a remark about grounding and thunder: requirements are formulated, but they were not mutually consistent, hence it needs review.

Going through the work package tasks was very concise as it was still in progress or already completed. Work package 4 conversion of tables was still in progress; Work package 5 Review GGI was done as comments have been provided and adjustments have been made; Work package 7 is a review by the chair of this meeting and the Assistant Project Manager; Work Package 8 ITCP is a work package that is experiencing a lesser degree of progress as the demarcation procedure document still has not been sent. It concerns one of the nine questions from the System Integrator and it most certainly will address the remaining eight questions if the document is provided; Work package 9 Input construction standards and discussion with TenneT has been done and completed, and will be processed. The meeting ended with the topic about properly labelling spaces. The Project Leader emphasized the importance of properly labelling the meeting room as a slightly different name will have to comply to all kinds of different building decree requirements.

Collected data

Table 5.4: Observation 3 Team Effectiveness scores 150/20kV

Observation 3 Team Effectiveness scores (06-02-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	14	17	17	16	19	12	N/A	N/A	10	N/A
Average score	15.00									
Standard deviation	3.16									

		Boundary Spanning 52	Consideration 19	Empowerment 16	Initiating Structure 46	Motivation 0	Transactional 4	Transformational 0
Architect	12	10	3	1	8			
Assistant Project Manager	0							
Custom Requirements Specifier	6	6	1	1	5			
Lead Engineer Installation Technology	4	3	2	2	4			
Lead Engineer Installation Technology 150kV	4	3	3		2			
Operational Installation Manager	0							
Project Leader	8	7	3	4	6		4	
Project Leader B	0							
Project Manager	7	5		2	6			
System Integrator	23	20	9	6	15			

Figure 5.17: Observation 3 Frequency Table - Role vs Shared Leadership

		1. Overall performance 59	2. Overall satisfaction 60	3. Quality effectiveness 48	4. Planning effectiveness (on-time) 15	5. Planning effectiveness (effective use of time) 2	6. Change effectiveness (problem handling) 12	7. Change effectiveness (coping with changes) 7
Boundary Spanning	52	50	51	43	14	2	10	5
Consideration	19	18	19	12	4		4	3
Empowerment	16	16	16	13	4	1	5	2
Initiating Structure	46	44	45	35	7	2	10	7
Motivation	0							
Transactional	4	4	4	1			1	
Transformational	0							

Figure 5.18: Observation 3 Frequency Table - Shared Leadership vs Team Effectiveness

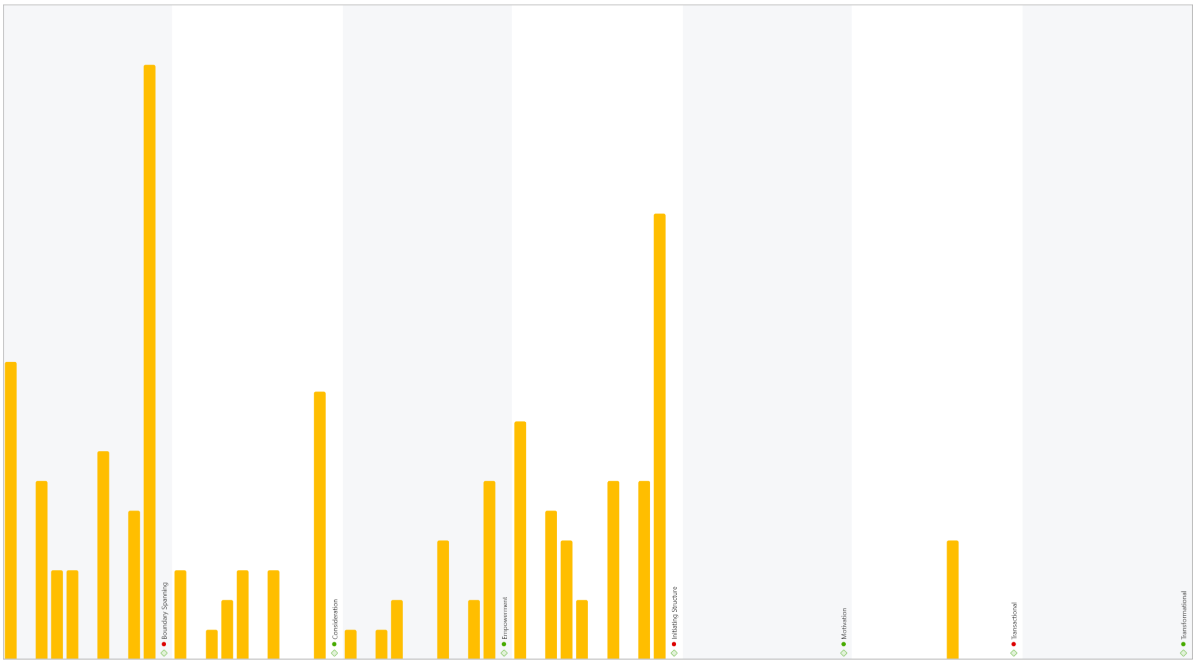

Figure 5.19: Observation 3 Bar Chart - Role vs Shared Leadership

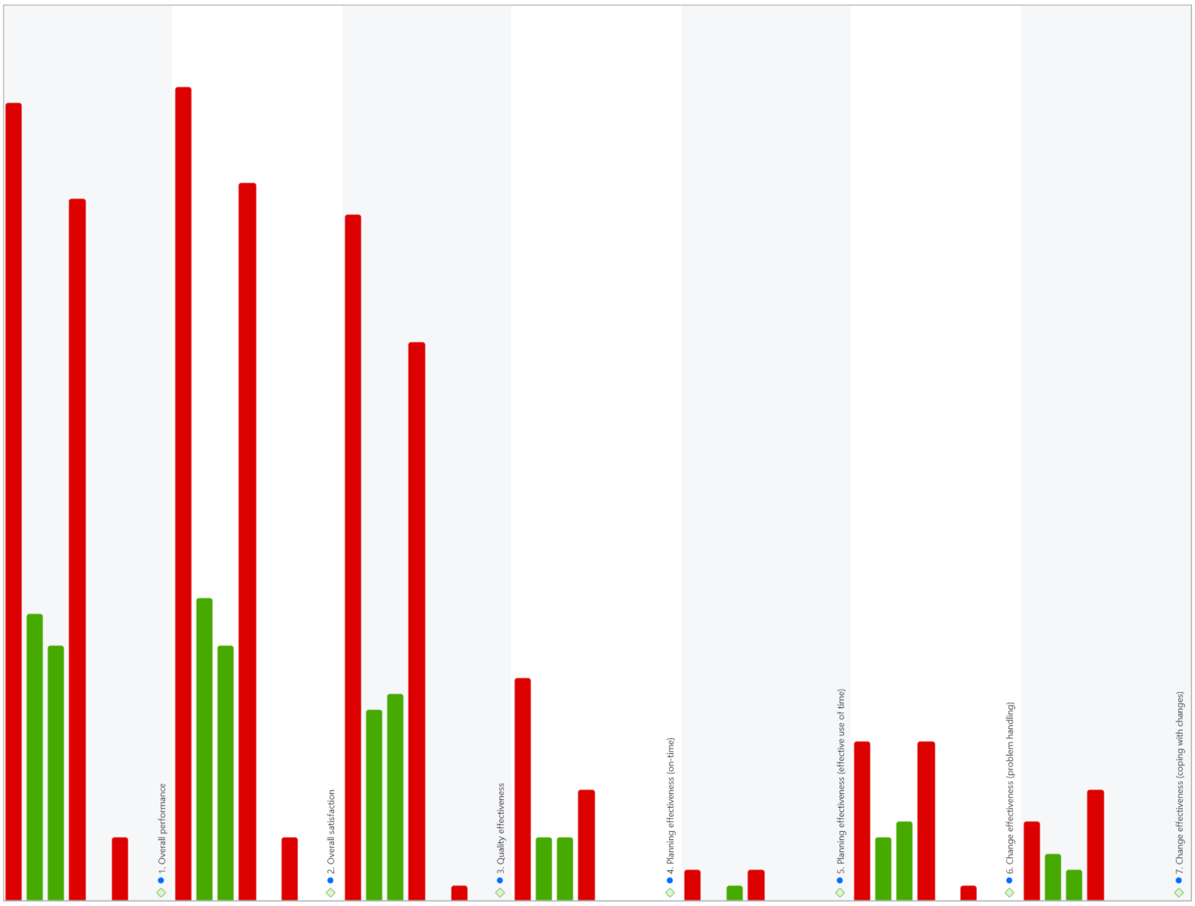

Figure 5.20: Observation 3 Bar Chart - Shared Leadership vs Team Effectiveness

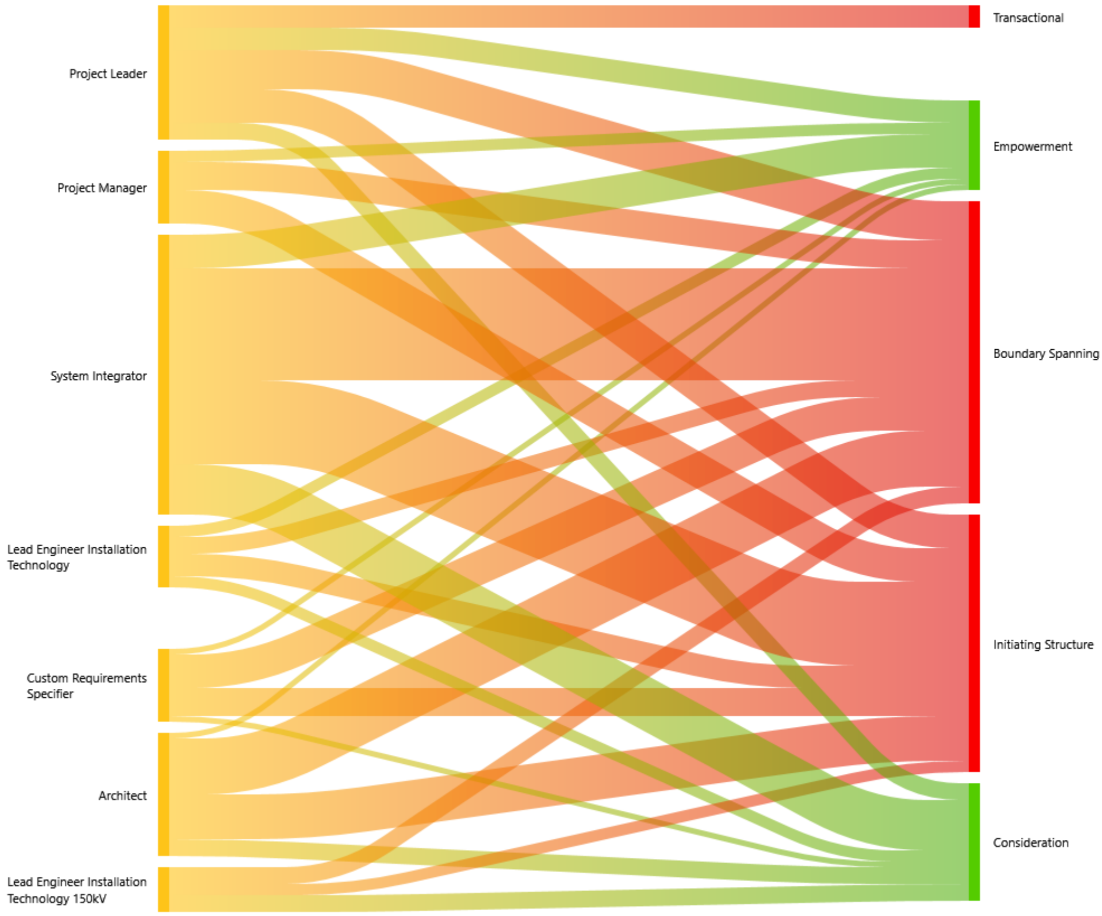

Figure 5.21: Observation 3 Sankey Diagram - Role vs Shared Leadership

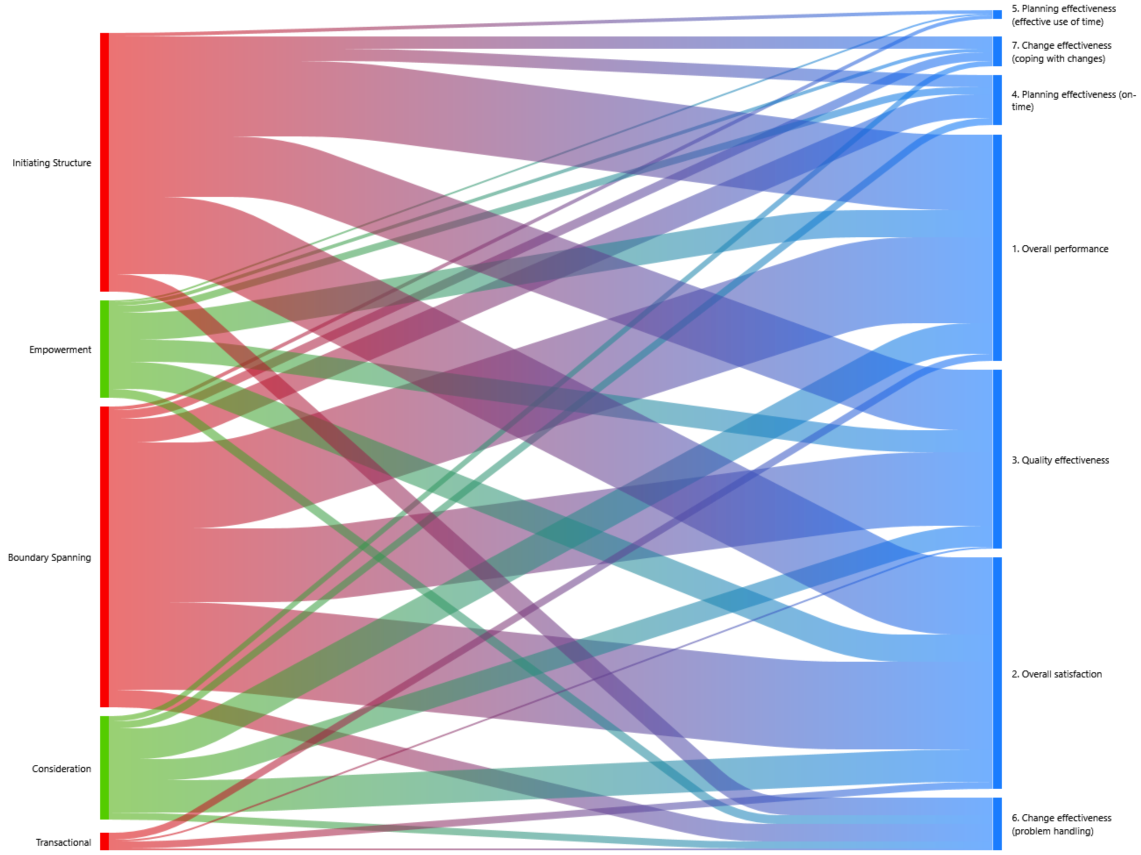

Figure 5.22: Observation 3 Sankey Diagram - Shared Leadership vs Team Effectiveness

5.5. Observation 4

General
Date: February 13, 2024
Type of meeting: Engineering Design Team
Duration: 27 minutes
Attendees:

- Architect;
- Assistant Project Manager;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Operational Installation Manager;
- Project Leader;
- System Integrator.

Agenda

- 150kV route permit;
- Status electrical supply;
- BO v1.0 baseline;
- Planning follow-up processes;
- Work Package 3 - Check completeness;
- Work Package 4 - Conversion tables;
- Work Package 5 - Reference thunder and electrical grounding;
- Work Package 6 - Tables;
- Work Package 8 - Amenities ITCP;
- Work Package 9 - Meeting TenneT and cross check-list;
- Verification acceptance and assessment documents ready;
- Deadline Specification of Requirements.

Summary of the project meeting
This meeting started with the announcement that due to circumstances and rescheduled follow-up meetings, only 30 minutes is available for this meeting to discuss the topics on the agenda. The first topic to be discussed was the 150kV route permit. The construction of the cable connections had already started which means the process regarding the route permit is still an on-going activity. Attention was drawn to monitoring and verifying whether each of the disciplines had delivered their work and drawings as well as the Lead Engineer Installation Technology coordinating the latest adjustments to the System Integrator. Thereafter, actions concerning the work packages were discussed that were mainly about the System Integrator checking the completeness of the documents according to the Program of Requirements (PVE), and properly and consistently referencing electrical grounding in one document. There was a concern about work package 8 in which there was a need to be provided the procedure guideline document from the ITCP department which was still lingering around somewhere. Near the end of the meeting there was a focus and coordination on finishing all tasks and to have the verification acceptance, assessment documents and all Specification of Requirements documents ready by February 28 for the tender invitation, which includes general specification, process specification, and requirement specification.

Collected data

Table 5.5: Observation 4 Team Effectiveness scores 150/20kV

Observation 4 Team Effectiveness scores (13-02-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	14	18	16	14.5	19	8	14	N/A	N/A	16
Average score					14.94					
Standard deviation					3.34					

	Boundary Spanning 50	Consideration 22	Empowerment 2	Initiating Structure 51	Motivation 2	Transactional 1	Transformational 0
Architect 3	3	2					
Assistant Project Manager 37	24	17		24			
Custom Requirements Specifier 3	2			3			
Lead Engineer Installation Technology 7	4		1	3	2	1	
Lead Engineer Installation Technology 150kV 2	1			2			
Operational Installation Manager 0							
Project Leader 15	12	3		13			
Project Leader B 0							
Project Manager 0							
System Integrator 9	4		1	6			

Figure 5.23: Observation 4 Frequency Table - Role vs Shared Leadership

	1. Overall performance 68	2. Overall satisfaction 52	3. Quality effectiveness 61	4. Planning effectiveness (on-time) 32	5. Planning effectiveness (effective use of time) 7	6. Change effectiveness (problem handling) 1	7. Change effectiveness (coping with changes) 6
Boundary Spanning 50	45	34	43	24	1	1	4
Consideration 22	19	12	17	14	1		2
Empowerment 2	2	2	2		1	1	1
Initiating Structure 51	46	38	41	19	7	1	4
Motivation 2	2	2	1				
Transactional 1	1	1					
Transformational 0							

Figure 5.24: Observation 4 Frequency Table - Shared Leadership vs Team Effectiveness

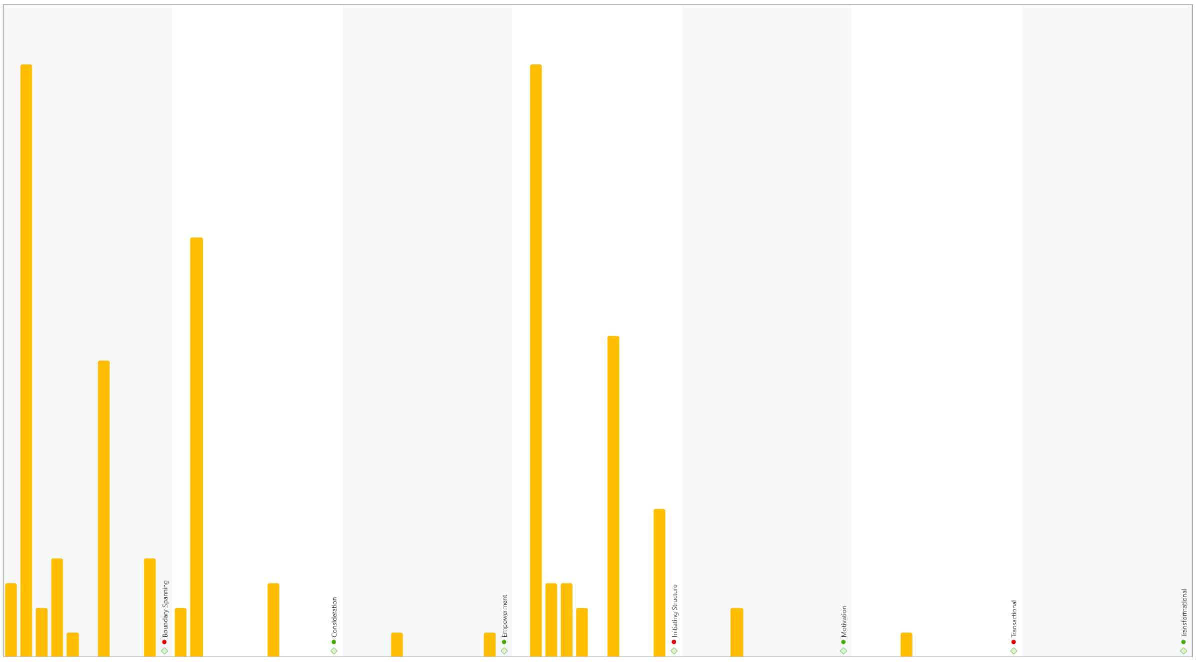

Figure 5.25: Observation 4 Bar Chart - Role vs Shared Leadership

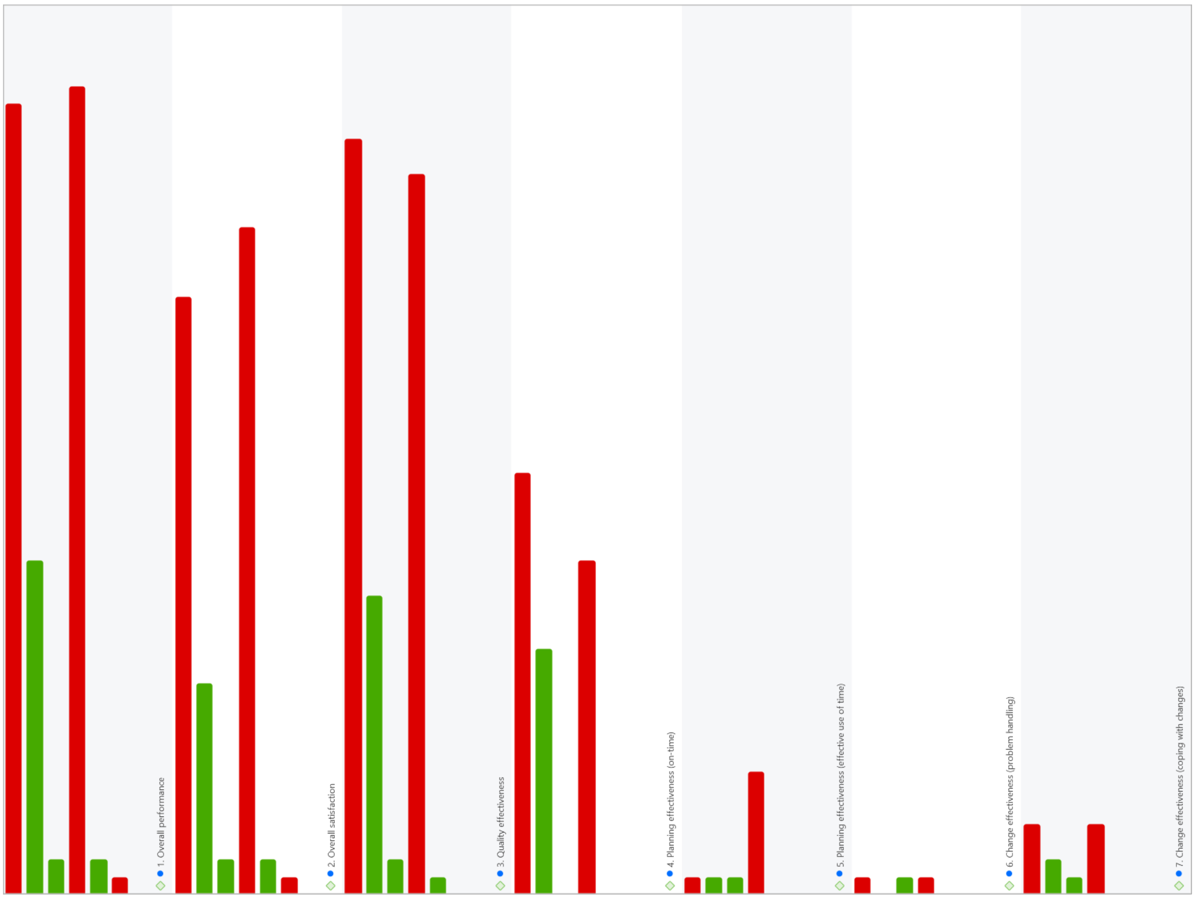

Figure 5.26: Observation 4 Bar Chart - Shared Leadership vs Team Effectiveness

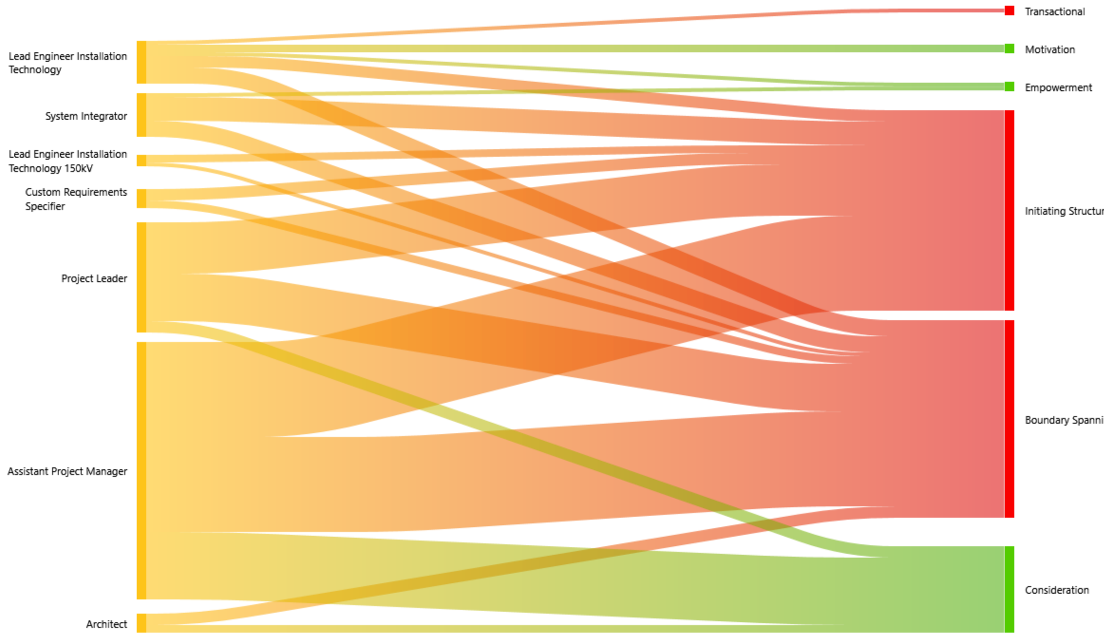

Figure 5.27: Observation 4 Sankey Diagram - Role vs Shared Leadership

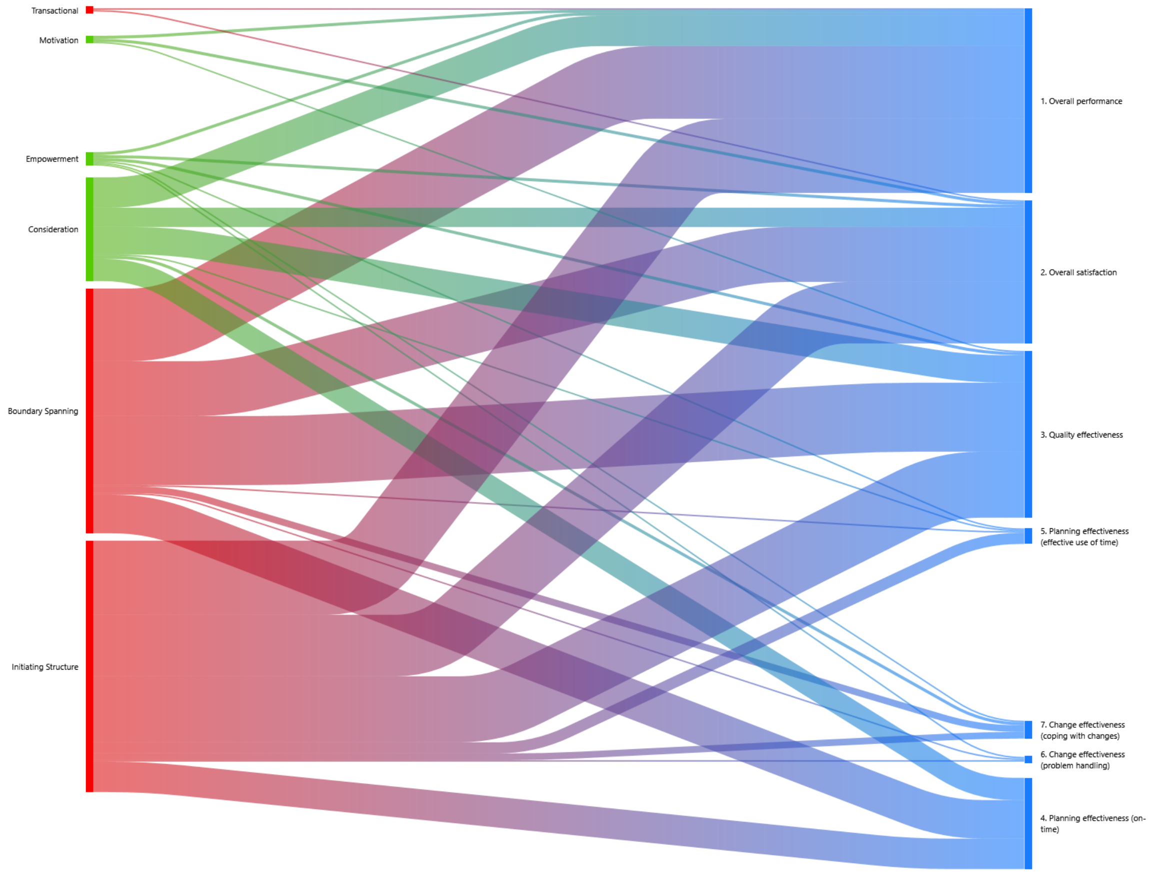

Figure 5.28: Observation 4 Sankey Diagram - Shared Leadership vs Team Effectiveness

5.6. Observation 5

General
Date: February 20, 2024
Type of meeting: Engineering Design Team
Duration: 2 hours and 26 minutes
Attendees:

- Architect;
- Assistant Project Manager;
- Custom Requirements Specifier;
- Lead Engineer Installation Technology;
- Lead Engineer Installation Technology 150kV;
- Operational Installation Manager;
- Project Manager;
- Project Leader;
- System Integrator;

Agenda

- Work Package 3 - Check completeness Specification of Requirements;
- Work Package 3 - Add preliminary design document;
- Work Package 3 - Check bearing capacity road;
- Work Package 3 - Fencing specification;
- Work Package 3 - Input martens;
- Work Package 4 - Conversion to tables;
- Work Package 5 - Consistent referencing grounding and thunder;
- Work Package 8 - Amenities ITCP;
- Work Package 9 - Meeting TenneT and cross check-list;
- Update document list and folder structure;
- Information meeting selected contractors.

Summary of the project meeting
This is the last meeting before handing in all the Specification of Requirements documents. This is the longest meeting as it started with discussing the weekly actions followed by an extensive collective review of the Specification of Requirements document. Checking the completeness of this document based on the Program of Requirements and complementing the documents overview are still on-going tasks for the System Integrator. New items have been added to the issue list of which security is still a concern. Several important topics have been discussed. First, specific requirements and temporary measures regarding the load on the roads due to transportation of transformers. Second, there is no ambiguous referencing of fencing requirements. Third, the Project Leader will take care of the vehicle access requirements as that still has not been specified. Fourth, relocating martens has been extensively discussed regarding how and who will be responsible for that. Lastly, the individual of ITCP will get back to this topic as the infamous nine questions are still unanswered.

The focus of the remaining part of the meeting was to collectively review the Specification of Requirements document, in particular the requirement specification, with the System Integrator fulfilling the guiding role. There were some topics that required special attention and was discussed extensively. An information meeting is organized for selected contractors in which the scope of the project and the requirements are communicated in a clear manner. The documents will be shared with the contractors after the information session to prevent asymmetric information and unnecessary questions. It is important to present all information in a well-organized table including operation and maintenance, and specific requirements for the contractor. Some requirements still needed to be added to make it clearer and more specific for the contractor. Moreover, there is a need to determine the scope with regard to maintenance and expansion of the project, and what tasks the contractor will be responsible for. Requirements for corrective maintenance have been specified. The cross check-list displays the scope, requirements, construction standards and explanations. However the client has not yet provided requirements for preventive maintenance. The Custom Requirements Specifier will arrange that. Lastly, concerns were raised about security requirements still not sufficiently specific and the weird aspect that the contractor is responsible for maintenance but has no control over delivery of materials and equipment.

Collected data

Table 5.6: Observation 5 Team Effectiveness scores 150/20kV

Observation 5 Team Effectiveness scores (20-02-2024)										
Team member	1	2	3	4	5	6	7	8	9	10
Score	15	15	14	14	16.5	10	15	N/A	7	13
Average score					13.28					
Standard deviation					2.97					

		Boundary Spanning 228	Consideration 142	Empowerment 41	Initiating Structure 240	Motivation 15	Transactional 10	Transformational 2
Architect	12	7	3	3	8			
Assistant Project Manager	42	24	11	3	32		1	
Custom Requirements Specifier	27	19	14	6	17			
Lead Engineer Installation Technology	52	42	24	7	34	3		1
Lead Engineer Installation Technology 150kV	7	4	3	1	6	1		
Operational Installation Manager	0							
Project Leader	33	31	16	4	31		4	1
Project Leader B	0							
Project Manager	11	9	4		10	1	5	
System Integrator	127	96	69	16	106	11		

Figure 5.29: Observation 5 Frequency Table - Role vs Shared Leadership

		1. Overall performance 288	2. Overall satisfaction 291	3. Quality effectiveness 174	4. Planning effectiveness (on-time) 28	5. Planning effectiveness (effective use of time) 8	6. Change effectiveness (problem handling) 57	7. Change effectiveness (coping with changes) 21
Boundary Spanning	228	223	222	144	22	3	43	18
Consideration	142	133	137	91	7	1	36	11
Empowerment	41	41	41	31	7	1	11	3
Initiating Structure	240	237	236	156	24	7	49	17
Motivation	15	11	12	9	4	1	1	1
Transactional	10	10	10	3	1		4	1
Transformational	2	2	2	1			2	

Figure 5.30: Observation 5 Frequency Table - Shared Leadership vs Team Effectiveness

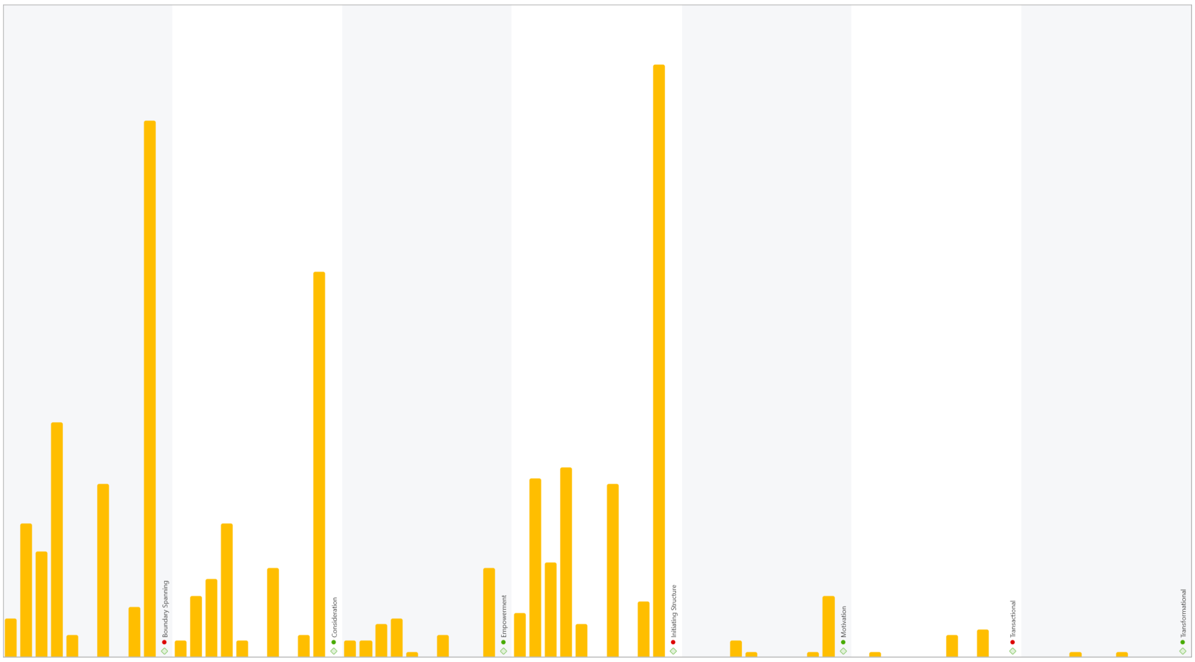

Figure 5.31: Observation 5 Bar Chart - Role vs Shared Leadership

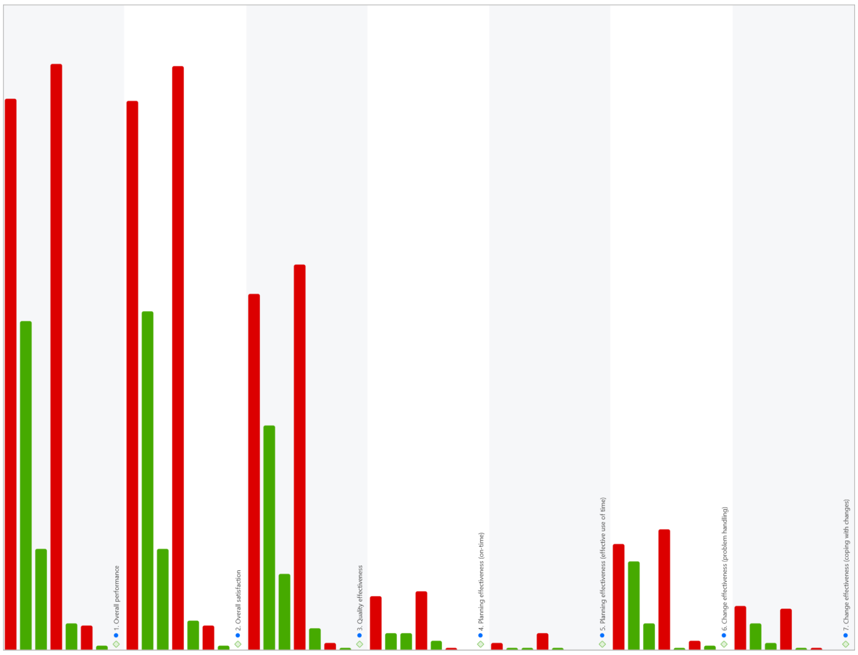

Figure 5.32: Observation 5 Bar Chart - Shared Leadership vs Team Effectiveness

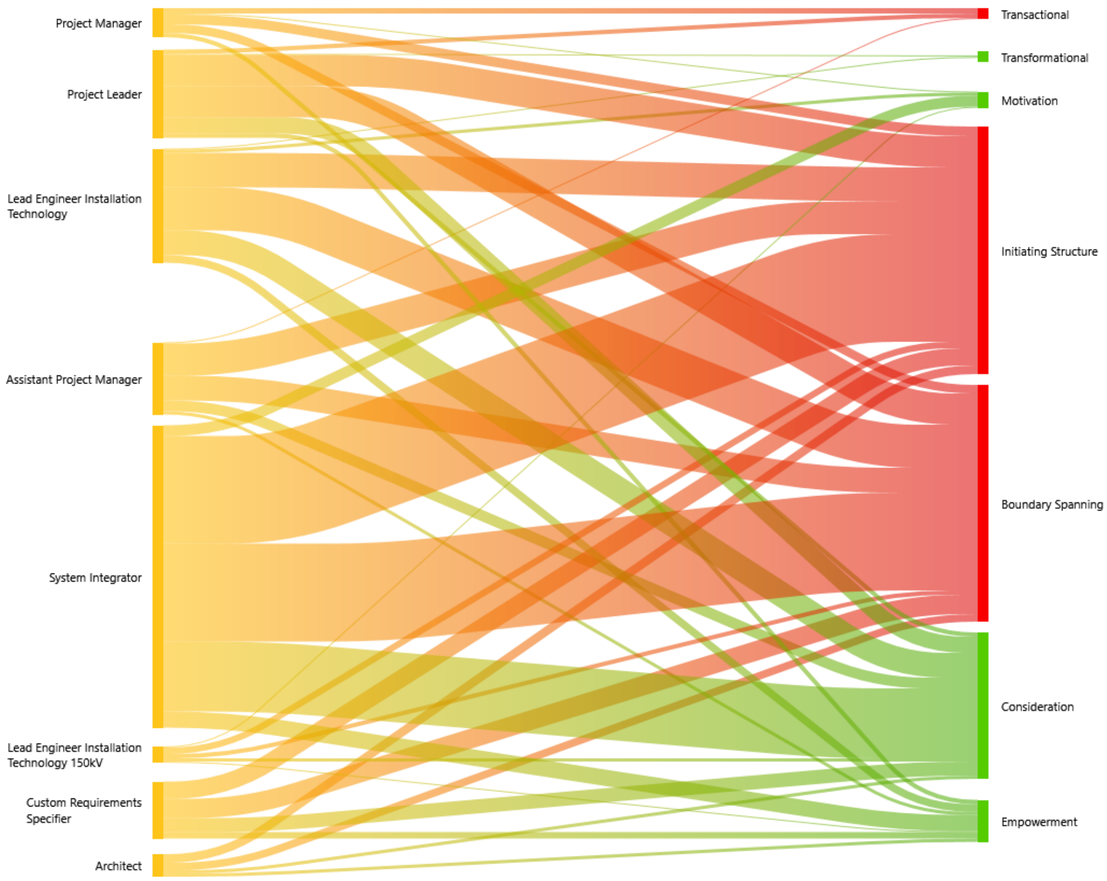

Figure 5.33: Observation 5 Sankey Diagram - Role vs Shared Leadership

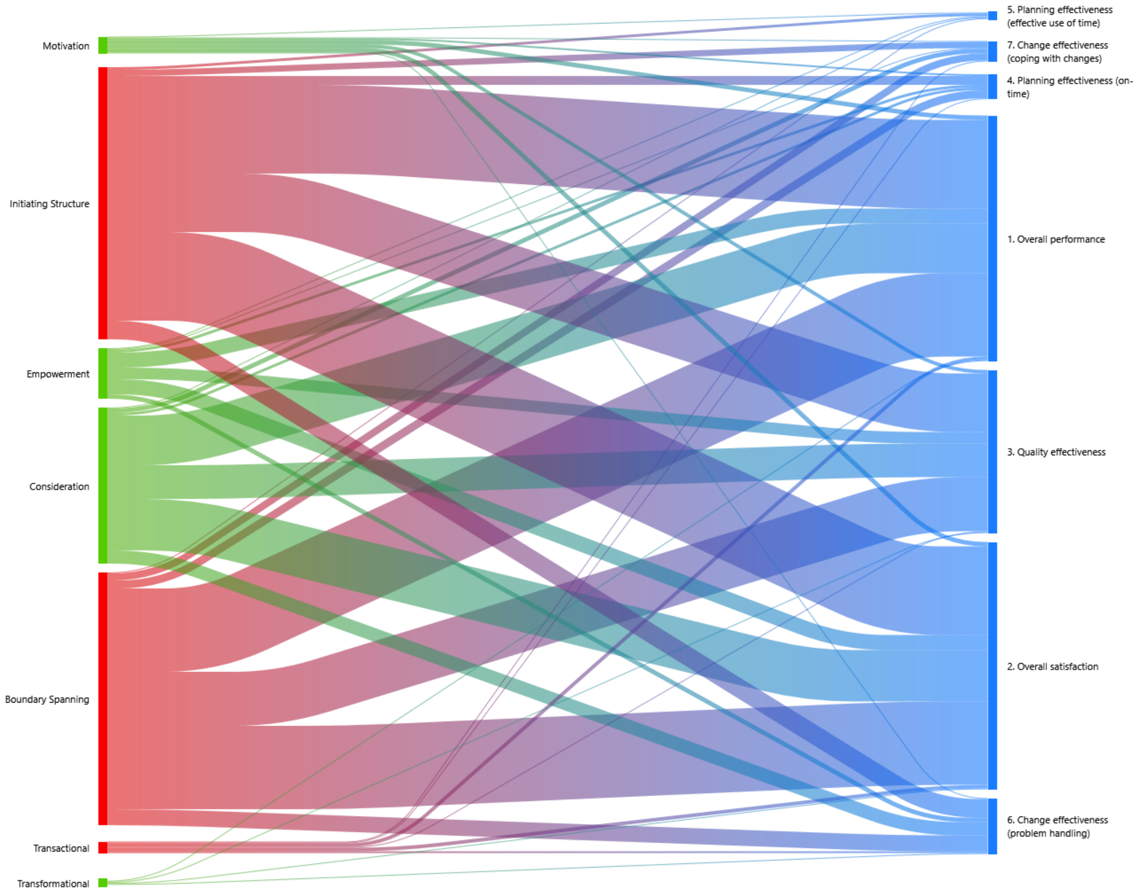

Figure 5.34: Observation 5 Sankey Diagram - Shared Leadership vs Team Effectiveness

5.7. Summary of the Observations

Table 5.7: Summary of the average Team Effectiveness scores and standard deviations 150/20kV

Summary Team Effectiveness scores 150/20kV						
Observation	Baseline	1	2	3	4	5
Average score	14.45	15.13	16.50	15.00	14.94	13.28
Standard deviation	3.37	2.23	3.16	3.16	3.34	2.97

Table 5.8: Summary individual Team Effectiveness average scores, standard deviations, and difference scores 150/20kV

Summary individual Team Effectiveness scores 150/20kV										
Team member	1	2	3	4	5	6	7	8	9	10
Average score	15.17	16.83	16.50	15.25	18.75	11.50	13.40	11.50	9.75	15.80
Standard deviation	0.98	0.98	1.97	1.19	1.47	3.08	1.34	0.71	1.89	1.64
Δ1	0	0	0	N/A	1	-5	0	-1	N/A	1
Δ2	0	0	-4	N/A	-2	-7	-2	N/A	0	0
Δ3	2	0	-1	0.5	0	-3	**-2**	N/A	1	**0.5**
Δ4	2	-1	0	2	0	1	-2	N/A	**2.5**	1
Δ5	1	2	2	2.5	2.5	-1	-3	N/A	4	4

Bold values are extrapolated values

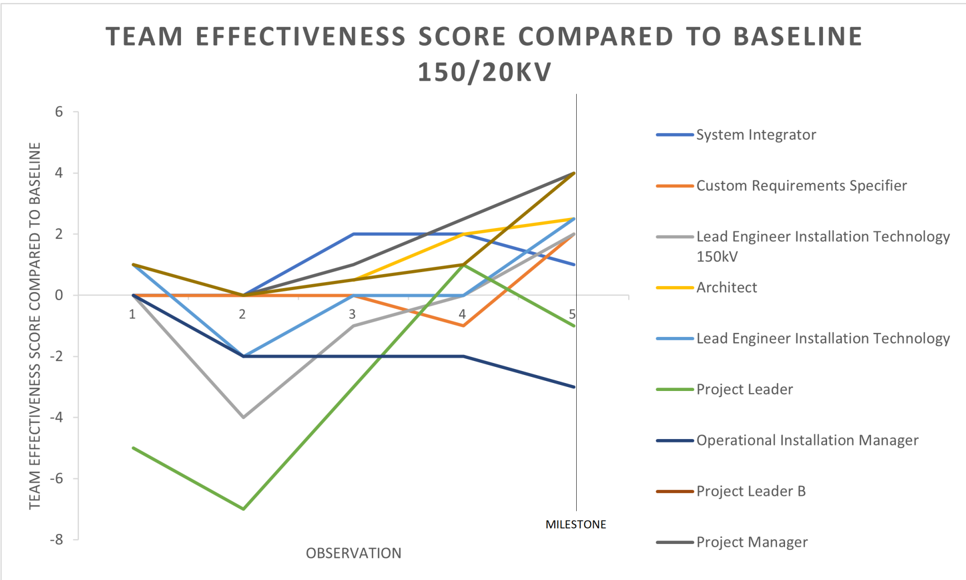

Figure 5.35: Summary Difference Scores 150/20kV

		Boundary Spanning 501	Consideration 272	Empowerment 84	Initiating Structure 477	Motivation 28	Transactional 19	Transformational 6
Architect	27	20	8	4	16			
Assistant Project Manager	122	78	47	6	79		1	
Custom Requirements Specifier	57	42	19	10	36			
Lead Engineer Installation Technology	88	69	36	15	58	5	2	1
Lead Engineer Installation Technology 150kV	24	17	8	1	15	1		
Operational Installation Manager	2	1	2		1			
Project Leader	95	77	38	12	70	6	11	4
Project Leader B	19	13	7	2	11			
Project Manager	29	19	10	4	22	1	5	
System Integrator	231	171	101	29	174	16		1

Figure 5.36: Summary Observations Frequency Table - Role vs Shared Leadership

		1. Overall performance 288	2. Overall satisfaction 291	3. Quality effectiveness 174	4. Planning effectiveness (on-time) 28	5. Planning effectiveness (effective use of time) 8	6. Change effectiveness (problem handling) 57	7. Change effectiveness (coping with changes) 21
Boundary Spanning	228	223	222	144	22	3	43	18
Consideration	142	133	137	91	7	1	36	11
Empowerment	41	41	41	31	7	1	11	3
Initiating Structure	240	237	236	156	24	7	49	17
Motivation	15	11	12	9	4	1	1	1
Transactional	10	10	10	3	1		4	1
Transformational	2	2	2	1			2	

Figure 5.37: Summary Observations Frequency Table - Shared Leadership vs Team Effectiveness

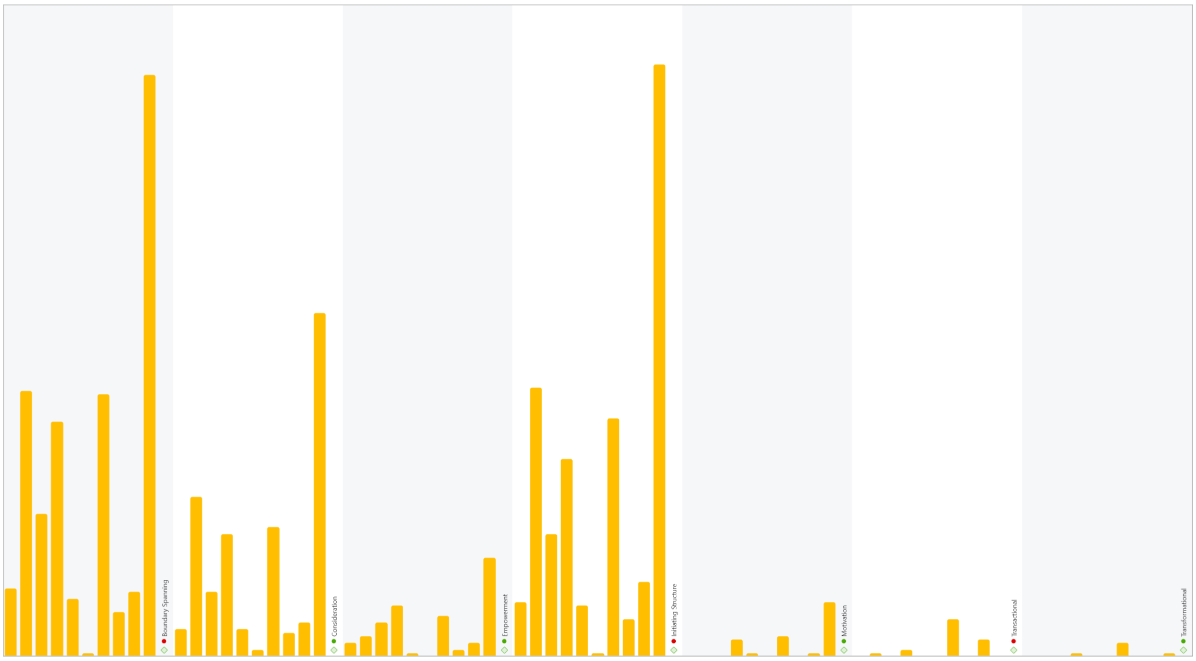

Figure 5.38: Summary Observations Bar Chart - Role vs Shared Leadership

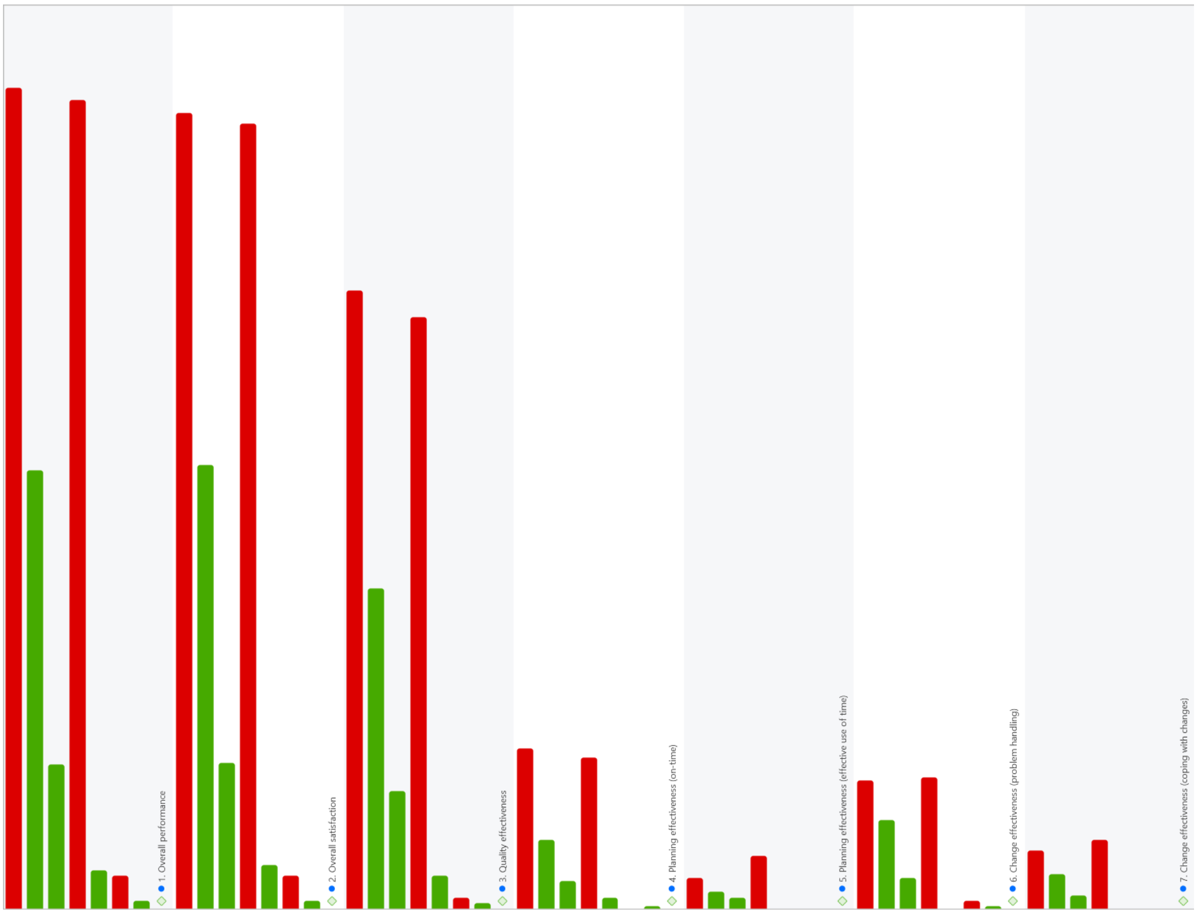

Figure 5.39: Summary Observations Bar Chart - Shared Leadership vs Team Effectiveness

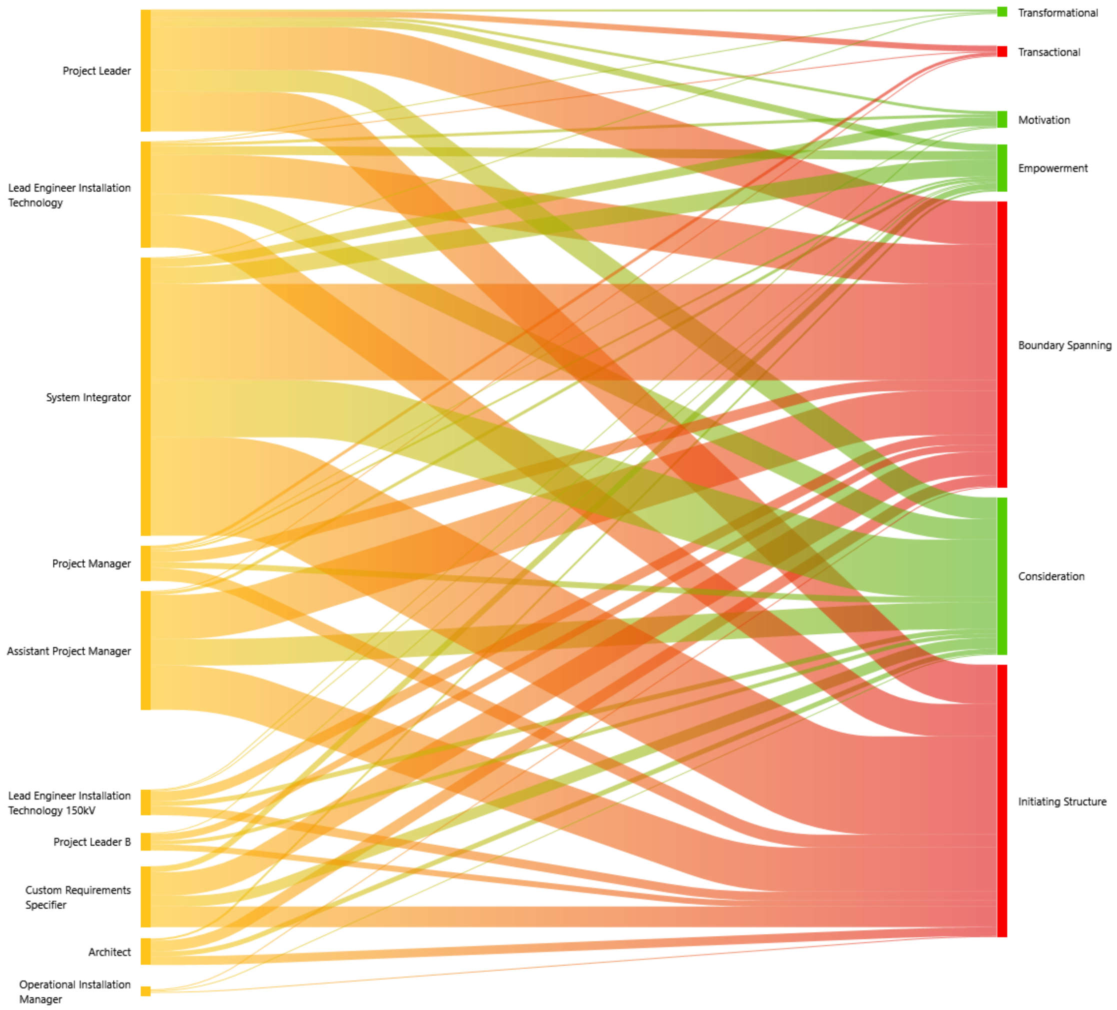

Figure 5.40: Summary Observations Sankey Diagram - Role vs Shared Leadership

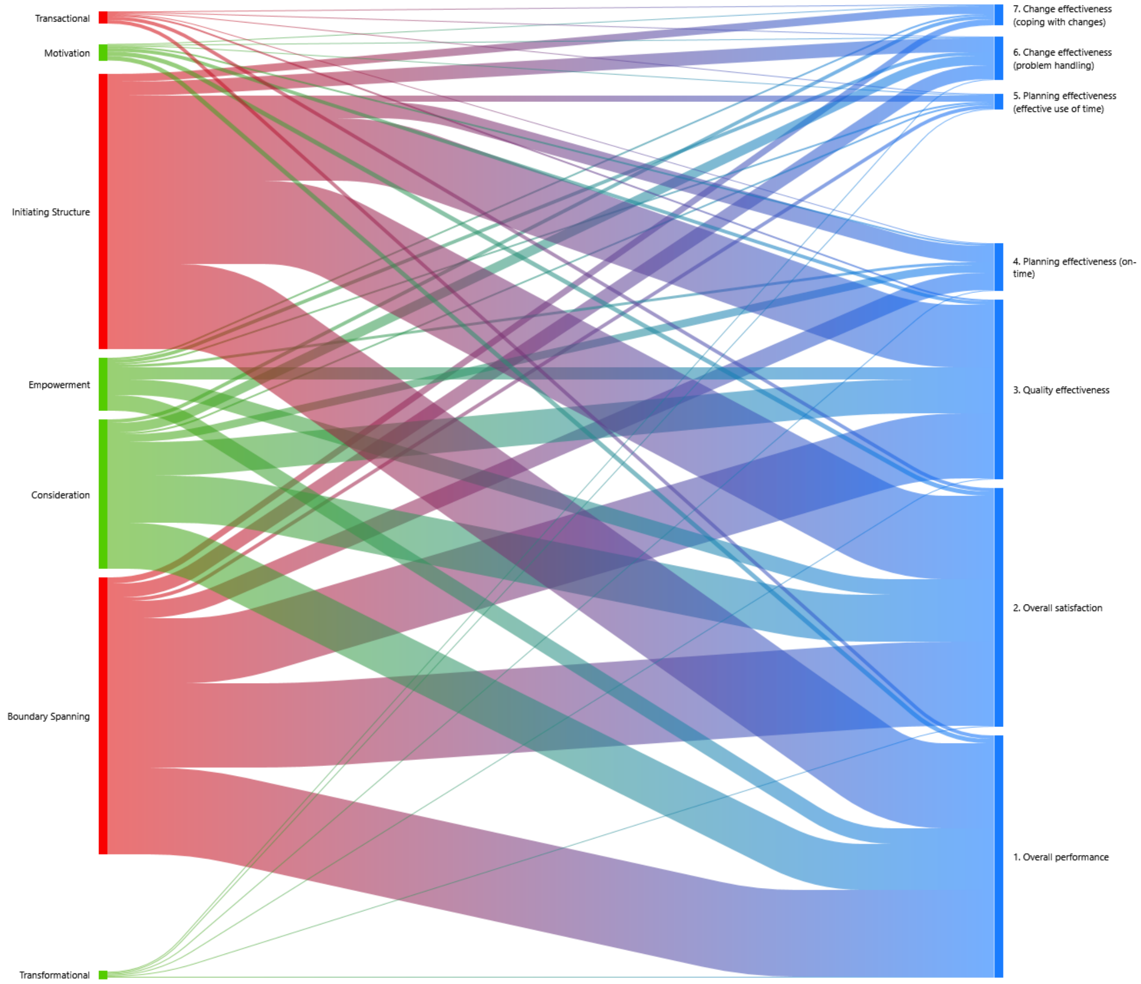

Figure 5.41: Summary Observations Sankey Diagram - Shared Leadership vs Team Effectiveness

6
Findings & Synthesis

This chapter presents the findings of the analyzed qualitative and quantitative data in order to provide answers to the research questions outlined in Chapter 1. The research findings are structured in line with the research questions. First, cumulative diagrams are provided to give an overall overview of the exhibited shared leadership behaviors by different roles and an overview of the exhibited shared leadership behaviors related to the team effectiveness codes per case as well as results on the individual-level. Second, findings from the observations of each team are presented in detail and compared with one another. The chapter concludes with a summary and synthesis of the key findings. The results presented in this chapter include relevant figures and tables to adequately illustrate the data.

6.1. Exhibited Leadership Behaviors and Team Functioning

Research Question 1: What leadership behaviors can be recognized and how does it contribute to the development of team functioning in Project-Based Cross-Functional Design Teams?

The principal analysis of the qualitative data involved coding and annotating audio-recorded meetings and comparing the exhibited shared leadership behaviors between the team members of the 50/10kV project and the 150/20kV project, as well as comparing the exhibited shared leadership behaviors with the team effectiveness codes. The findings indicated that shared leadership is indeed present in both teams, as shown by the cumulative sankey charts (Figure 6.1 and 6.2). From figure 6.1 it can be seen that all leadership behaviors were exhibited by the team members of the 50/10kV project, with task-focused behaviors being more prevalent. For the 150/20kV project it can also be seen that all leadership behaviors were exhibited, as shown in figure 6.2. Comparison of both sankey diagrams indicated that the frequencies of each exhibited leadership behavior in the 50/10kV team were nearly identical to the frequencies of the exhibited leadership behaviors in the 150/20kV team. Initiating structure and boundary spanning were the most prominent task-focused behaviors, while consideration and empowerment were the most prominent person-focused behaviors. Shared understanding and unambiguity were new codes created for boundary spanning and initiating structure respectively. The data suggested that in both PBCFDTs two or more individuals engaged in the leadership, displaying task-focused as well as person-behaviors. The larger proportion of task-focused behaviors indicated that team members had a higher perception of value for task and goal achievement, likely due to the team being project-based that strongly emphasized taking into account important stakeholders and adherence to the contents, scheduling and planning. This seemingly gave the impression by initiating structure and boundary spanning being most prevalent. Furthermore, the presence of person-focused behaviors with consideration and empowerment being most prevalent showed that team members are not only focused on task information and operating procedures, but are also drawing attention to facilitating interactions and prioritizing development and needs of team members. The occurrence of shared leadership and the presence of task-focused and person-focused behaviors in this particular composition could be attributed to the project characteristics and the teams being project-based and cross-functional, which cater to different needs of the team members.

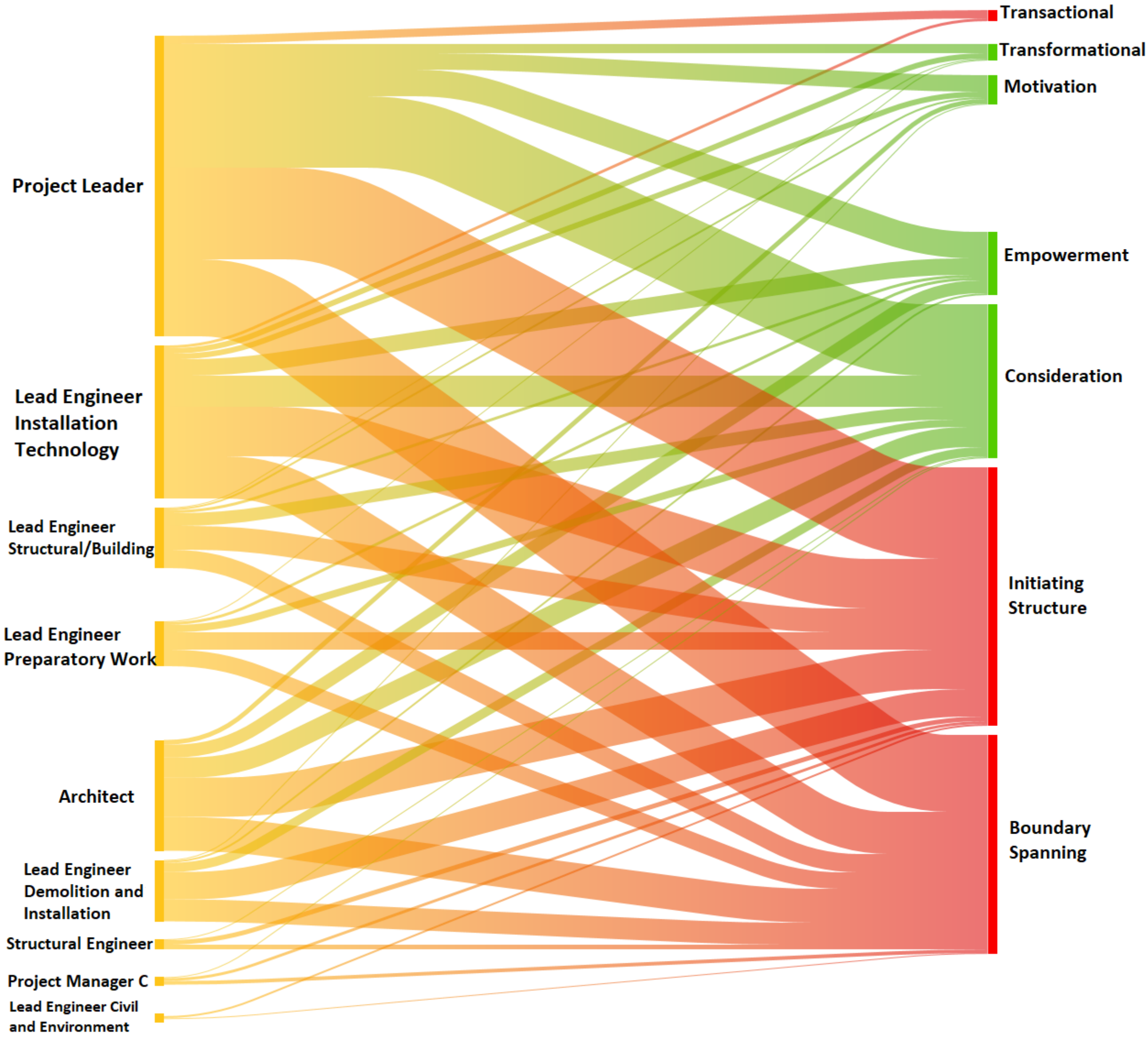

Figure 6.1: Cumulative Observations Sankey Diagram - Role vs Shared Leadership (50/10kV)

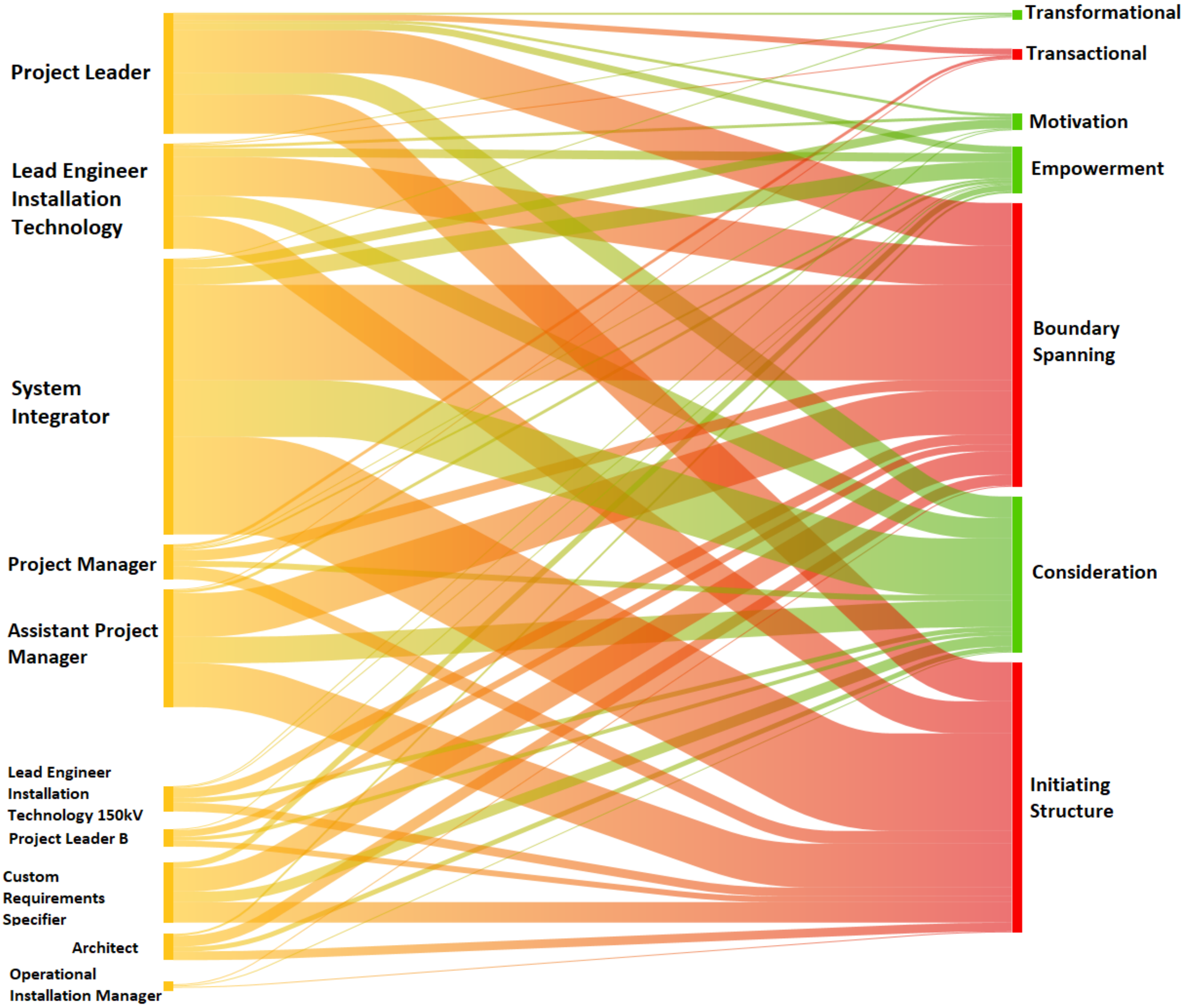

Figure 6.2: Cumulative Observations Sankey Diagram - Role vs Shared Leadership (150/20kV)

From further comparison between the teams it emerged from the data that the project leader adjusted their leadership behaviors according to their role and the roles of the team members in the other project. According to the data collected from the observations, the project leader, lead engineer installation technology and architect exhibited leadership most frequently in which the project leader exhibited significantly less person-focused behaviors in the 150/20kV team compared to the 50/10kV project, while the lead engineer installation technology and architect displayed the same and less leadership respectively, as shown in figure 6.1 and 6.2. The data suggested the presence of situational leadership displayed by the project leader depending on the roles of team members in the other project, which is an important finding as the project leader backed up the team by assuming the 'vacant' roles that changes the dynamics. The roles of the team members in the other project indicated that the project leader had to adapt their exhibited leadership behaviors as their role in the 50/10kV project was the chair and therefore a more facilitating role, therefore exhibiting more person-focused behaviors. In the 150/20kV project however, the assistant project manager and the system integrator were the chairs assuming the facilitating role, and in particular, the system integrator fulfilled the role of writing and preparing the specification of requirements based on the deliverables of the other team members, which is in line with person-focused behaviors. Moreover, the shift in exhibited person-focused behaviors from the project leader seemed to suggest that situational leadership was not only present in the project leader, but in other team members as well. This can be attributed to the ability of the project leader to adapt their leadership behaviors by prioritizing, steering and meeting the needs of the team.

The exhibited shared leadership behaviors of each team were then plotted against the team effectiveness codes in a sankey diagram. Highest occurrence of overall satisfaction and quality effectiveness were mostly related to boundary spanning, initiating structure, consideration, and empowerment. The data for the 50/10kV project indicated that team effectiveness codes 1 to 7 were observed in relation to the displayed shared leadership behaviors (Figure 6.3). On the one hand, boundary spanning and initiating structure had nearly identical magnitude and were mostly related to the items overall performance, overall satisfaction, and quality effectiveness. On the other hand, consideration and empowerment were mostly related to the same items. For the 150/20kV it can be seen in figure 6.4 that the results were similar to the 50/10kV project. Overall, comparison of figure 6.3 and 6.4 indicated nearly identical flow and magnitude from the shared leadership behaviors to the team effectiveness codes, in which overall performance, overall satisfaction and quality effectiveness were most prominent. However, overall performance was not intentionally not taken into consideration in the exemplification as this code was an overarching code that represented the remaining codes. These findings suggested that quality effectiveness and overall satisfaction occurred most frequently by the most prominent leadership behaviors. Frequent occurrence of quality effectiveness indicated that the teams were focused on the quality of the deliverables such as design/requirement documents and calculations, likely due to tight schedule and external approval of the client and other key stakeholders, expressed through boundary spanning and initiating structure. Besides, frequent occurrence of overall satisfaction seemed to show not only satisfaction about the quality of deliverables but also the interactions, expressed through consideration and empowerment. These frequent occurrences can be attributed to displayed leadership behaviors of the team members that are on the one hand bounded by organizational context such as the needs of the client and key stakeholders, and on the other hand the team context including needs of fellow team members. Quotes from the observations are included to illustrate the findings:

Initiating structure - Consideration - Empowerment - Overall satisfaction
'If it turns out that a significant problem is going to arise here, which you should already have identified at this moment, I want to know about it right away. Then we can see how we can address this issue together. I do not want to say: Why didn't you handle that well? That is not what the discussion is about. You have a puzzle and then we can figure out how to solve that puzzle together'. (Project Leader, 50/10kV)

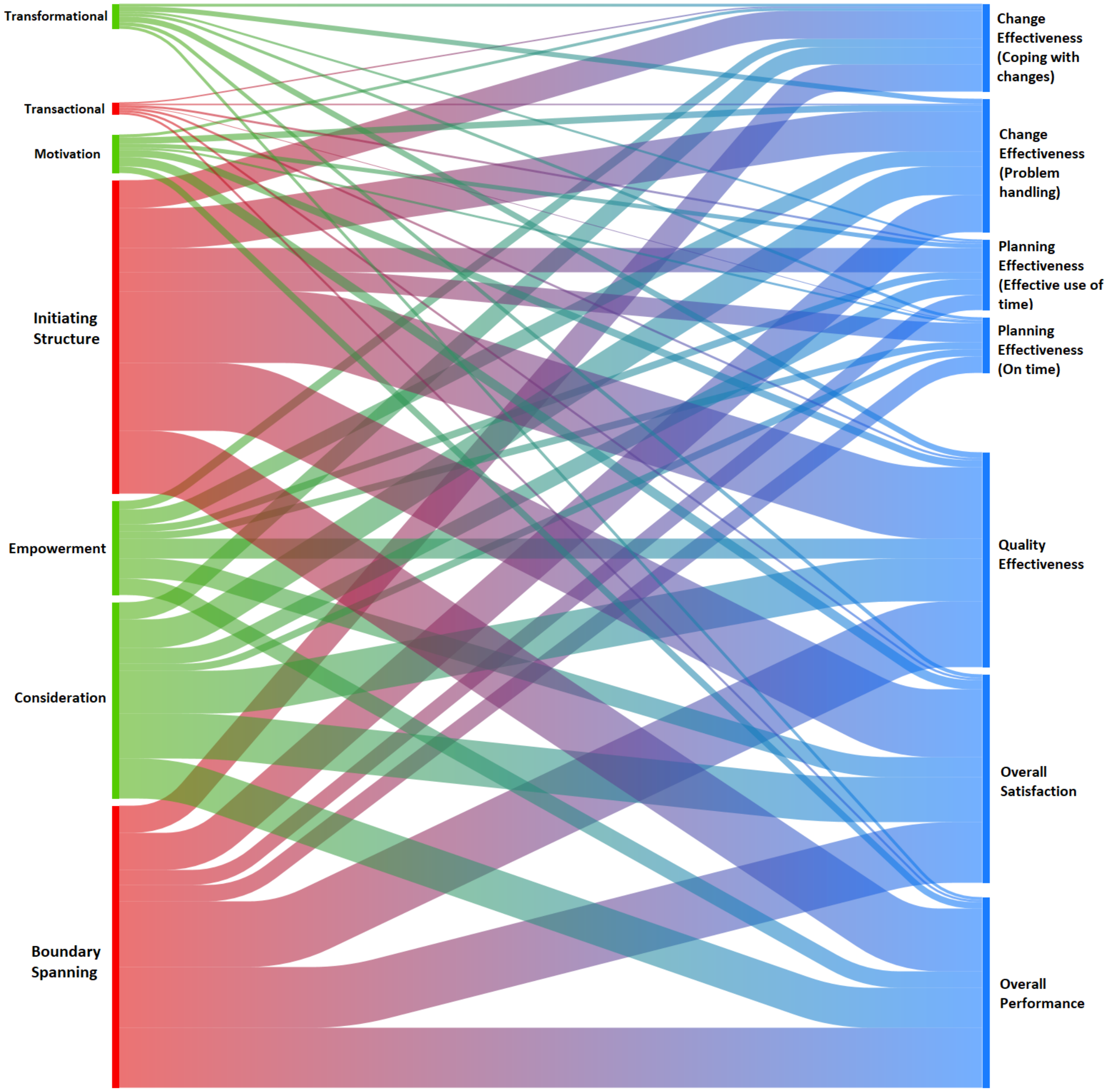

Figure 6.3: Cumulative Observations Sankey Diagram - Shared Leadership vs Team Effectiveness (50/10kV)

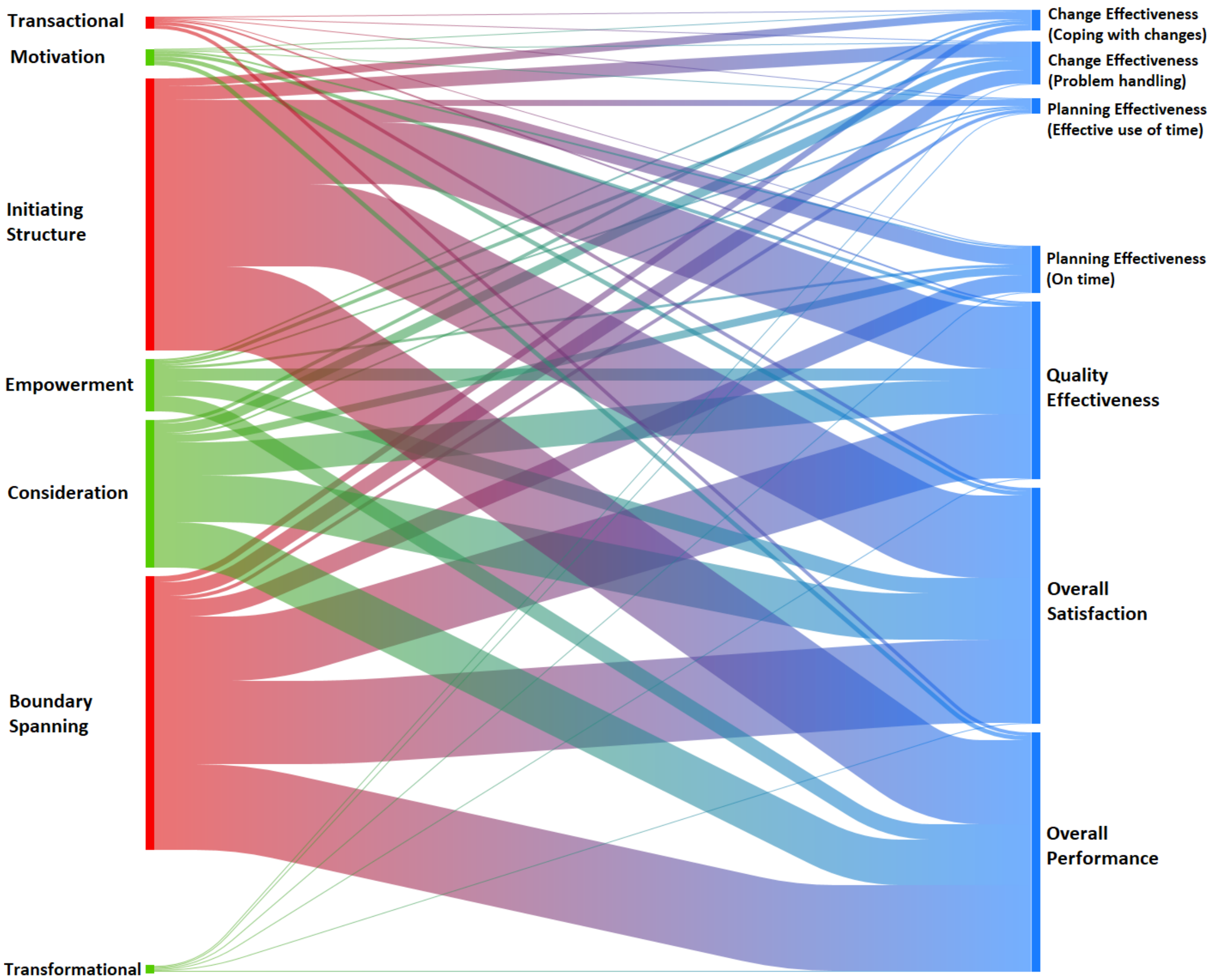

Figure 6.4: Cumulative Observations Sankey Diagram - Shared Leadership vs Team Effectiveness (150/20kV)

Boundary spanning - Initiating structure - Quality Effectiveness
'The assignment being issued states: You must comply with all the requirements we have included. This is how we want the structure to be. If you make any changes compared to the drawn plans, you need to think carefully about it because the environmental permit is based on these plans. Therefore, we don't want to revisit the connection structure, and this is how we guide such a group. It's not the case that they receive a fully developed preliminary design, final design, or technical design from all disciplines. This is indicative because it is an integrated contract.' (Project Leader, 150/20kV)

Consideration - Empowerment - Overall satisfaction
'You can see that it is pleasant to discuss this with the group. I appreciate that we took the time to go over this. I think it's perfectly fine to do that. I'm glad that we, well, again I keep repeating myself, but that we took a moment to go through it. I think we're making good progress and we hadn't seen anything too crazy. Now we know who to give a phone call. Yes, this works for me because we're also going to go over a few key points with [..] shortly.' (Architect, 50/10kV)

Boundary spanning - Initiating structure - Quality Effectiveness
'I also sent an email this morning. I expect that I will submit the final documents for the construction pit and the L-wall as version 1.0 next week. I have received feedback on the TIS comments. I don't think we need to do anything further with that. The question remains, at least, I am curious about how the approval process will look because I will send revision 1.0 next week. I will sign it, and then it will go to Schiphol. Will it also go to the TIS again? Do they still want a final report?' (Lead Engineer Preparatory Work, 50/10kV)

Boundary spanning - Initiating structure - Overall satisfaction - Quality Effectiveness
'We had a meeting with TenneT about access, the site, and possibly Schiphol space as well. It's actually very simple: we make agreements with each other, we always come to an agreement, and we record it in the ATO (aansluit- en transportovereenkomst). It's really about how do we deal with each other. So also any emerging requirements from Schiphol towards TenneT need to be documented. TenneT suggested recording this in the ATO. But I have the feeling, at least my impression from the conversation, that we will always come to an agreement.' (Project Manager, 150/20kV)

Boundary spanning - Initiating structure - Consideration - Empowerment - Overall satisfaction - Quality Effectiveness
'It will be fine. I should actually wrap up now. As far as I'm concerned, I'm satisfied with how far we've come. But this one still remains for me, number seven. I don't want to discuss it now, but I have some things here that I can turn into requirements.' (System Integrator, 150/20kV)

The quotes suggested that for there were different combinations of boundary spanning, initiating structure, consideration and empowerment with the occurring team effectiveness codes: overall satisfaction and quality effectiveness. Not only were there instances in which only task-focused behaviors or only person-focused behaviors were displayed, but also many occasions in which combinations of task-focused and person-focused behaviors were observed by different team members. The occurrence of inexhaustible combinations indicated that there is no one-size-fits-all leadership behavior and that two or more leadership behaviors can be displayed simultaneously, probably because of open communication and steering of other team members. Open communication and steering allowed for various topics to be brought to the meeting table besides the agenda topics, resulting in occurrence of combinations, which appeared to indicate that interactions are highly dynamic.

6.2. Team Effectiveness: Case Comparison

Research Question 2: How does team effectiveness of a Project-Based Cross-Functional Design Team with a Bouwteam project-delivery method compare to an integrated project-delivery method?

Team Effectiveness of the two teams was assessed by comparing shared leadership behaviors of the observations with qualitative and quantitative results of team effectiveness . Figure 6.5 and 6.6 shows the team effectiveness scores compared to the baseline scores on the vertical axis and the observations on the horizontal axis, with a vertical line indicating the milestone. The average team effectiveness score of an observation is subtracted from the baseline score, in which a positive number indicated improvement and a negative number deterioration. The graphs were extrapolated to take into account missing data. The results from figure 6.5 and 6.6 seemed to suggest significant improvement in team effectiveness in the 50/10kV team during observation 4 and in the 150/20kV team during observation 5, which happened to be the milestones according to the project planning. A milestone in the two projects was defined as an event in which significant objectives were achieved with regard to finishing deliverables and the transition to a new phase. The milestone for the 50/10kV project was the completion of the final design and transition to the technical design phase, while for the 150/20kV project the milestone was the completion of the specification of requirements for inviting tenders.

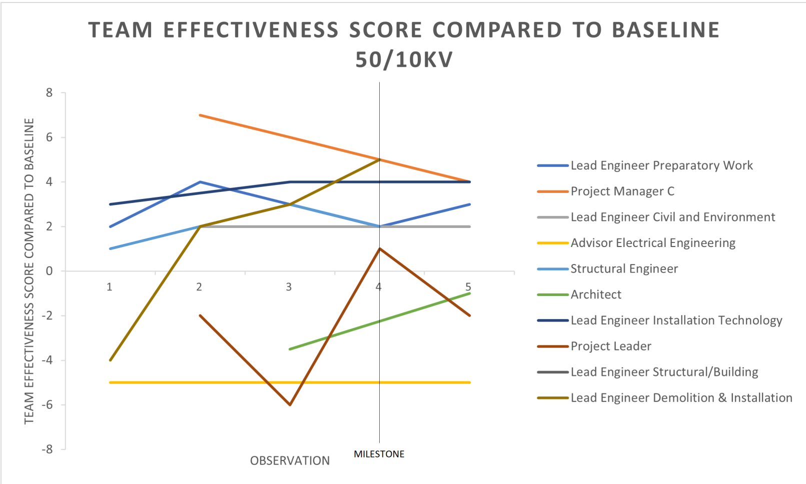

Figure 6.5: Team Effectiveness Score compared to Baseline - 50/10kV

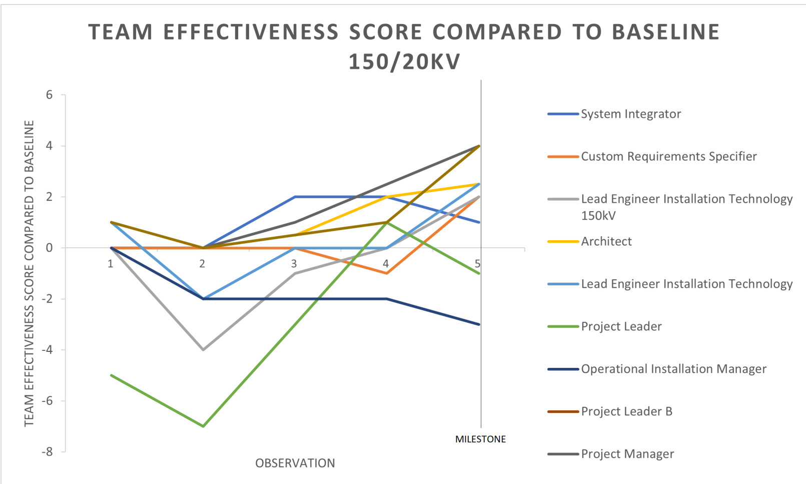

Figure 6.6: Team Effectiveness Score compared to Baseline - 150/20kV

Figure 6.7 presents the approach for a structured comparison between observations within a case and comparison between the two cases. First, the milestone of the 50/10kV project (observation 4) was aligned with the milestone of the 150/20kV project (observation 5), in order to identify patterns, commonalities and differences prior to the milestones. In case 1, comparison was made between observation 4 and the previous three observations (observations 1,2, and 3). In case 2, comparison was made between observation 5 and the previous four observations (observations 1, 2, 3, and 4). Subsequently, the milestone and non-milestone observations were analyzed between the two cases, that facilitated the identification of possible commonalities, differences and insights, which would not have been apparent by analyzing and comparing only the milestone observations. This approach enhanced the comparative analysis and promoted gaining comprehensive understanding and insights into milestone as well as non-milestone observations.

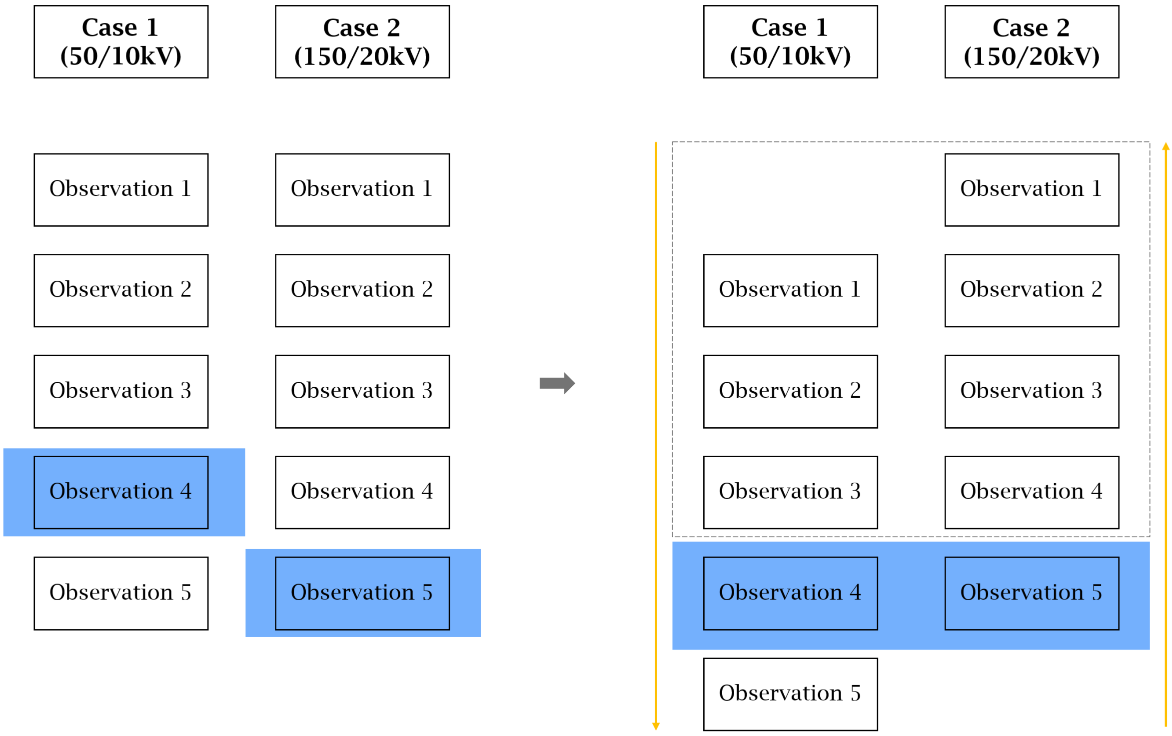

Figure 6.7: Shifting observation milestones

Figure 6.8 is an integration of the qualitative and quantitative data, in which the frequency table, sankey diagram, and team effectiveness scores were combined into one figure. First, the frequencies indicate how many times a specific leadership behavior was displayed. Second, the sankey diagram connects the frequencies of the specific leadership behavior through different flows to the respective observation. Third, the average scores of team effectiveness (lower score means higher team effectiveness) from the questionnaire and the PT-Ratios can be seen on the right-hand side corresponding to their observation. A Person Task-Ratio was defined as the ratio between the frequency of exhibited person-focused behavior and the frequency of exhibited task-focused behavior. It was introduced in order to account for the various lengths of the observations, that facilitated comprehensive comparison between observations and between teams. Table 6.1 summarizes the PT-Ratios of the analyzed observations of both teams with their respective team effectiveness scores, in which the milestone values are indicated with bold letters.

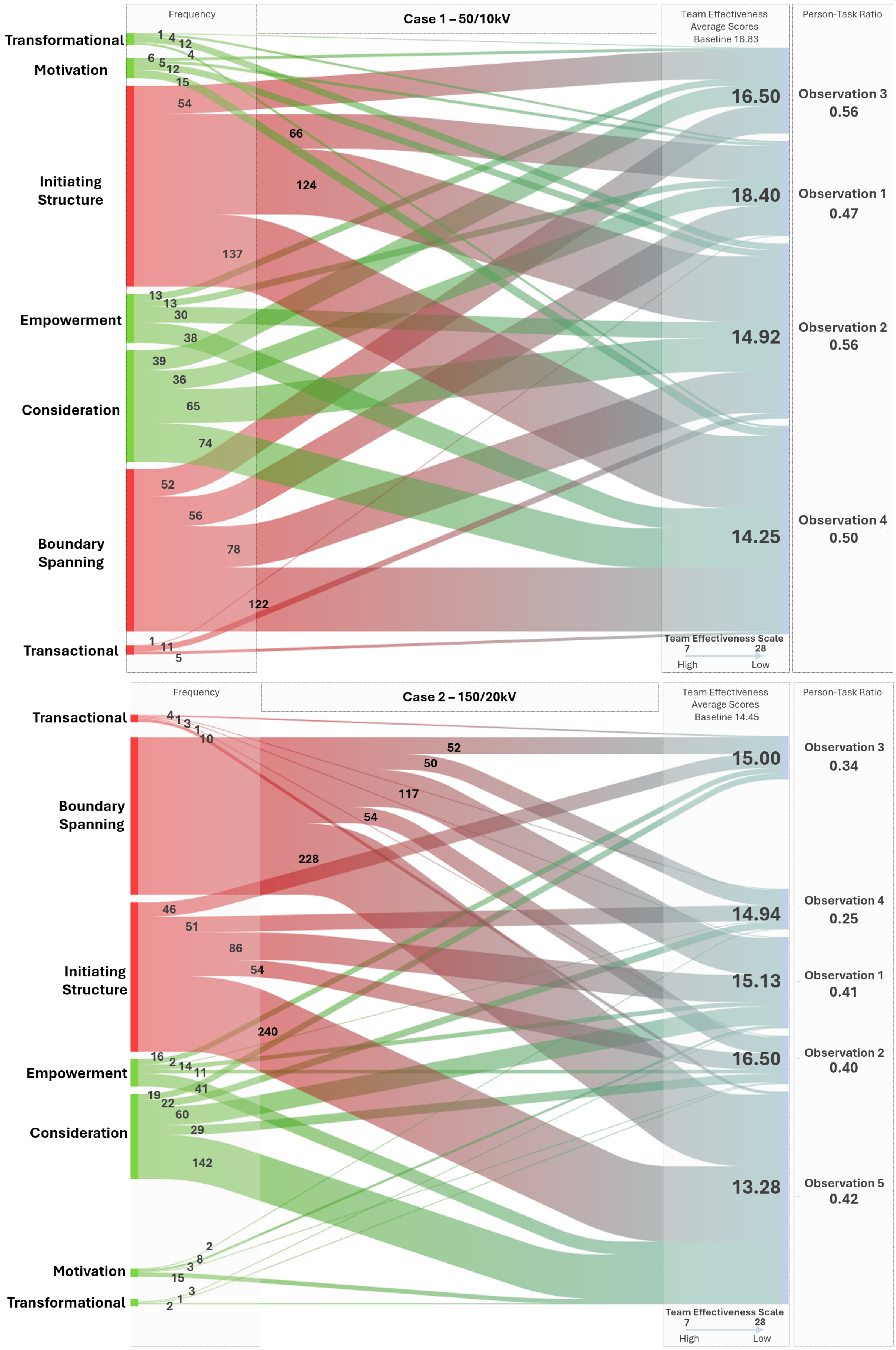

Figure 6.8: Integrated Sankey Diagrams (50/10kV & 150/20kV) - Shared Leadership vs Observations

Table 6.1: Summary of PT-Ratios and Team Effectiveness Scores

Observation	PT-Ratio		Team Effectiveness Score	
	50/10kV	vs 150/20kV	50/10kV	vs 150/20kV
Baseline	N/A	N/A	16.83	14.45
1	0.47	0.41	18.40	15.13
2	0.56	0.40	14.92	16.50
3	0.56	0.34	16.50	15.00
4	**0.50**	0.25	**14.25**	14.94
5	N/A	**0.42**	15.30	**13.28**

Comparing results within the 50/10kV team
The findings and results from figure 6.8 seemed to give the impression of significant increased exhibition of both task-focused and person-focused leadership behaviors during the milestone, which had the highest team effectiveness (lowest score) compared to earlier observations. It can be seen that observation 2 and observation 4 had similar frequencies of exhibited leadership for both task-focused and person-focused behaviors, while observation 1 and observation 3 had similar frequencies of exhibited leadership. Observation 2 and observation 4 had higher frequencies of leadership behaviors and higher team effectiveness with scores of 14.92 and 14.25 respectively, whereas observation 1 and observation 3 had lower frequencies and lower team effectiveness scores of 18.40 and 16.50 respectively.

From visual inspection and based on the absolute value of the frequencies, exhibition of person-focused behaviors, in particular consideration and empowerment, had a slightly larger presence during milestones in comparison to non-milestone observations. As detailed in table 6.1, the observations pointed towards no identification of clear patterns with regard to the PT-Ratios as well as patterns in relation to the team effectiveness scores across the observations. The PT-Ratios seemed to be more or less constant, whereas the team effectiveness seemed to fluctuate. Nonetheless, both the PT-Ratio and team effectiveness score increased notably during the milestone. Though, it was noticeable that the PT-Ratios were chaotic, likely due to the absence of team members across observations, resulting in missing data and the necessity for extrapolation, as shown in figure 6.9. Present team members are indicated with green, absent members with red, and team members who were present but did not fill in the questionnaire are indicted with yellow.

Case 1 - 50/10kV (High Absence)	Baseline score	Observation 1	Observation 2	Observation 3	Observation 4	Observation 5
	20	18	16	AFW	18	17
	17	AFW	10	AFW	AFW	13
	19	AFW	17	17	AFW	Niet ingevuld
	13	18	AFW	AFW	AFW	AFW
	18	17	AFW	15	16	AFW
	14.5	VAK	VAK	18	Niet ingevuld	15.5
	21	18	17.5	17	AFW	17
	12	AFW	14	18	11	14
	ZIEK	ZIEK	ZIEK	ZIEK	ZIEK	ZIEK
	17	21	15	14	12	AFW

Case 2 - 150/20kV (Low Absence)	Baseline score	Observation 1	Observation 2	Observation 3	Observation 4	Observation 5
	16	16	16	14	14	15
	17	17	17	17	18	15
	16	16	20	17	16	14
	16.5	VAK	VAK	16	14.5	14
	19	18	21	19	19	16.5
	9	14	16	12	8	10
	12	12	14	AFW	14	15
	11	12	ZIEK	ZIEK	ZIEK	ZIEK
	11	AFW	11	10	AFW	7
	17	16	17	AFW	16	13

Figure 6.9: Presence of team members - 50/10kV vs 150/20kV

Two quotes are included to illustrate this phenomenon:

1. *'I personally notice, and I believe from our side as well, that there is a need to sit together more frequently, ideally for at least half a day, and that everyone is present. Even if it's just to have a cup of coffee, but at least talk about the project. Right now, it's noticeable that this person is absent, this person is absent and this person is absent. Without looking at anyone's schedule, you notice that you're missing each other. In the Final Design phase (DO), you saw that the alignment we needed with each other only happened after the 0.8 version. That simply can't continue if we want to meet this planning. This is one of the requirements or conditions, to put it that way.'* (Architect, 50/10kV)

2. *'Yes, I would really like to steer, or at least meet once a week, and maybe, yes, we've spent two hours together now. I think that's fine, maybe a little longer, but that we at least set aside time to sit together every week. Yes, you just see that not everyone is present, so to speak.'* (Architect, 50/10kV)

These findings and results appeared to suggest that increased exhibition of both task-focused and person-focused behaviors contributed to higher team effectiveness during milestones, likely due to the importance of such moment. Furthermore, the notable increase in person-focused behaviors seemed to indicate that a milestone provided space for meeting the needs of team members and to discuss how to proceed in the next phase. This improvement in team effectiveness may be attributed to the significance of a milestone which can be regarded as a review of not only the final deliverables, but also the interpersonal processes.

Comparing results within the 150/20kV team

The findings and the results from figure 6.8 appeared to give the impression of substantial increased displayed exhibition of both task-focused and person-focused behaviors during the milestone, which also had the highest team effectiveness compared to previous observations, similar to the 50/10kV project. From figure 6.8 it can be seen that the non-milestone observations (observation 1, 2, 3, and 4) had similar frequencies of exhibited leadership for both task-focused and person-focused behavior, however with a notable higher frequency for boundary spanning in observation 1. This was likely due to many agenda topics, open tasks, many issues, lack of clarity about certain topics, and lack of information exchange. Moreover, the System Integrator managed the specification of requirements document and needed to exhibit task-focused behaviors more frequently to steer members for input and deliverables (Figure 5.9). One quote is included to illustrate this:

'No, I understand. The reason, which I explained again this morning, is very simple: we chose to include it in Chapter Six of [..]. It makes sense to also include it in Chapter Five, because otherwise, I would be handling it in two different ways, aside from the comments that it might belong in Chapter Four.' (System Integrator, 150/20kV)

From visual inspection and based on the absolute value of the frequencies of figure 6.8, exhibition of person-focused behaviors, in particular consideration and empowerment, had a substantial larger presence during milestones in comparison to non-milestone observations. The results from table 6.1 seemed to suggest that the PT-Ratios of the 150/20kV team gradually decreased with time and had a major increase to 0.42 during the milestone exceeding the initial value of 0.41, which indicated a shift to person-focused behaviors becoming more prominent during this meeting. Furthermore, table 6.1 indicated that team effectiveness slightly declined at observation 2, but gradually increased again with a significant surge during the milestone observation. These results denoted that person-focused behaviors during milestones contributed to improved team effectiveness. The gradual decline of the PT-Ratio along the increase of team effectiveness may be attributed to the following: 1) the deadline approached shortly; 2) Tasks were completed gradually; and 3) issues and lack of clarity were steadily solved. As a result, the focus was placed on task accomplishment. These aspects are related to the longitudinal approach that includes iteration and cyclic feedback loops which was overlooked by Wu and Cormican (2021). Topics and issues from the past are recurring aspects in a cyclical manner in which the outcomes of the meetings form the basis and new inputs for the following meetings.

A final review was done during the milestone in which the PT-Ratio and team effectiveness had a major increase. This seemed to suggest that reaching a milestone allowed for reflection not only about the deliverables (task-focused), but also about team processes (person-focused), in particular recognition of what the team had achieved. In other words, the pressure of a deadline was temporarily taken away for that milestone, which facilitated display of more person-focused behaviors to reflect and to look forward to the next milestone.

Comparing results between the 50/10kV and 150/20kV team
Subsequently, the findings and results emerging from the comparisons between observations of each case, seemed to suggest the following identified patterns, commonalities and differences between the 50/10kV team and the 150/20kV team:

Commonalities

- Shared Leadership was indeed present as two or more individuals engaged in the leadership of the team;
- All leadership behaviors were exhibited by the team members of both teams;
- Cumulative exhibited leadership behaviors had nearly identical frequencies;
- Initiating structure and boundary spanning were the most prominent task-focused behaviors, while consideration and empowerment were the most prominent person-focused behaviors;
- Situational Leadership was present and exhibited by the project leader and architect;
- Highest occurrence of overall satisfaction and quality effectiveness were mostly related to boundary spanning, initiating structure, consideration, and empowerment;
- Two or more leadership behaviors were displayed simultaneously;
- Individual Team Effectiveness Scores compared to Baseline increased during milestones;
- Exhibition of task-focused and person-focused behaviors increased significantly during milestones;
- Non-milestone observations had nearly identical frequencies of exhibited leadership behaviors;
- Team effectiveness was highest during milestones.

Differences

- The 50/10kV case had higher PT-Ratios compared to the 150/20kV case;
- The 50/10kV case had no clear pattern with regard to the PT-Ratio;
- Team effectiveness of the 50/10kV case during non-milestone observations fluctuated and had no clear pattern;
- The 50/10kV case had a less consistent team composition;
- The 150/20kV case had a decreasing PT-Ratio with approaching deadline;
- Team effectiveness of the 150/20kV case was higher than the 50/10kV case;
- Team effectiveness of the 150/20kV case increased gradually;
- The 150/20kV case had a more consistent team composition;
- Addressing issues and lack of clarity contributed to higher team effectiveness in 150/20kV;

6.3. Synthesis

Among the two project cases, the 150/20kV project seemed to have achieved the highest team effectiveness (lowest average scores). This was manifested by increased exhibited task-focused and person-focused behaviors during milestones as well as consistent team composition. In the 150/20kV project, exhibition of task-focused behaviors increased gradually as the deadline was approaching. Team members of the 150/20kV as well as the project manager were highly satisfied with the final results of the specification of requirements and team collaboration. Shared leadership, team behavioral processes, and situational leadership were important factors that contributed to these achievements and improved team effectiveness.

In the 50/10kV project, the early contractor involvement to provide input and expertise did not seem to have notable improvement on team effectiveness, most likely due to the trade-off between focusing on the design (task-focused behaviors) and building consensus (person-focused behaviors). On the one hand, early contractor involvement could result in improved quality of the design. On the other hand, the provided input and expertise could clash with other disciplines. Design freedom in the 50/10kV project seemed to have created space for person-focused behaviors (shared understanding, consensus building) compared to the 150/20kV project. Moreover, the PT-Ratio and team effectiveness in the 50/10kV project were fluctuating as a result of frequent team member absence.

All things considered, the findings and results seemed to suggest that team composition moderates the relationship between shared leadership and team effectiveness, more than the project-delivery method in this study. This means that the relationship between exhibited leadership behaviors and team effectiveness would differ between the presence and absence of team members. Therefore, from the findings and results, a new hypothesis is formulated that deserves further research, describing how shared leadership and team effectiveness changes with team composition.

H1: Team composition moderates the relationship between shared leadership and team effectiveness in Project-Based Cross-Functional Design Teams.

Moreover, the findings suggested that the project phase and responsibilities of individuals play a significant role in the involvement and presence during meetings. Hence, the study should be extended to fully observe and comprehend the influences of the project-delivery method on team composition, which resulted in a second hypothesis that deserves further research.

H2: Team composition in Project-Based Cross-Functional Design Teams is project phase-dependent.

Figure 6.10 depicts the resulting theoretical model from the findings, suggesting the moderating role of team composition as well as a possible relationship between the project phase and team composition.

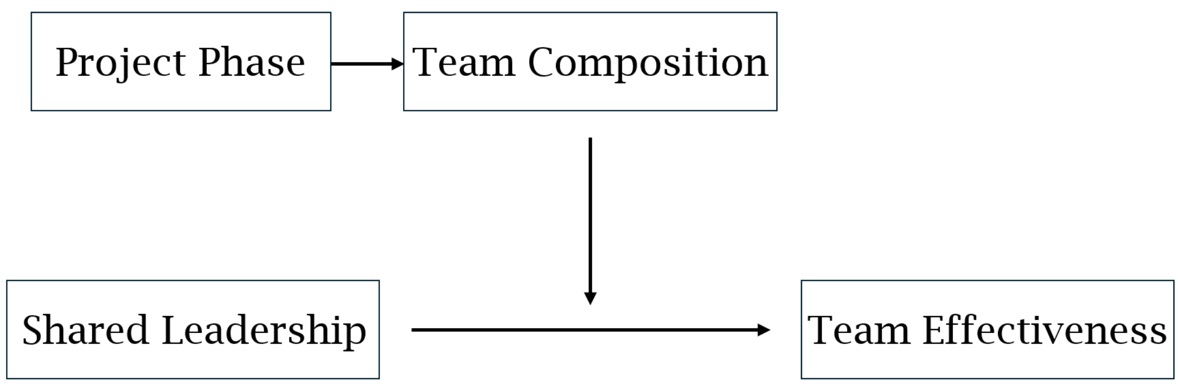

Figure 6.10: Theoretical model of Team Composition as a moderator between Shared Leadership and Team Effectiveness, and the relationship between Project Phase and Team Composition

7

Discussion

The integration of concepts from the field of project management, shared leadership and team effectiveness, enriches our understanding of the influences of shared leadership behaviors on team effectiveness. More specifically, this comparative case study advances previous work by suggesting the effects of shared leadership behaviors on team effectiveness in Project-Based Cross-Functional Design Teams operating under different project-delivery methods in the Dutch construction industry. Hence, the study aimed to provide an answer to the research question:

What effects do shared leadership behaviors have on team effectiveness in Project-Based Cross-Functional Design Teams under different project-delivery methods in the Dutch construction industry?

The first research sub-question is what leadership behaviors can be recognized and how does it contribute to the development of team functioning in Project-Based Cross-Functional Design Teams. The second research sub-question aimed to explore and compare team effectiveness of Project-Based Cross-Functional Design Teams with a Bouwteam project-delivery method and an integrated project-delivery method. Therefore, the second research question addressed what the team effectiveness patterns, commonalities and differences were between the two teams.

Drawing on a comparative case study of two engineering design teams with nearly identical team members, this study revealed the effects that shared leadership behaviors have on team effectiveness. The main finding is the presence of every task-focused and person-focused leadership behaviors, individually or in combination, as well as the presence of situational leadership in both teams.

The second main finding is that milestone observations with highest exhibition of leadership behaviors, in particular person-focused behaviors, were associated with higher team effectiveness, with team composition probably moderating the relationship between shared leadership and team effectiveness. This means that the relationship between shared leadership and team effectiveness would differ between teams with varying combinations of individuals. The findings suggested team composition being a moderating role more than project-delivery method was likely due to the early contractor involvement not being prominent in the researched phase in addition to limited time of the study.

Therefore, two hypotheses are formulated that deserve further research, specifically suggesting that team composition moderates the relationship between shared leadership and team effectiveness in Project-Based Cross-Functional Design Teams, and that team composition in Project-Based Cross-Functional Design Teams are project phase-dependent.

Collectively, the findings of this study provide significant theoretical contributions, practical implications, limitations as well as directions for future research.

7.1. Theoretical Contributions

This research extends the findings of the works by Syed (2017), Jon (2019), and Wu and Cormican (2021) by conducting mixed methods research to leverage the strengths of each method for more inclusive findings, as many studies did not integrate qualitative and quantitative data (Guetterman et al., 2015). On the one hand, Syed (2017) and Jon (2019) conducted qualitative research, in which they determined team functioning only by observations and through the perceptions of the researcher that introduces subjectivity and bias as well as a lack of contextual understanding of participant's perspectives in relation to team functioning. On the other hand, Wu and Cormican (2021) conducted quantitative research, which may lack contextual understanding of individual experiences and perspectives.

This study also extends previous findings by implementing cross-functional communication and coordination, which was critical for simulating the dynamics of shared leadership. Moreover, the study adopted the longitudinal approach that involves iteration and cyclic feedback loops, which was overlooked by Wu and Cormican (2021). Topics and issues from the past are recurring aspects, that may recur at any moment in a cyclical manner in which the outcomes of the meetings form the basis and become new inputs for the following meetings. Moreover, topics and issues from far in the past may be relevant again at some point that influences the feedback loop.

These contributions to this study underscore the need to revise current frameworks to incorporate cross-functional communication and coordination, as well as adopting the longitudinal approach and direct examination of shared leadership. This refined framework addressed the identified research gaps and limitations, while enriching comprehension of shared leadership behaviors and team effectiveness.

The findings of the study add to the body of knowledge about the role of shared leadership behaviors in enhancing team effectiveness in Project-Based Cross-Functional Design Teams (Daspit et al., 2013; Edmondson & Lei, 2014; Koolwijk et al., 2020). The study shows that with the presence of shared leadership, all task-focused and person-focused behaviors were exhibited individually or in various combinations. This finding is consistent with the results of Syed (2017), who found that shared leadership consists of multiple dynamic leadership behaviors to maximize team effectiveness.

This research additionally unveiled milestones as a critical moment that had a substantial impact on the exhibition of shared leadership behaviors as well as team effectiveness. The impact on team effectiveness may be attributed to high exhibition of in particular person-focused behaviors during milestones, which is in alignment with the work of Fiore et al. (2010), who identified that person-focused are especially important in guaranteeing team effectiveness, supported by the results of Burke et al. (2006) which suggested that the importance of task-focused and person-focused behaviors are nearly equal. This finding highlights the importance of the adoption of the Input-Mediator-Outcome Team Effectiveness Framework that includes the aspect of time and cyclic feedback mechanism (Ilgen et al., 2005; Kozlowsik et al., 1999; McGrath, 1984). Otherwise, the occurrence and development of shared leadership would not have emerged. In addition, the adoption of the Input-Mediator-Outcome Team Effectiveness Framework contributed to addressing the research gaps identified by Wu and Cormican (2021) about including the aspect of time, iteration, and direct examination of team environments (cross-functional communication and coordination).

7.2. Practical Implications

The importance of person-focused behaviors on team effectiveness, supported by Fiore et al. (2010) and Burke et al. (2006), reinforces the recommendation that all team members in an engineering design team exhibiting shared leadership need to be instructed in task-focused as well as person-focused behaviors as they both enhance team effectiveness.

Subsequently, the research uncovered an unrecognized aspect in shared leadership, which was not discussed in the literature review. The research identified the presence of situational leadership, which entails adapting one's leadership according to each unique task or situation to meet the needs of team, team members and key stakeholders (Hersey & Blanchard, 1969). This finding is consistent with the result of Jon (2019), in which the author found adaptation of leadership behaviors in engineering design teams in accordance with the situation at hand. The identification of situational leadership in the two cases emphasizes the necessity to revise the traditional one-size-fits-all approach, and suggests that not only the project leader, but also every single member of an engineering design team must adopt flexible and dynamic leadership behaviors appropriate to the situation to enhance team effectiveness. Perhaps this study might contribute to developing new approaches in leader training.

Furthermore, the findings of this comparative case study unveiled the suggestion that team composition moderates the relationship between shared leadership and team effectiveness more than the project-delivery method, which was previously not recognized and not extensively discussed in the literature review. Observations of case 1 - 50/10kV indicated that the team experienced fluctuating team dynamics, likely due to the frequent absence of various team members across the meetings. This finding is in agreement with the previous work of Jon (2019), who found that constantly varying combinations of individuals present across meetings made it challenging to conduct comparisons between observation and between cases. Additionally, early involvement of various parties is a work arrangement that is becoming prominent nowadays, in which one is occupied with multiple tasks from multiple projects, that necessitates the decision and priority for certain tasks and projects. Consequently, this leads to frequent absence and affects team composition. This is line with Mathieu et al. (2008) who acknowledged that individuals have multiple memberships and that there is limited research on how this impacts teams. For example, individuals are picked based on their KSAs and the needs of the project and the team. However, individuals may have multiple memberships in which they are simultaneously part of multiple teams, that are often not well coordinated, resulting in some individuals being underutilized or subjected to undue pressure in certain phases.

Case 2 - 150/20kV on the other hand, had a more consistent team composition every meeting. This novel finding contributes to addressing a research gap identified by Mathieu et al. (2008) in a meta-analysis study, that there is scant research on dynamic team composition and a lack of studies that mention dynamic team composition as a result of individuals moving on and off teams during the project.

This finding and the quotes by the architect provide support for the recommendation that all team members need to contribute to structuring meetings, with the project leader making the necessary arrangements, such that team members are able to attend as much as possible, whether it is online or physical to prevent missing each other too frequently. Moreover, it is recommended for project managers to carefully consider which individuals and parties are absolutely necessary to involve early in the process.

7.3. Limitations and Future Research

While this study provides valuable insights into the relationship between shared leadership behaviors and team effectiveness in Project-Based Cross-Functional Design Teams within the Dutch construction sector, several limitations must be addressed.

First, although mixed methods approach was adopted, this study was primarily focused on qualitative data. While qualitative methods provided comprehensive contextual understanding and in-depth insights of the occurrences, it lacked objectivity which is characteristic to quantitative methods. This concern was partly mitigated by taking into consideration Guba's Four Criteria to attain trustworthiness in this study, that must be considered when interpreting the data and findings (Shenton, 2004). Prior to the start of the study, the researcher developed early familiarity with the culture of participating individuals. This was done through preliminary immersion into the organisation by attending various meetings, interacting with potential participants and other team members clarifying the research study, as well as reading up on the two cases. The company supervisor stated that the researcher was integrated into the work environment and both teams, and that the researcher was accepted by the participants of the study and other team members. Moreover, debriefing sessions with the thesis supervisors allowed for sharing and developing the interpretations of the researcher to partly mitigate researcher bias, while broadening the vision from the input and feedback of the supervisors. Taken together, these two provisions contributed to appropriate quality of the observations, interviews and interpretation of the data and therefore enhanced trustworthiness of this study.

Second, this study focused primarily on observing project meetings, which did not take into account activities outside the meetings that may be of influence but could not be incorporated into the analysis and interpretation of the collected data. Moreover, the time span of conducting this study may not have been sufficient to gain a more satisfying set of data to partly mitigate the absence of team members and to observe the impacts of project-delivery methods. Although, team members were present, the researcher was not able to get all team members to fill in the questionnaire. However, case 2 had a more complete set of data in which the findings were in alignment with previous works, that supports the robustness of the findings in this study.

Third, since this research was conducted within a specific industry and type of team, the Dutch construction industry and Project-Based Cross-Functional Design Teams respectively, it may limit the generalizibility of the findings to various sectors and categories of teams.

Regardless of these limitations, the findings of this study lay the groundwork and suggest directions for future research.

Subsequent research could address the limitation of partially self-reported data by adopting objective measures and other strategies mentioned by Shenton (2004) to comply with Guba's Four Criteria to further enhance trustworthiness of a qualitative study.

Furthermore, as supported by Koolwijk et al. (2020) and Wu and Cormican (2021), longitudinal studies have the capabilities to unveil more inclusive findings as construction projects have long spans. Therefore, the findings of this study underscore the need for further research with more representative samples, interactions during other moments other than meetings, and conducting research over a longer time span to extend the conclusions. It would be noteworthy to conduct a follow-up study on these two cases to see the development of shared leadership and team effectiveness as these projects last until 2027.

Moreover, considering the contextual limitations of this study, further studies should conduct multi-site studies to assess the generalizability of the findings in this study across various sectors and types of teams to improve upon the current research.

Lastly, the findings that team composition moderates the relationship between shared leadership and team effectiveness, and that team composition in Project-Based Cross-Functional Design Teams is project phase-dependent are speculative. Hence, two hypotheses are formulated that deserve further research.

H1: Team composition moderates the relationship between shared leadership and team effectiveness in Project-Based Cross-Functional Design Teams.

H2: Team composition in Project-Based Cross-Functional Design Teams is project phase-dependent.

8

Conclusion

By exploring and analyzing displayed leadership behaviors in Dutch Project-Based Cross-Functional Design Teams operating under different project-delivery methods, this thesis has shown how various task-focused and person-focused leadership behaviors manifest in practice and how they can shape team effectiveness throughout time. In other words, the main research question that this study aimed to answer was defined as:

What effects do shared leadership behaviors have on team effectiveness in Project-Based Cross-Functional Design Teams under different project-delivery methods in the Dutch construction industry?

The research questions that contributed in answering the main research question were as follows:

1. What leadership behaviors can be recognized and how does it contribute to the development of team functioning in Project-Based Cross-Functional Design Teams?
2. How does team effectiveness of a Project-Based Cross-Functional Design Team with a Bouwteam project-delivery method compare to an integrated project-delivery method?

Meeting observations were audio-recorded, converted to a script and subsequently annotated to indicate the team effectiveness topic and displayed leadership behaviors of each team member in both teams. The analyzed scripts of the 50/10kV team was then compared compared with the analyzed scripts of the 150/20kV team. The findings showed the presence of all task- and person-focused behaviors, on its own and in various combinations in both teams, and the presence of situational leadership. The findings also suggested that high exhibition of leadership behaviors, especially person-focused behaviors, was associated with higher team effectiveness. An unexpected but interesting finding brought to light, suggested that team composition moderates the relationship between shared leadership and team effectiveness, more than the project-delivery method. This was likely due to influences of project phases, frequent absence, team members moving on and off during the project, and multiple memberships. Moreover, the 150/20kV team with a consistent team composition had a higher team effectiveness compared to the 50/10kV team with an inconsistent team composition.

In conclusion, this study provided valuable insights into the importance of shared leadership on team effectiveness in engineering design teams in the Dutch construction sector. The findings strengthen the idea that person-focused behaviors are equally important, if not, more important than task-focused behaviors in enhancing team effectiveness in Project-Based Cross-Functional Design Teams. Emphasizing person-focused behaviors should be beneficial to increasing overall performance, satisfaction and quality effectiveness. However, the 50/10kV team was facing challenges related to presence and team coordination, which must be resolved first. All team members can contribute to addressing this challenge, which promotes cohesion, satisfaction and improved team work. Ultimately, the findings are not only valuable for Project-Based Cross-Functional Design Teams in enhancing team effectiveness, but also for Royal HaskoningDHV and the organizations involved with the two cases.

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A

Interview Protocol

Protocol

- Het interview kan zowel fysiek als online worden afgenomen, afhankelijk van de voorkeur en beschikbaarheid van de geïnterviewde;
- De geïnterviewde zal de interviewvragen toegestuurd krijgen ter voorbereiding, zodat de deelnemer weet wat hij/zij kan verwachten tijdens het interview;
- Bij een fysieke interview zal het interview opgenomen worden met een uitbreidingsmicrofoon, aangesloten op een smartphone of laptop, om een zo duidelijk mogelijke audio-opname te verkrijgen;
- Bij een online interview zal het interview opgenomen worden met Microsoft Teams waarbij de transcriptie functie aangezet wordt. Achteraf zal audio en video van elkaar gescheiden worden waarbij het videodeel direct vernietigd zal worden;
- De audio-opname zal gestart worden en de geïnterviewde wordt gevraagd nogmaals toestemming te geven voor het opnemen van het interview.

Interviewvragen

Algemene vragen:

1. Wat is je achtergrond en hoe ben je bij dit project terechtgekomen?
2. Wat voor ervaringen, vaardigheden en leiderschap vraagt dit project?
3. Wat verwacht je van andere teamleden?
4. Wat is de motivatie voor een roulerende voorzitter?
5. In hoeverre zie je het belang van gedeelde leiderschap in tegenstelling tot de traditionale leiderschap?
6. Hoe zou je je eigen leiderschap omschrijven?

Teamprocessen:

1. Zou je een voorbeeld kunnen geven van teamprocessen die effectief waren en wat bijdroeg aan deze positieve uitkomst? *(Initiating structure - Boundary spanning - Consideration - Empowerment)*
2. Tegen welke ongestructureerde problemen (wicked problems) is het team tegenaangelopen en hoe is daarmee omgegaan? *(Transformational - Consideration)*

3. Hoe worden teamleden gemotiveerd en gemachtigd? Wat is invloed hiervan op het team? *(Motivation - Empowerment)*

4. Hoe wordt waardering geuit voor prestatie? Gebeurt het vaak en door wie? Zijn er teamleden die meer waardering krijgen dan de ander? *(Motivation)*

5. Zijn teamleden complementair/aanvullend? *(Transformational - Consideration)*

Samenwerking:

1. Hoe is het team omgeggaan met conflicten wanneer er moeilijkheden optreden? Was er iemand die dit heeft aangepakt en wat zijn of haar rol hierin? Hoe is dit opgelost? *(Transformational - Consideration)*

2. Kun je een ervaring beschrijven die een positieve of negatieve invloed had op jouw samenwerking met een teamlid? Wie heeft hierin sturing gegeven welke acties hebben bijgedragen tot een positieve of negatieve sfeer? *(Consideration - Empowerment)*

3. Hoe communiceren en delen teamleden effectief informatie? Wat zijn hierin de getrokken lessen voor het andere project en vice versa? *(Initiating structure - Boundary spanning - Consideration)*

Werkomgeving (Consideration - Empowerment - Motivation):

1. Kun je de algehele sfeer en werkcultuur van het team omschrijven? Wat is het belang hiervan op de productiviteit en de samenwerking?

2. Zijn er gevallen geweest waarin de werkomgeving een positieve of negatieve invloed had op het team? Hoe is hiermee omgegaan?

3. Wat zijn de getrokken lessen en opgedane ervaringen om de teamdynamiek en de sfeer te verbeteren?

B

Observation Template

Project	
Date (session)	
Agenda	
Chair	

Legend	
Action	1
Reaction	2

	Attendees						
	Name	**Function / role**	**0:00 - 0:10**	**0:10 - 0:20**	**0:20 - 0:30**	**0:30 - 0:40**	**0:40 - 0:50**
1							
2							
3							
4							
5							

Figure B.1: Observation checklist

C

Team Effectiveness Questionnaire

Team Effectiveness (Pearce & Sims, 2002; Van Den Bossche et al., 2006)

1. How proud are you with the performance of the team? (overall performance)
   (i) Very proud
   (ii) Proud
   (iii) A little proud
   (iv) Not proud
2. How satisfied are you with the performance of the team? (overall satisfaction)
   (i) Very satisfied
   (ii) Satisfied
   (iii) Partly satisfied
   (iv) Not satisfied
3. The quality of the teams' output is very high (think about design documents, calculations, etc) (quality effectiveness)
   (i) Strongly agree
   (ii) Agree
   (iii) Partly agree
   (iv) Disagree
4. The team delivers it commitments on time. (planning effectiveness)
   (i) Strongly agree
   (ii) Agree
   (iii) Partly agree
   (iv) Disagree
5. The team used the available time effectively (planning effectiveness)
   (i) Strongly agree
   (ii) Agree
   (iii) Partly agree
   (iv) Disagree

6. The team handles new problems effectively (change effectiveness)
   (i) Strongly agree
   (ii) Agree
   (iii) Partly agree
   (iv) Disagree
7. The team copes with change very well (changes effectiveness)
   (i) Strongly agree
   (ii) Agree
   (iii) Partly agree
   (iv) Disagree

D

ATLAS.ti Code List

Table D.1: ATLAS.ti Code List

ATLAS.ti Code List		
A. Roles	Group cohesion	**J. Transactional**
Advisor Electrical Engineering	Needs assessment	Active management
Architect	Openness	Exchange relationships
Assistant Project Manager	Team satisfaction	Passive management
Custom Requirements Specifier		
Lead Engineer Civil and Environment	**E. Empowerment**	**K. Interpersonal Processes**
Lead Engineer Demolition and Installation	Developing self-leadership skill	Conflict management
Lead Engineer Installation Technology	Distributed autonomy and authority	Consensus-building
Lead Engineer Installation Technology 150kV	Guidance	
Lead Engineer Preparatory work	Proactivity	**L. Transition Processes**
Lead Engineer Structural/Building	Shared responsibility	Goal specification
Operational Installation Manager	Team learning and adaptation	Planning
Project Leader		
Project Leader B	**F. Initiating Structure**	**K. Team Effectiveness Questionnaire Items**
Project Manager	Clarity	Overall performance
Project Manager C	Conflict minimization	Overall satisfaction
Structural Engineer	Coordination & Structure	Quality effectiveness
System Integrator	Directive	Planning effectiveness (on-time)
	Efficiency	Planning effectiveness (effective use of time)
B. Action Processes	Purpose-oriented	Change effectiveness (problem handling)
Communication	Role unambiguity	Change effectiveness (coping with changes)
Coordination & Structure	Unambiguity	
C. Boundary Spanning	**G. Interpersonal Processes**	
Adherence to criteria	Conflict management	
External approval	Consensus-building	
Monitoring & Networking		
Organizational transparency	**H. Motivation**	
Reality check	Facilitation of needs and core values	
Resource management	Individual effort	
Shared understanding	Recognition	
D. Consideration	**I. Transformational**	
Active listening	Complex problem-solving	
Conflict management	Idealized influence	
Consensus-building	Individualized consideration	
Encouragement	Inspirational motivation	
Facilitation	Intellectual stimulation	

E

Team Effectiveness Scores 50/10kV

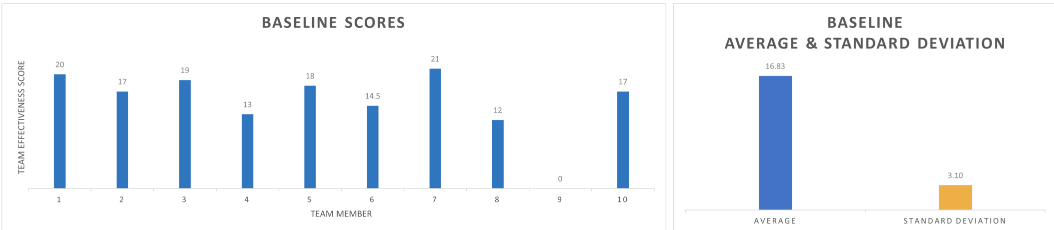

Figure E.1: Baseline Team Effectiveness scores

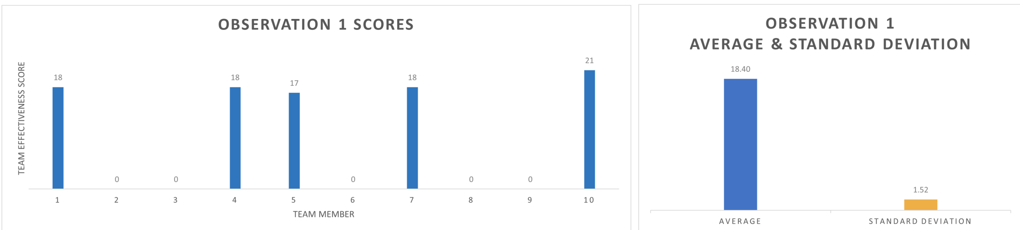

Figure E.2: Observation 1 Team Effectiveness scores

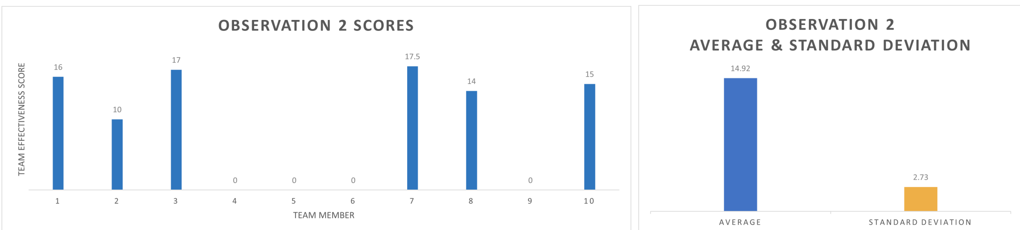

Figure E.3: Observation 2 Team Effectiveness scores

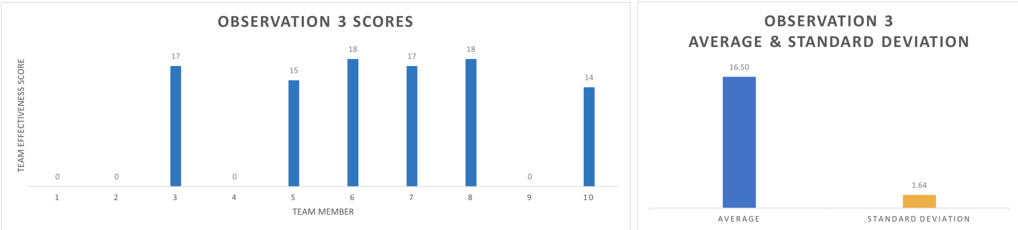

Figure E.4: Observation 3 Team Effectiveness scores

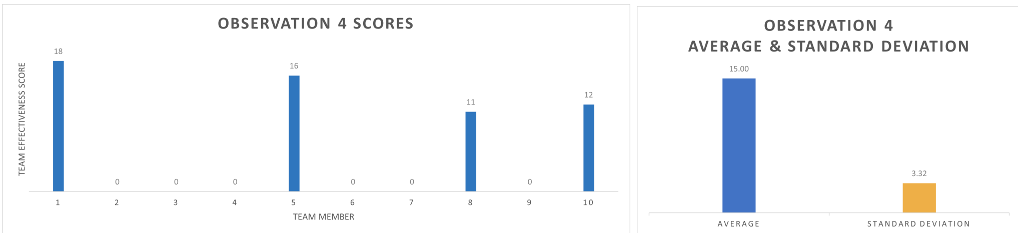

Figure E.5: Observation 4 Team Effectiveness scores

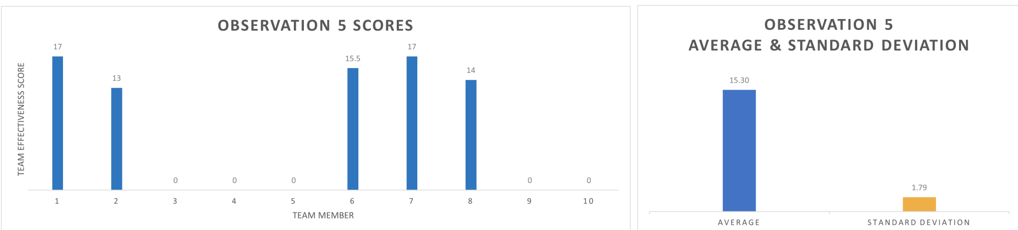

Figure E.6: Observation 5 Team Effectiveness scores

F

Team Effectiveness Scores 150/20kV

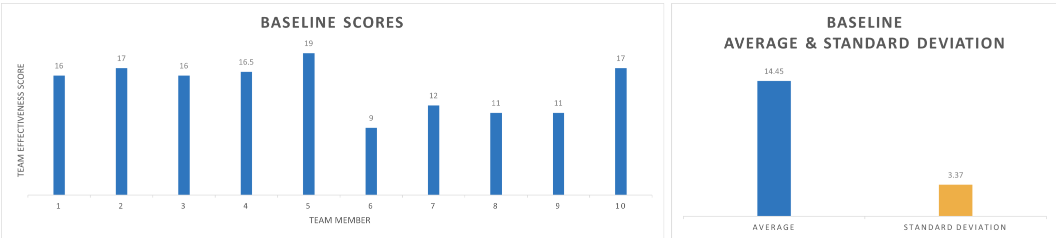

Figure F.1: Baseline Team Effectiveness scores

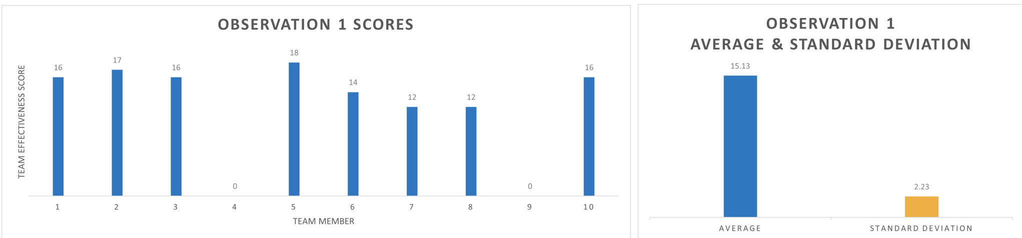

Figure F.2: Observation 1 Team Effectiveness scores

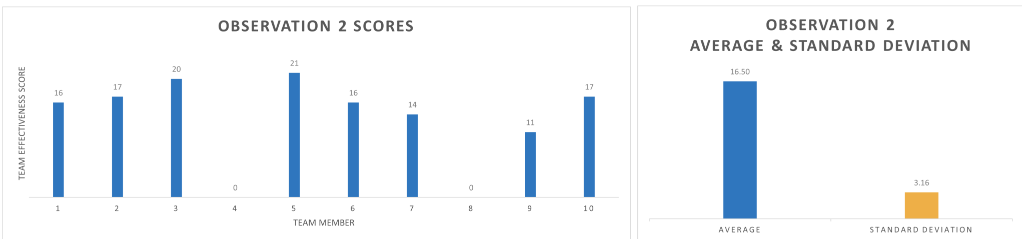

Figure F.3: Observation 2 Team Effectiveness scores

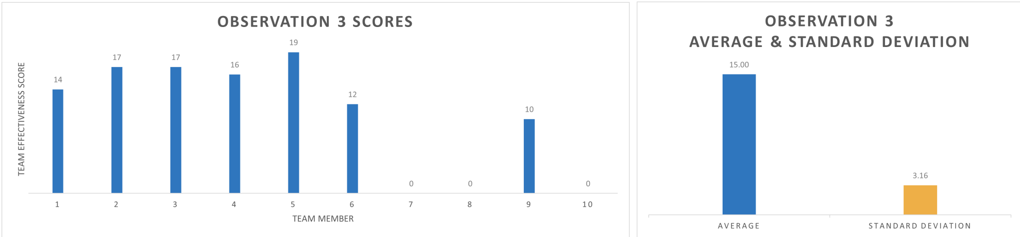

Figure F.4: Observation 3 Team Effectiveness scores

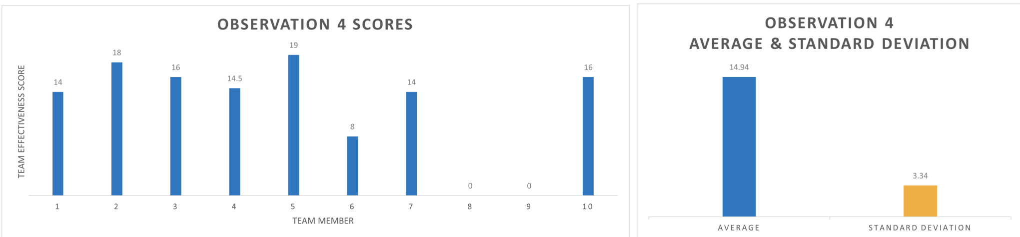

Figure F.5: Observation 4 Team Effectiveness scores

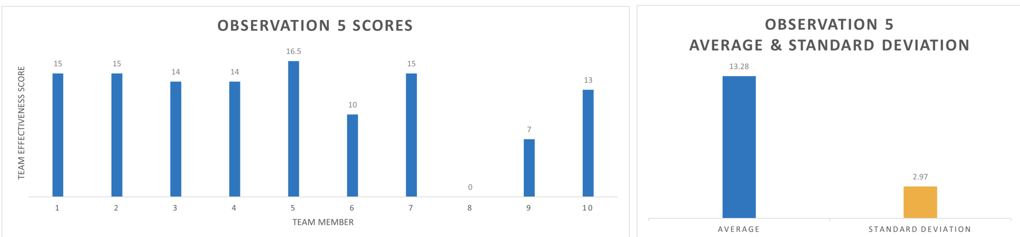

Figure F.6: Observation 5 Team Effectiveness scores