ALMA MATER EUROPAEA

EUROPEAN CENTRE, MARIBOR

DOCTORAL PROGRAMME OF PROJECT MANAGEMENT

DOCTORAL DISSERTATION

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EUROPEAN CENTRE, MARIBOR

DOCTORAL DISSERTATION

OF THE DOCTORAL PROGRAMME IN

PROJECT MANAGEMENT

VPLIV LAST-PLANNER® SYSTEM-A NA KULTURO PROJEKTNEGA OKOLJA

THE IMPACT OF THE

LAST-PLANNER® SYSTEM

ON PROJECT CULTURE

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Maribor, June 2021

ACKNOWLEDGEMENT

I started the "Doctoral Journey" as I decided already at my diploma of applied sciences in civil engineering at the former Cologne University of Applied Sciences that I want to continue my academic journey. To qualify myself for a doctoral program, I had to do an academic intermediate step which I choose at the University of East London to study an MBA program in International Business. This study opened me, in addition to my gained engineering knowledge, a new world of academia in social-, interdisciplinary-, and multicultural science. The doctoral program in project management at the Alma Mater Europaea with its international and practical focus was for me the logic continuation and combination of my two previous studies steps and my experiences in the construction industry. I would like to thank all people that have helped me to finish this journey and like to name some of them in particular.

Zuallererst möchte ich meiner Frau und meinen „3 Jungs" danken, die mir am mittelbarsten die Reise ermöglicht haben. Danke für das aufgebrachte Verständnis bei allen emotionalen Höhen und Tiefen. Danke, dass Ihr das Freizeitprogramm zum größten Teil ohne mich organisiert und durchgeführt habt, um mir die Möglichkeit zu geben mich in meinem Arbeitszimmer zu verkriechen um zu studieren. Bij het thema familie hoort natuurlijk ook mijn „Doctormoeder" Marian: Hartelijk bedankt dat jij deze rol hebt ingevuld: met onvoorwaardelijke opname in jouw werkomgeving in Delft. Bedankt dat jij altijd gedurende „het spel" mijn mentor bent geweest, die mij steeds gestimuleerd heeft en mij het gevoel gaf om trots op mezelf te zijn. Ich danke meinen Eltern für den Heimathafen und den mitgegebenen Ehrgeiz. Ich danke meinen Schwiegereltern für die gegebenen Rückzugsmöglichkeiten, die ich ab und zu brauchte, um zur Ruhe zu kommen. Danke O. Kloth für Deine Freundschaft und dafür, mir immer wieder deutlich aufzuzeigen, dass ich mehr auf mich achten muss. Danke Premium MBA-Gang für die moralische Unterstützung und die gemeinsamen Erfahrungen.

Mladen, hvala Vam što ste osnovali studijski program, i što pružate podršku i razumijevanje tijekom svih faza studija i za sva pitanja. Thank you, fellow students, and lecturers from the Alma Mater Europaea and my research group from the TU Delft for the live changing experiences during our mutual time and for your multiple support.

Danke, an dat kölsche Dreigestirn met all dr kompletten Bajaasch! Ohne de Unterstützung un de Freiheiten de isch vun Üch bekumme han, wör dat nit müjjelich gewesen.

ABSTRACT

Construction projects are frequently characterised by cost- and time overruns and poor quality- and safety conditions. One of the reasons for these conditions is found in the common adversarial project cultures. 'Partnering' as a management approach and the 'Last Planner® System of Production Control' as a business approach both try to overcome these adversarial project cultures and strive for partner-like conditions between the project members. These two approaches show some obvious interfaces, and the question arises if the 'Last Planner® System of Production Control', which core idea is to involve all stakeholders in a transparent and joint planning process, influences project cultures from traditional- towards partnering project cultures.

To answer this question, this dissertation is divided into four explorative parts which all were implemented through mixed methods: First, it was investigated how project culture can be measured under the aspects of partnering. Second, the common project culture and the intended partnering culture were defined. Third, the impact of the 'Last Planner® System of Production Control' was investigated by comparing projects not applying it and those applying it and by putting the findings in the context of the common- and the intended partnering culture. Forth, the relevance of these findings was discussed with practitioners that focus strategically on partnering and have experience in this field.

The dissertation's main finding is that the Last Planner® System of Production Control's implementation does not necessarily lead towards a higher level of partnering. It does lead to a high level of mutual control which enables all project members to distinguish who acts partner-like, and who does not.

Keywords

IZVLEČEK

Gradbeni projekti pogosto potekajo s presežki stroškov in časa in slabimi pogoji na področju kakovosti in varnosti. Eden od razlogov za takšne pogoje so pogoste splošne nasprotujoče si kulture vodenja projektov. 'Partnerstvo' kot menedžerski pristop in sistem 'Last Planner® System of Production Control' (sistem nadzora dela z zadnjimi načrtovalci) kot poslovni pristop poskušata obvladati te pogoje in si prizadevata za vzpostavitev partnerskih pogojev med člani projekta. Ta dva tokova prikazujeta nekatere očitne vmesnike in pojavlja se vprašanje, če sistem 'Last planner® System of Production Control' (sistem nadzora dela z zadnjimi načrtovalci), pri katerem je osrednja ideja vključiti vse deležnike v pregleden in neprekinjen skupen proces načrtovanja, vpliva na projektno kulturo s spreminjanjem iz tradicionalne v partnersko projektno kulturo.

Da bi lahko odgovorili na to vprašanje, je ta disertacija razdeljena na štiri raziskovalne dele, vse vpeljane z različnimi mešanimi metodami: Najprej je šlo za raziskavo, kako je mogoče meriti kulturo projektiranja z vidika partnerskega sodelovanja. Nato smo opredelili splošno kulturo projektiranja in nameravano kulturo projektiranja. Kot tretje, smo preiskali sistem 'Last Planner® System of Production Control' (sistem nadzora dela z zadnjimi načrtovalci) tako, da smo primerjali projekte, ki tega ne uporabljajo in projekte, ki to uporabljajo in ugotovitve smo nato postavili v kontekst splošne in nameravane kulture partnerstva. Četrtič, razpravljali smo o pomembnosti teh ugotovitev s praktikanti, ki se osredotočajo na partnerstvo.

Glavna ugotovitev disertacije je, da uvedba sistema Last Planner® System of Produciton Control (sistem nadzora dela z zadnjimi načrtovalci) nadzora proizvodnje ne pripelje nujno do višje stopnje partnerstva. Poleg tega pripelje do višje stopnje medsebojnega nadzora, ki omogoča, da vsi člani projekta razlikujejo, kdor ravna na partnerski način in kdo ne.

Ključne besede

Projektna kultura, vitka gradnja, Last Planner® System of Production Control (sistem nadzora dela z zadnjimi načrtovalci), nemška gradbena industrija na ključ

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LIST OF ABBREVIATIONS

CL   *Client*

CPM   *Critical Path Method*

CVF   *Competing Values Framework*

LPS   *Last Planner® System of Production Control*

MC   *Main Contractor*

OCAI   *Organizational Culture Assessment Instrument*

PPC   *Percent Plan Complete*

SC   *(Sub-) Contractor*

SRQ   *Sub-Research Question*

1 INTRODUCTION

Parts of this Chapter were published in Lühr (2018); Lühr and Bosch-Rekveldt (2019); Lühr et al. (2020, 2021)

1.1 Initial situation in the construction industry

Scholars report frequently about poor project results in the construction industry in terms of cost overruns, time overruns, poor safety conditions and quality issues (Smiley et al. 2014, 804; Sohi et al. 2016, 252). One reason for this situation is that the number of necessary stakeholders that need to cooperate to construct the projects grows with the project's complexity (Chen et al. 2019, 1) and has increased in the past decades (Ranf 2010, 657). These stakeholders do often not share project objectives. Rather, the project parties' interests are often in direct conflict with those of others (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1), and the emerging singular focus on their respective interests hinder collaboration between the parties (Akintan and Morledge 2013, 1).

A high level of competition is especially true in economic recessive times (Eschenbruch 2008, 4) during which the contractors face a high level of competition due to a low number of actual construction projects, and the investors have numerous choices for rivalling contractors. The appropriate competitive tendering processes frequently lead to unprofitable contracts for the contractors with trim margins. This stimulates a strategic focus from the contractors on claims to still realize profitable projects rather than create partner-like project conditions (Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Eschenbruch 2008, 4; Chen et al. 2019, 2). These conditions lead towards a lack of information exchange and relationships on arm's-length, which are in such highly competing industries often the case (Johnston and Lawrence 1988, 98). Even though cooperation from the different stakeholders is necessary to realize a project (Cheng et al. 2001, 62; Cheung et al. 2003, 339; Chen et al. 2019, 1), the behaviours are especially characterized by attempts to protect the respective interests of the stakeholders, to avoid litigation, and to minimize their own risks instead of moving a goal forward. Thus, organizations specialize in specific disciplines to gain deep knowledge about their niches, which enables them to gain advantage through this knowledge to avoid litigation (Winch 2000, 143).

In such multi-actor environment, the simplified definition of traditional criteria for project success, such as cost, schedule, technical performance as well as avoiding litigation, satisfying customer needs, and the overall results (Larson 1995, 33), is accordingly inadequate (Turner

and Zolin 2012, 1) and way too simple as the notion of project success is known to be subjective anyway (Koops et al. 2016, 884).

The industries' culture and project culture is characterized by defensive and adversarial behaviours (Beach et al. 2005, 612), and escalating relationships (Eschenbruch 2008, 3 - 4). "Culture" is the "collective programming of the mind which distinguishes the members of one group or society from those of another" (Hofstede 1984, 82) and is as such something that a (project) organization "is" instead of what it "has" (Meyerson and Martin 1987, 623; Meek 1988, 470; van Marrewijk 2018, 146).

There are different streams of scholars and practitioners that try to overcome the poor project performances. Some common examples in the German construction industry are (1) Total Quality Management, (2) Lean Management and (3) Partnering (Racky 2008, 3). They are abstract management approaches and as this "neither a business- nor a contractual approach" (Racky 2008, 2). As such, they are rather described as higher level philosophies (Bresnen and Marshall 2000b, 230; Liker 2004, 67 ff.; Zuo and Zillante 2005, 354; Polesie 2010, 376 ff.; Rother 2010, 37 ff.) or as cultures (Phua and Rowlinson 2004, 913; Bygballe et al. 2010, 245; Zollondz 2013, 261; Bortolotti et al. 2015, 1 ff.; Santorella 2017, 1 ff.). The different management approaches do not rule each other out but can be realised in parallel or can be combined (Racky 2008, 2). Such management approaches are created or conducted through concrete methods and tools as business approaches that enable the management approaches (Racky 2008, 2). Examples for business approaches are related contracting models or working approaches. As especially Partnering and Lean Construction as a part of Lean Management are of interest for this thesis, those approaches are briefly described in the following Subsections in order to define the research gap.

1.1.1   Partnering

As the economic situation changes, so does the availability of resources and the competition in an industry, and hence, the appropriate strategies of the various stakeholders. In time of economic booms, which was for example the case in Germany the last decade through a continuous economic growth (Federal Ministry for Economic Affairs and Energy 2019) and the industry's high utilization, investors and Main Contractors (MC) tend to make their projects and themselves more attractive for qualified contractors and designers as their capacity is scarce. This desired shift from an adversarial culture towards a more partner-like culture is noticeable in the German turnkey construction industry since the last few years (Racky 2008,

2; Boldt 2020, 11; Haghsheno 2020, 13). This desired change is also internationally recognisable (Dorée et al. 2003, 818).

One management approach with the aim to fulfil this cultural change and focus on partner-like conditions instead of the described adversarial relationships is called "Partnering". On its abstract level, it is described as a philosophy (Bresnen and Marshall 2000b, 230) or as a culture (Phua and Rowlinson 2004, 913; Bygballe et al. 2010, 245). As traditional adversarial relationships in the construction industry are described as "lose/lose' relationships (Larson 1995, 30), partnering is described as a culture "where all can win" (Harback et al. 1994, 23).

Examples for related business approaches are visualized in Figure 1. 'Partnership-models' focus especially on (1) early involvement of construction companies in the design phase to participate from their practical experiences, (2) mutual definition of the project targets prior contract conclusion, (3) levelled contract design with a low level of risk for the client and the contractor, (4) transparent working methods and contracts as "Guaranteed Maximum Price" or "Open Books", (5) mutual definition of project structure and -controlling approaches and mechanisms, (6) agreement for predetermined dispute resolution methods (Hauptverband der Deutschen Bauindustrie e.V. 2005, 4). Public Private Partnership (PPP) models are specially named as they are mostly the case for projects where the client is a public building owner (Racky 2008, 2).

Figure 1 - Partnering as a management approach in the context of partnership business approaches in the German construction industry
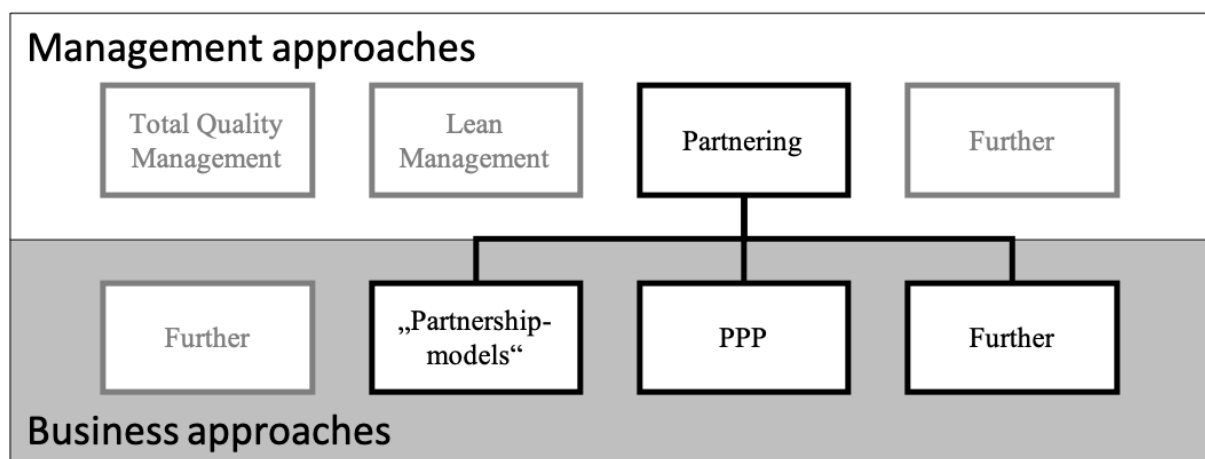
Source: Racky (2008, 3)

Partnership-models can be seen as a business approach which has the aim to create partnering as a culture. Therefore, Nyström (2005, 478) breaks the partnering further down and defines which relationship features must be present in order to reach partnering. Figure 2 shows his 'Partnering Flower' which defines (1) Trust and (2) Mutual understanding as necessities for the

successful implementation of partnering. (3) Predetermined dispute resolution methods, (4) Economic inventive contracts, (5) a Facilitator, (6) Openness, (7) Continuous and structured meetings, (8) the Choosing of working partners and (9) Relationship building activities are defined as helpful add-ons or ways to reach trust and mutual understanding.

Figure 2 - Partnering Flower
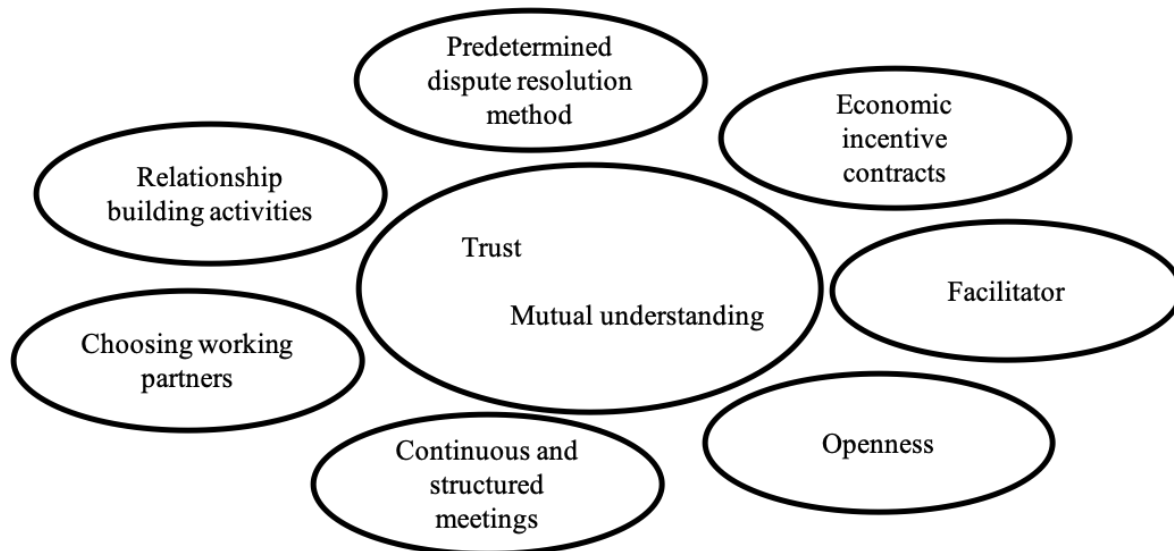
Source: Nyström (2005, 478)

As this framework describes the necessary ingredients of partnering as well as approaches to reach them, it is used for this thesis as a general guideline. Partnering, and especially its necessities 'trust' and 'mutual understanding' will be described in more detail as part of the literature review (Section 2.2).

Even if partnering is intended, various issues, such as the barrier to change cultural aspects, organizational issues like traditional rules and processes, the shift of competences or traditional procurement procedures, the availability of resources, functioning processes or routines (Eriksson et al. 2008, 534 - 537) hinder frequently its successful implementation. But also the commercial pressure (Bresnen and Marshall 2000b, 233; Alderman and Ivory 2007, 388) stimulates a strategic focus on individual project objectives rather than striving for partner-like project conditions (Hinze and Tracey 1994, 274; Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Winch 2000, 144; Eschenbruch 2008, 4; Chen et al. 2019, 2).

1.1.2 Lean Management, Lean Production, Lean Construction and the Last Planner® System of Production Control

"Lean Management" is one common management approach (Racky 2008, 2) and as such often defined as a philosophy (Thompson and Sanders 1998, 73; Liker 2004, 67 ff.; Zuo and Zillante

2005, 354; Polesie 2010, 376 ff.; Rother 2010, 37 ff.; Krajewski et al. 2013, 296 ff.) or as a culture (Zollondz 2013, 261; Bortolotti et al. 2015, 1 ff.; Santorella 2017, 1 ff.).

"Lean Production" is the neologism of Womack et al. (1990, 2) and based on their study of the "Toyota Production System". Lean production (also called "lean manufacturing" as in Sanchez and Nagi (2001, 3562)) was developed to be competitive on the automotive Market and its focus on mass production despite the lack of resources as the competitors had (Sanchez and Nagi 2001, 6526; Ohno 2013, 37). This original car mass production was focused on competitive advantage through scale and efficiency (Krafcik 1988, 42) through the reduction of fixed costs per product through a high assembled number of products in a possibly short time frame (Grant and Jordan 2015, 50, 132 ff.). In doing so, the focus was on big batches of similar products with few variations which led to high inventories with possibly repetitive errors and high carrying costs (Womack et al. 1990, 51 - 52). The focus was on continuous production without stopping the assembly lines. If error occurred, they were, if possible, rectified in a later rework area. The tasks for the line workers were predetermined, simple and repetitive (Womack et al. 1990, 54).

Lean production has evolved through observations and improvements of this mass production approach. It focuses on the individual customer's satisfaction and the continuous reduction of 'waste' (Liker and Morgan 2006, 5 ff.), whereas everything is defined as waste, which does not directly add value to the final outcome of the production. During the implementation of Lean production, the following types of waste were identified, which are typical for mass production: (1) overproduction, (2) wasting times, (3) transport, (4) waste of processing, (5) stocks, (6) motions, (7) faulty products (Liker 2004, 28 - 29; Ohno 2013, 54) and (8) unused employee creativity (Liker 2004, 28 - 29).

As partnering has different business approaches with several contractual models and working tools and methods, so does Lean Management have similarly structured business approaches and methods. The change from mass production towards Lean Management led towards faster product development, higher product quality, less manufacturing costs and greater profit (Liker and Morgan 2006, 6).

Lean Construction is the adaptation of Lean Management to the construction industry and follows its basic principles (Fiedler 2018, XV). Some of the business approaches and methods must be "abstracted, adapted, and further developed" (VDI 2019, 9) for the construction industry with its particularities, which are especially: (1) one-of-a-kind production, (2) site production, (3) temporary multi-organization, and (4) intervention of regulatory authorities

(Koskela 1992, 49). It is, as Building Information Modelling, seen as a way to improve construction industry's project efficiency (Wünsch Alvarenga et al. 2017, 1904).

Figure 3 shows Lean Construction as a management approach and the three Lean construction practices, which are mostly discussed in research literature (Babalola et al. 2019, 37). The "Last Planner® System of Production Control" (LPS) (Ballard 2000, 3-1) is the most common approach that belongs to Lean Construction (Babalola et al. 2019, 37; Poudel et al. 2020, 3). There are similarities with the partnering framework (Figure 2) and the similarities between partnering and LPS are presented in Sub-Section 1.1.3, after introducing the Last Planner® System of Production Control.

Figure 3 - Lean Construction as a management approach in the context of Lean construction business practices
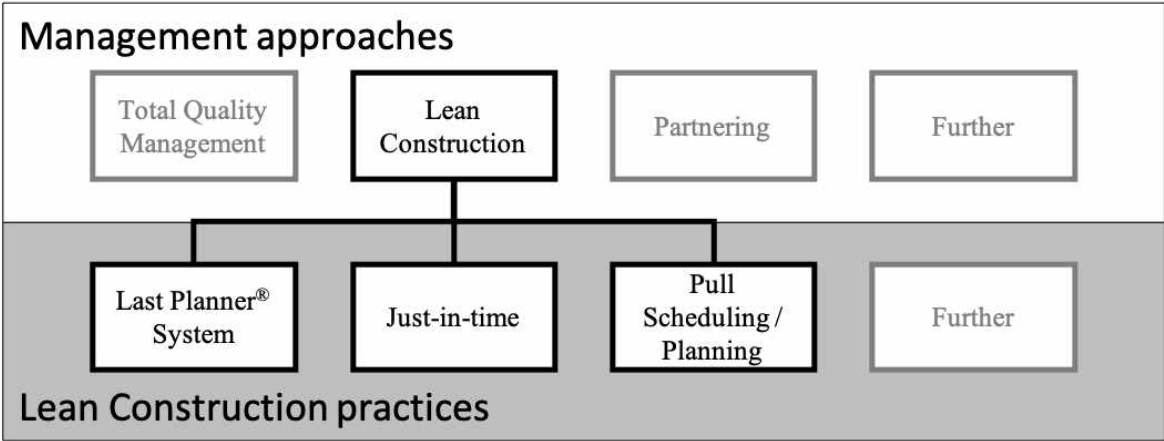
Based on Racky (2008, 3) and Babalola et al. (2019, 37)

LPS as an Lean Construction approach is a continuous planning process with the aim to improve workflow predictability and reliability of complex production systems (Aslesen and Bertelsen 2008, 334; Mossman 2015, 2). The focus is the management of "relationships, conversations and commitments that together enable program & production planning decisions to be made collaboratively at the lowest possible level" (Mossman 2015, 2). Whereas the traditional way of planning construction processes is that they get conducted through individual professional planners and project managers (Mossman 2015, 5), LPS involves all parties in an active, regular, integrative and cooperative planning process (VDI 2019, 77). The "Last Planner" is preferably the last person in the value chain (usually the foreman or site manager of the appropriate trade or for planning tasks, the specialist planner or team leader of a discipline (Ballard and Howell 2003b, 4; Fernandez-Solis et al. 2013, 354; VDI 2019, 77).

The project is divided into various scheduling hierarchies with different levels of detail whereas the preciseness gets refined at each level, as the time gets closer to the start of the task (Frandson

and Tommelein 2015, 175 - 176). Single work packages get usually visualized through sticky notes in different colours, whereas respectively one colour represents one discipline. The Last-Planners by themselves place their work packages on sticky notes on a schedule and coordinate and discuss them with the other Last-Planners, guided by a facilitator (VDI 2019, 78). Figure 4 shows an impression of an LPS meeting, where two foremen from different trades visualise and discuss the work packages for the upcoming weeks.

The past work packages get reviewed in retrospective during the weekly meetings and the schedule is updated. If tasks could not be fulfilled, the reasons for these failures are jointly discussed, and changes are worked out to improve the future processes (VDI 2019, 79) and to prevent the repetition of failures.

Other ingredients of LPS are next to these meetings and include visualizations according to Davidson (2015, 7): 'daily huddles' where the weekly work plan gets controlled on a daily basis, a statistic called 'Percent Plan Complete' (PPC) which expresses the percentage distribution of the amount of commitments that got fulfilled respectively not fulfilled in the last week. The PPC score shows how many of the promised commitments could be fulfilled. Scholars report that the PPC score can get raised from 30 - 60%, which is the common number of construction projects with conventional conducted project management approaches, to over 70% or even 80% through the implementation of the LPS (Ballard 1999, 276; Jin 2013, 1780). Another ingredient of LPS is an evaluation chart of the reasons for not fulfilling the planned tasks, aiming to help to focus on improvements (Davidson 2015, 7).

Some benefits attributed to LPS' implementation are (1) a smooth workflow, (2) reduced costs, (3) reduced time of project delivery, (3) improved productivity, (4) collaboration of the field personnel (Fernandez-Solis et al. 2013, 359), (5) transparency and (6) mutual understanding between the participating individuals (VDI 2019, 77). Especially the collaboration is often named in the context of the LPS (Aslesen and Bertelsen 2008, 333; Porwal et al. 2010, 549; Fauchier and Alves 2013, 559; Mossman 2015, 2).

Figure 4 - Last-Planner-Meeting impression
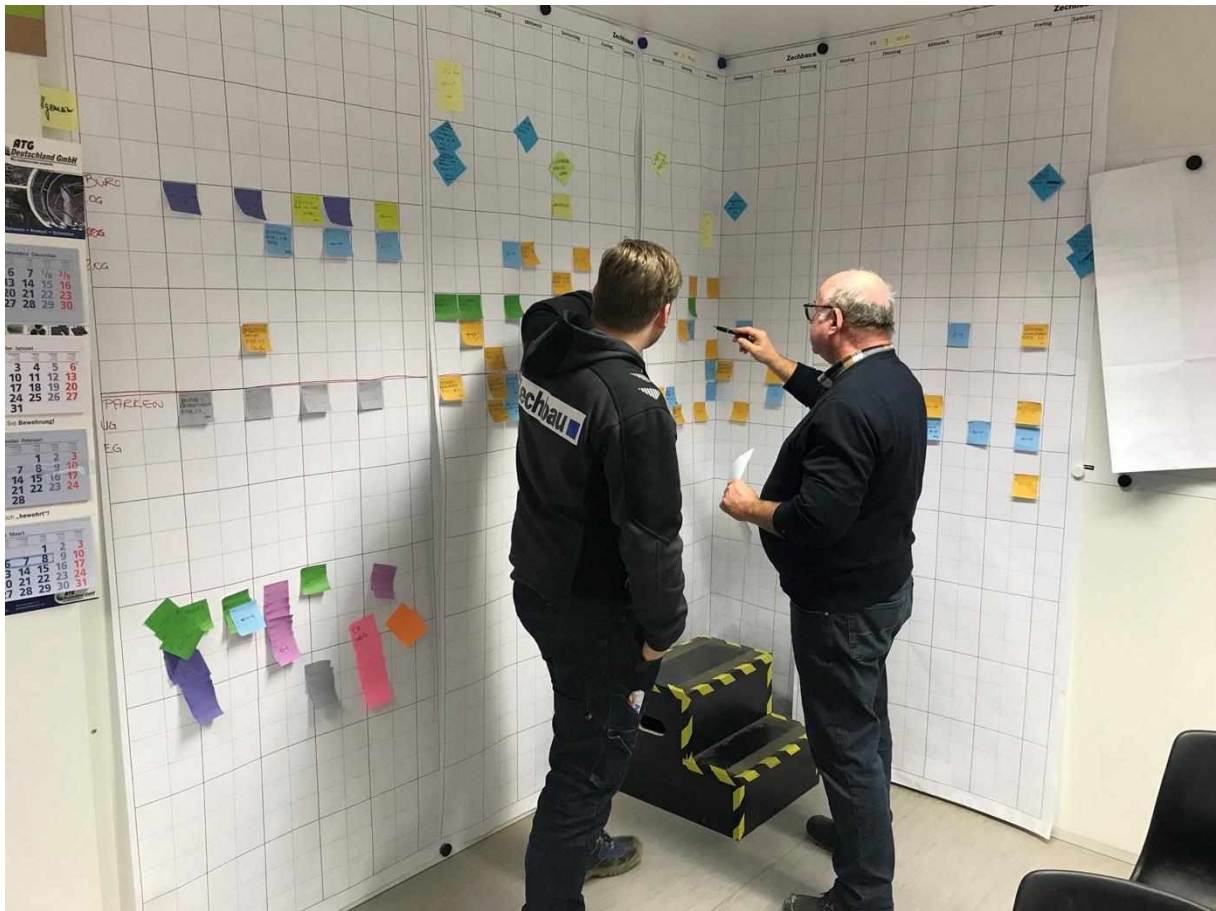
(Photo by author)

1.1.3   Interfaces between partnering and LPS

There are interfaces between the partnering concept by Nyström (2005, 478) and LPS, see Figure 5.

These elements of the partnering concept seem to match LPS:

- LPS is executed through a *facilitator* (VDI 2019, 78). This facilitator can be a part of the project team or an external person. His role is especially to lead through the LPS agenda and to balance the power and influences of all parties (Nyström 2005, 477).
- LPS is also a *continuous and structured meeting* application (Mossman 2015, 20) which takes usually once a week place (Ballard and Howell 2003b, 7).
- The transparency through the visualization of work packages through sticky notes leads towards *openness* between all parties.

There are no interfaces between LPS and *predetermined dispute resolution methods* if those are not connected with the LPS meetings. However, as LPS is a way of jointly discussing the past

and the upcoming issues, and as this discussion is facilitated by a more or less neutral party, it can be argued that this is a structured way to clarify disputes.

LPS has also *no influence on the choice of working partners* and there is no connection to the *economic incentives of the contracts* between the various parties. There are also no regulations on who actually participates at the LPS meetings, even if it is intended that all parties that currently or in the near future fulfil tasks participate.

For some elements, the interfaces between the partnering flower and LPS are not evident:

- It is unclear if LPS's application leads to more *trust* within the project team.
- If LPS would lead to a high level of trust within the project team, LPS could be seen as a *relationship activity* that improves the project's culture in terms of partnering.
- There is no information if LPS's application, and especially the gained transparency, leads towards more mutual understanding between the participants

Concluding, there are some obvious interfaces between Partnering as a management approach and LPS as a business approach, but there is no information about the impact of LPS on the necessity elements of partnering: trust and mutual understanding.

Figure 5 - Interfaces between partnering and LPS
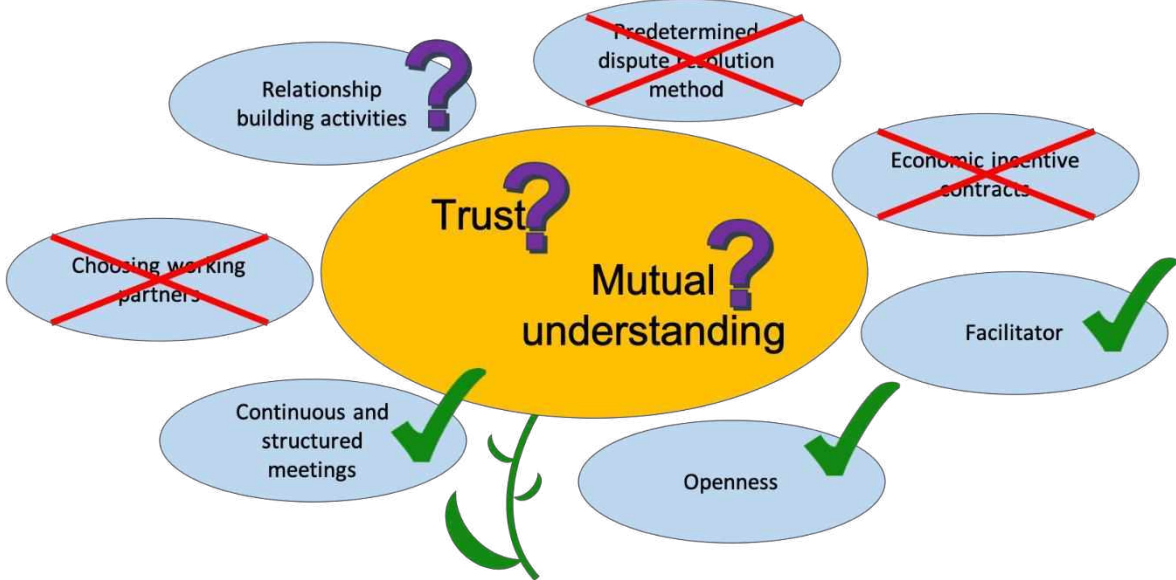
Based on Nyström (2005, 478)

Especially trust is a complex issue and influenced by multiple factors (Khalfan et al. 2007, 385), which is illustrated by the existence of various definitions (Blomqvist 1997, 273). For this thesis, the following definition of Mayer et al. (1995, 712) was chosen:

9

"Trust […] is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party".

The reason for this choice is the definition's distinction between trusting, irrespectively of the ability of monitoring and the contrary – high level of monitor and control. Such high level of monitor and control is facilitated by LPS through the clear visualization of work packages and the detailed reflection of fulfilment- of not fulfilment of commitments.

Recent studies (Priven and Sacks 2013, 543; Uusitalo et al. 2020, 11) show that applying LPS does not necessarily lead towards more trust between LPS's participants, which is next to mutual understanding one crucial ingredient of a partnering culture (Nyström 2005, 478). The reason might be rooted in the relation between trust and control:

Based on the 'subsidiary perspective' there is a dilemma between trust and control (Jørgensen and Åsgård 2019, 399), as monitoring and controlling which is executed in detail at LPS is a clear signal of distrust (Mayer et al. 1995, 712; Kadefors 2004, 177) and their application might hinder the development of trust (Schoorman et al. 2007, 347). On the other hand, the relationship between trust and control can be considered under a 'complementary perspective', with mutually supportive effects (Jørgensen and Åsgård 2019, 399). Risks can be reduced through communication (Cerić 2016, 13), and if these risks can be reduced to a certain level, trust can overtop the residual risk (Schoorman et al. 2007, 346). Direct and open communication within flat hierarchical structures and on the lowest possible Hierarchy level, which is performed at LPS, promotes a trustful project culture (Barlow 2000, 984). And shown cooperation and trust can strengthen each other (Kadefors 2004, 177).

The question arises if LPS's application impacts project cultures under the aspects of partnering, or if it essentially is a controlling tool that not necessarily contributes to partnering. No earlier research was found, however, on actual LPS projects' cultures, nor on the comparison between projects not applying LPS and those applying LPS. This study aims to close this gap by comparing those project cultures, to explore LPS's impact on project culture.

This knowledge enables practitioners to decide whether and for what reason LPS should be implemented and applied. The value for scholars is the further exploration of the alleged trust and control dilemma.

1.2 Research objective and research questions

As there are similarities between the presented partnering framework and LPS, the question arises if a scheduling and controlling approach as LPS can affect project culture in such a way that it changes from traditional and adversarial relationships towards a partnering culture. If this would be the case, LPS's application could be recommended for all projects where a partnering culture is sought.

Santorella (2017, 1, 2) and Herranz Limon (2015, 14) point out that especially the construction industry often fails to measure lean practices, what makes it hard to improve them or to measure their impact. Furthermore, Gorse and Emmitt (2007, 1197) show that there is only little research about interaction and communication between individuals in the field of construction project research, even if this field is fundamental for construction projects.

The purpose of this thesis is to close the gap and investigate the impact of LPS as a scheduling, controlling and communication approach on project culture in terms of partnering.

The main research question is accordingly:

How does the Last-Planner-System influence Project Culture?

To answer this question, the following sub-research questions (SRQ) were defined:

- SRQ1: How to measure project culture?
- SRQ2: What are the characteristics of the common project culture and the intended partnering project culture in the German turnkey construction industry?
- SRQ3: How do project cultures of projects not applying and those applying LPS differ?
- SRQ4: Does LPS's application lead towards a partnering project culture?
- SRQ5: What is the relevance of the findings about LPS's impact on project culture?

1.3 Research approach

To answer the research questions, a multi-stage research approach is developed. First, background information about the belonging research philosophy for research in project management and especially cultural project management is provided in Subsection 1.3.1. Second, the logics of quantitative and qualitative approaches and their relation are presented (Subsection 1.3.2). Next, the methods which were applied to answer the different sub-research-questions and the main research question are presented in Section 1.3.3.

1.3.1 Research philosophy

Projects are per definition "unique, timely limited, interdisciplinary and organised undertakings" (IPMA 2015, 27) and research about projects and project management is the attempt to capture the interactions, the organisation and the management of projects as complex systems (Söderlund 2004, 185). Research about project management is traditionally focusing on engineering science, as planning-techniques and optimization theory (Söderlund 2004, 183 - 184; van Marrewijk 2018, 143). As a second and newer stream, he identifies social sciences with ingredients from disciplines as "psychology, pedagogy, business administration, organization theory, industrial engineering and sociology" (Söderlund 2004, 183 - 184). This dissertation focuses on the impact of a scheduling and controlling approach on project culture, so it can be argued that all of the named academic disciplines are included. Nevertheless, as the main focus is on project culture, mainly social research aspects influence the research philosophy and the research approach. Especially social research is always influenced by the point of view of the researcher and his social background and experiences. This point of view affects the choice of the research objectives, their definition, the ways how they are investigated and how the investigations are understood and used (Blaikie and Priest 2017, 10).

In the 'research philosophy' (Maylor et al. 2017, 104), or 'Paradigms' (Blaikie and Priest 2019, 105), ontology and epistemology play a role (Maylor et al. 2017, 104) and guide the choice of research approaches (Blaikie and Priest 2019, 105). Research philosophies can get distinguished in different schools, dependent of their position about reality. The two extremes are subjectivity and objectivity. Subjectivity expresses that social reality does not exist and that it can therefore not be accurately described. Objectivity describes that social reality exists and can be entirely pictured (Maylor et al. 2017, 104). Maylor et al. (2017, 106) cluster between these extremes different "Schools of Philosophy" (listed from the subjective extreme towards the objective extreme): (1) Radical Constructivism, (2) Constructivism, (3) Interpretivism, (4) Critical realism, (5) Realism and (6) Positivism.

As project culture is this dissertations' main interest, it must be considered that project cultures are consisting of multiple cultural layers of the individual project members which influence each other and that project cultures are especially dynamic, so continuously changing (Sackmann 2009, 4). This context fits especially to an interpretivism philosophy, where social reality is seen as the product of everyday activities and interactions from a group of people (Blaikie and Priest 2019, 107). Nevertheless, there are frameworks and surveys that quantify cultural aspects, and make measurable, describable and comparable, which represents objective

characteristics. But those frameworks describe through the dynamics of project cultures only a snapshot of the cultural characteristics. To put them in a more general context, subjective impressions of project members are considered, which is less objective, but mainly subjective. The dissertation's focus is hereby not on explaining how the individual project members interact, but to understand, what the consequences of a meeting approach is on the social system of a project culture. This focus on understanding behaviours instead of describing them is another typical attribute of interpretivism (Maylor et al. 2017, 106).

1.3.2   Quantitative, Qualitative and Mixed research methods

For answering research questions, decisions about scientific methods have to be made. 'Logics of inquiry' guide hereby the choice of research strategies. Four logics of inquiry can be clustered in (1) Inductive, (2) Deductive, (3) Abductive and (4) Reductive approaches (Blaikie and Priest 2017, 12).

(1) Inductive approaches are especially chosen to answer 'what' questions (Blaikie and Priest 2017, 13). Inductive approaches follow a logic, where theory is built through collected data (Blaikie and Priest 2017, 13; Maylor et al. 2017, 111) as through observations. Qualitative research methods are chosen as they allow the researcher to investigate more about "meaning rather than measurement, through investigating feelings, attitudes, values, perceptions or motivations and the state, actions and interactions of people, groups and organisations" (Maylor et al. 2017, 119).

At (2) deductive approaches, regularities that have previously identified get tested through counting or measuring (Blaikie and Priest 2019, 200) collected data (Blaikie and Priest 2017, 13; Maylor et al. 2017, 111). Quantitative research approaches are applied as objective research methods which focus on understanding general patterns through measurements (Maylor et al. 2017, 115).

Figure 6 shows the 'Wheel of Science' which visualises how inductive and deductive approaches are related to each other (Wallace 1971).

Figure 6 - The Wheel of Science
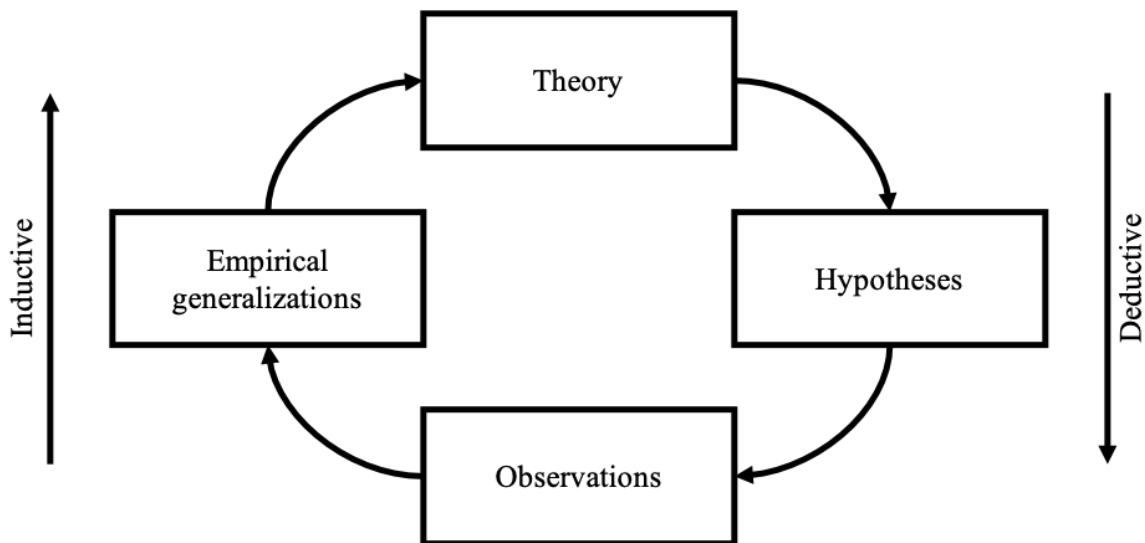
Based on Wallace (1971)

Inductive and deductive approaches do not rule each other out. This combination, and also the combination of quantitative and qualitative approaches, is called "mixed methods" (Weber 2015, 96). Mixed methods are not only seen as the combination of quantitative and qualitative data, but as a third research approach, which is especially in social research 'normal', especially if various research questions need to be answered (Blaikie and Priest 2019, 219). Mixed methods allow the researcher to move back and forth between different research stages (Blaikie and Priest 2019, 219) and adding different research methods to investigate social characteristics which are not foreseen.

To combine and verify the different findings which ae gathered through the mixed methods, 'triangulation' is applied, see Figure 7. Variations of triangulation are multiple methods, multiple sources of data, multiple measures and multiple viewpoints (Maylor et al. 2017, 219 ff.). One advantage of the use of various research tools is that the accuracy of the study findings through the different sources of information is high (Yin 2018, 128).

Figure 7 - Triangulation
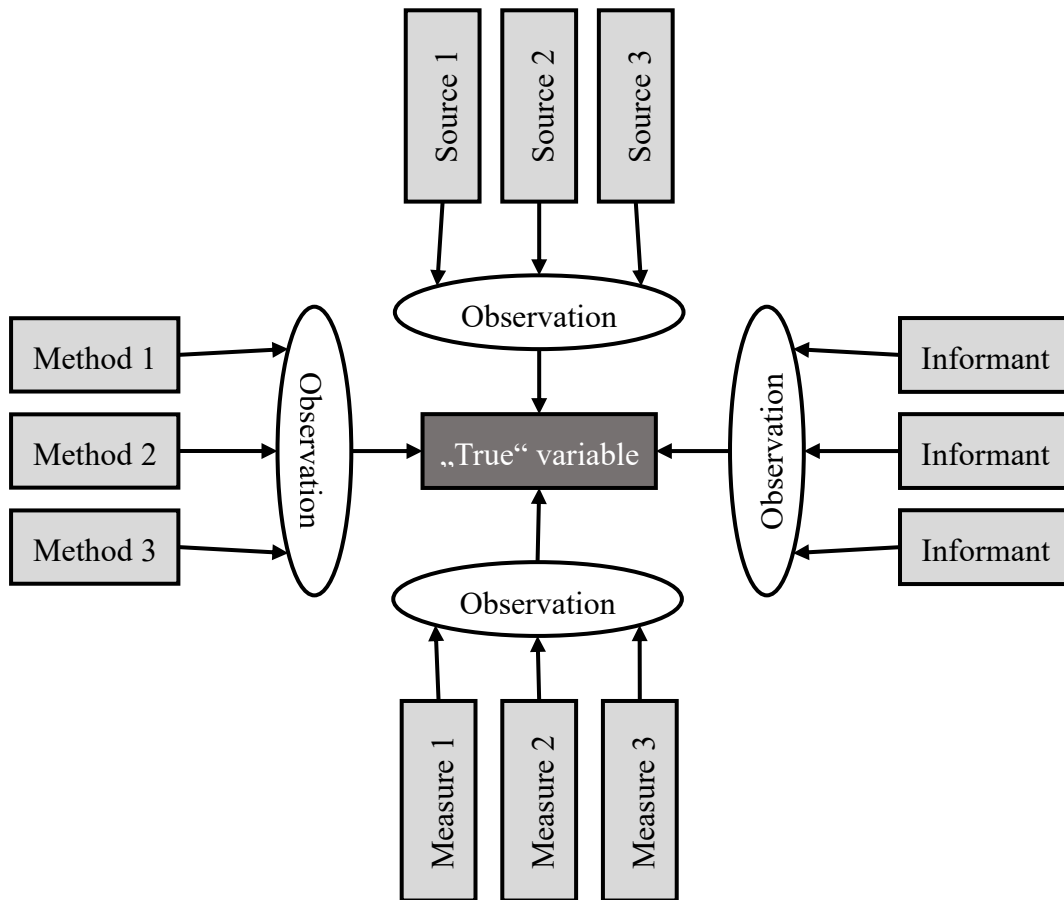
Source: Maylor et al. (2017, 221)

(3) Abductive logics starts with 'lay concepts', so investigations from everyday experiences, and explores scientific descriptions and explanations through inductive and/ or deductive logics (Blaikie and Priest 2017, 13).

(4) Reductive logics apply such mixed methods to investigate already documented and modelled regularities to understand how these known regularities have arisen (Blaikie and Priest 2017, 13).

For the interpretivism philosophy, abductive research logics are common (Blaikie and Priest 2017, 13). This also fits the formulated hypothesis in Figure 5, which was derived through the recognition of interfaces between two concepts (partnering and LPS) and practical experiences of implementing LPS on construction sites. Therefore, inductive and deductive approaches as mixed methods are appropriate to answer the research questions.

1.3.3 Methods applied in this research

To answer the presented main research question, answering the sub-research questions is necessary. Therefore, this research is clustered into four phases of empirical research, based on an initial literature review. An overview of the empirical research is given in Table 1.

The initial literature review is conducted to understand the backgrounds of a research topic, to analyse ideas and to find relationships between different subjects (Hart 2018, 2-3). Therefore, the literature review of this dissertation includes the topics 'Culture' as this is the core interest of this dissertation, 'Partnering' as a management approach, which is defined as a special culture, and 'LPS' as a Lean construction practice.

In general, there are two common literature search approaches to find relevant sources for the literature review. The 'key word search' and the 'snowball technique' (Ridley 2012, 55 ff.): Through the key word search, literature catalogues get searched through identified key words, so nouns and adjectives, which describe the content of interest most accurately. The disadvantage is that not all relevant articles might be found due to alternatively chosen key words by the authors. The snowball technique is an approach where sources within sources; specific authors, databases or journals are followed by the researcher if they are for interest for the own research field. The focus of the literature search approach for the doctoral thesis is the snowball technique because of its strengths to cover a wide range of content without the danger of missing sources due to varying keywords. Literature review is the secondary analysis of existing studies in a specific field of knowledge (Weber 2015, 121). In general, it leads to knowledge about (1) what other studies have already investigated; (2) what conceptual frameworks were studied in the field of interest; (3) which research methods were chosen and (4) what is the context of the research field (Maylor et al. 2017, 74). The literature review will show the contemporary context and thus, the significance of the research (Ridley 2012, 28). The main results of the literature review are the crucial project cultural ingredients for partnering projects, the interfaces and differences of those with conventional scheduling and controlling approaches and LPS, and the choice for a framework to measure and describe project culture.

The *first phase* of the empirical research deals with the question: "*How to measure project culture?*". This question is necessary for two reasons: (1) to define the common project culture and the intended project culture in the German turnkey industry (*second phase*) to investigate if the application of LPS improves project culture in the direction of partnering, and (2) to examine differences and similarities of different projects (*third phase*). As there is only little

knowledge about project cultures and its measurement (Zell 2009, 161), this research phase focuses on tools to measure organizational culture and investigates if they are also suitable for measuring project culture. As project culture is such a dynamic and complex topic, a case study approach is chosen to verify the applicability of the chosen framework for project cultures instead of organizational cultures. Case study research is a qualitative research approach (Weber 2015, 97). It is used to investigate questions, causal links and relationships that are too complex for single alternative methods like surveys or controlled experiments (Brookes et al. 2016, 370; Yin 2018, 18). Case study research is an empirical method to "investigate contemporary phenomenon in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin 2018, 15). Thus, case study research is a suitable approach to deal with project cultures and their temporal content-related and context. There are different methods available at case study research to gather data: (1) documents; (2) archival records; (3) interviews; (4) direct observations; (5) participant-observations and (6) physical artefacts (Yin 2018, 110 ff.). Yin (2018, p. 129) merges structured interviews with survey whereas other authors name explicit (7) surveys (Gable 1994, 112 ff.). The selection of the cases for a qualitative study should be driven by the research question (Wahyuni 2012, 73). Methodical categories for the case compilation are: (1) typical; (2) diverse; (3) extreme; (4) deviant; (5) influential; (6) most similar and (7) most different (Seawright and Gerring 2008, 294, 297, 298). The availability of data is especially a challenge by investigating cultures (Taras et al. 2009, 364). But also practical considerations like the access to the data (Seawright and Gerring 2008, 295; Yin 2018, 26) or temporal- or monetary aspects or expertise are crucial for the choice of the cases (Seawright and Gerring 2008, 295). The sample size is dependent of the chosen category (Flyvberg 2006, 34). In general, case studies with single cases help to "uncover suspected causal connections" but are not suitable to generate theory from the findings while studies with multiple cases allow more generalisation and thus theoretical saturation (Brookes et al. 2016, 372). Under these aspects, a survey which belongs to the chosen framework to measure and describe culture is applied at three cases, and observations are used to verify if the outcomes of the survey and framework under the aspects of the characteristics of interest.

The *second phase* of the empirical research uses the findings of the *first phases* to define the common project culture and the intended project culture in the German construction industry. These examinations are necessary to investigate in a further step if the application of LPS impacts project culture, this impact leads towards the intended project culture, or in a different direction. In this phase the sub-research question *"What are the characteristics of the common*

project culture and of the intended partnering project culture in the German turnkey construction industry?" is answered. A workshop setting with the determined quantitative framework to describe and to measure project culture is chosen. The participants of these workshops are selected from different stakeholder groups and job functions to gather information from the different actors that shape project cultures.

In the *third phase* of the empirical research project cultures of projects not applying and those applying LPS are investigated and compared to answer the sub-research question *"How do project cultures of projects not applying and those applying LPS differ?"*. To answer this question, in-depth case studies are carried out. These are suitable to investigate questions and relationships that are too complex for alternate methods as surveys or experiments (Brookes et al. 2016, 216; Maylor et al. 2017, 204; Yin 2018, 18). A multiple case study approach is chosen for two reasons: first, to identify similarities and differences within the groups of projects that do apply LPS and those that do not apply LPS (Maylor et al. 2017, 208) and second, to compare the findings of these groups. To investigate these cases in-depth, different research methods were applied to obtain detailed information about such a complex, dynamic and specific phenomenon as project culture, thereby focusing on 'triangulation' (Maylor et al. 2017, 221), see Figure 7. Therefore, the survey that belongs to the quantitative framework of the *first phase* is applied to quantify the project cultures in general. Additionally, one survey about trust and one survey about mutual understanding are carried out as these are the core elements of a partnering culture. Further, data is gathered and investigated through semi-structured interviews to obtain information about the production control meetings and to gather deep insights about the project cultures, especially under the aspects LPS and its impact in terms of partnering. Interviews are one of the most important research methods in case study research, especially because the most case studies are about human affairs or actions (Yin 2018, 121). Interviews as a research method can be either structured, which is chosen for quantitative research (Maylor et al. 2017, 148 - 149) and mostly for surveys in project management research (Bosch-Rekveldt 2016, 318), or less structured with open questions as a qualitative research method (Maylor et al. 2017, 189), mostly used for case study research in the field of project management (Bosch-Rekveldt 2016, 318). The sampling strategy depends on the research approach. While the samples at quantitative research are chosen randomly to generalize the outcomes, samples at qualitative research approaches are chosen intentionally to represent a concept (Maylor et al. 2017, 192). One of the strengths of interviews is that they can give information about the personal views (Yin 2018, 114). As such personal views are very crucial for the topic of this dissertation, qualitative interviews are chosen to understand the project cultures in depths and

through the chosen participants (like different stakeholders) from different perspectives. This approach is very common for research about project organizations to deal with its complexity (Söderlund 2004, 183). These interviews are analysed through qualitative content analysis as this is especially suitable to analyse data in terms of cultures and their attributes in specific contexts (Krippendorff 1989, 403; Elo et al. 2014, 6).

In the *fourth phase* of the empirical research the results of the *third phase* are discussed with practitioners to investigate the practical relevance of the presented study and the implications on future projects to answer the sub-research-question: *"What is the relevance of the findings about LPS's impact on project culture?"*. To answer this question, a workshop setting as a group discussion was chosen. Such a group discussion is a qualitative method to gain multiple data, based on the outcome of the dynamic discussion of various individual experts (Weber 2015, 100; Maylor et al. 2017, 190). The outcomes of such group interviews are strongly subjective and attitudinal (Weber 2015, 53) and the facilitator of such a research workshop has an active role in the process of the discussion (Weber 2015, 100 ff.).

Table 1 - Overview of the empirical part of the research

Main method, sample	Research question	Main result
PHASE I Case Studies 3 Projects applying LPS	How to measure project culture?	The CVF is a suitable tool to measure and describe project culture in general. But as it lacks in terms of statistical inner test consistency, additional research methods should be added to investigate project culture in depth.
PHASE II Survey in a workshop setting 12 companies 72 participants	What are the characteristics of the common project culture and of the intended partnering project culture in the German turnkey construction industry?	The common project culture in the German turnkey construction industry is very similar to earlier global studies. It is only slightly more characterised by CVF's features from the Hierarchy quadrant. The intended partnering culture differs from the common culture only in terms of more cooperation instead of competition.
PHASE III In-depth case studies 3 projects not applying LPS 3 projects applying LPS	How do project cultures of projects not applying and those applying LPS differ? Does LPS's application lead towards a partnering project culture?	LPS leads to increased levels of mutual understanding and control between the parties. This detailed overview leads towards a more distinguished evaluation of the trustworthiness of individuals, but not necessarily to a partnering project culture.
PHASE IV Group discussion	What is the relevance of the findings about LPS's impact on project culture?	LPS is a controlling tool. Other variables, such as a focus on a partner-like contracts or the choice of known and fair working partners might have a bigger impact on project culture in terms of partnering.

1.3.4 Research scope

This research focusses on the German turnkey construction industry and projects in the construction phase. The reason is that in this special sub-industry, a desired shift from an adversarial culture towards a more partner-like culture is noticeable since the last few years (Racky 2008, 2; Boldt 2020, 11; Haghsheno 2020, 13) and that LPS is especially applied in construction phases. It is assumed that the desire for partner-like conditions is dependent of the actual economic situation, which was in the last years characterised by a long and continuous growth phase (Federal Ministry for Economic Affairs and Energy 2019), as these times are characterised by fewer competition than recessive times with less construction projects.

The main perspective of this research is the Main Contractor (MC) point of view. The reason is that most construction projects are carried out by relationships between a Client (CL) and his representatives as project managers, a MC and various sub-contractors (SC) (Hinze and Tracey 1994, 274; Cornick and Mather 1999, 31) and designer organisations (Cornick and Mather 1999, 31). The MC's main tasks are to manage and coordinate all necessary resources, so also the SCs, to realise the construction processes (Tomczak and Jaśkowski 2020, 4). To do so, MCs started to implement LPS as an alternative scheduling and controlling tool. As project cultures are created through the interactions of all project parties, also the perspectives of CLs, designers and SCs are considered, but the MC's perspective gets primary focus.

1.4 Scientific and social relevance

During the 20th century, projects management approaches replaced more and more traditional functional management techniques (Maylor et al. 2006, 663). Therefore, project management can be seen as the signum for organizational structure for this century (GPM 2015, 2). As it is a relative young profession, interest in project management is growing in academia, industry and society as a whole (Bakker 2018, 3), and with specific interest in the multicultural and multidisciplinary aspects of projects (Crawford and Anichenko 2018, 80). This research focuses on these aspects with its special attention on project cultures, which are formed by individuals with different cultural backgrounds, tasks, and stakeholder interests.

Social relevance is evident if we realise the order of magnitude of the construction industry and the reported project conditions with low productivity, cost overruns, time overruns, poor safety conditions and quality issues (Hatush and Skitmore 1998, 1; Eriksson et al. 2008, 527; Smiley et al. 2014, 804; Sohi et al. 2016, 252). Shaping a project culture through the targeted use of project management methods can lead to more successful projects under the named criteria (Radujković and Sjekavica 2017, 609). Under this aspect, partnering promises to improve these

conditions through higher productivity (Chan et al. 2006, 1928). As partnering, also LPS aims to improve construction project's productivity through a collaborative culture (Fernandez-Solis et al. 2013, 359; Mossman 2015, 2).

Nevertheless, scholars show since decades that implementing partnering successfully is an issue (Hinze and Tracey 1994, 274; Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Bresnen and Marshall 2000b, 233; Winch 2000, 144; Alderman and Ivory 2007, 388; Eriksson et al. 2008, 534 - 537; Eschenbruch 2008, 4; Chen et al. 2019, 2). Implementing Lean Construction methods as LPS is also an issue (Sarhan and Fox 2013, 4 ff.; Wandahl 2014, 106). In the most of these sources, cultural change is named as a reason why these concepts often fail. In general, there is only little knowledge about measuring and describing project cultures as special organizational cultures (Zell 2009, 161) and the construction industry fails frequently to measure lean construction efforts to really understand their impact on construction projects (Herranz Limon 2015, 14; Santorella 2017, 1-2).

The aim of this dissertation is to do better and to contribute to practice and science to the theory of partnering and LPS. The strategy is to define the differences between common project cultures and an intended project cultures, as well as the impact of LPS on project culture through gathering empirical data. Section 2.4 will show that partnering and LPS play a critical role in the project culture. Hereby, LPS impacts as a 'Lean Construction Practice' an outer layer of project culture, which is easier to influence than the inner layers. Partnering presents as a management philosophy an inner layer of project culture, which is influenced by the outer layers. The question is if the application of LPS has that much power, that it would change project culture towards partnering.

In terms of *social relevance*, a discrepancy is identified through this study: Does openness and mutual understanding for the efforts and the issues of others lead towards a partner-like culture, which is characterised by a high level of trust, or is openness used for mutual control, which is a clear signal of distrust? Answering this question is not only relevant for the construction industry, but also contributes to social research in general. Furthermore, this study gives insight about how much in detail scheduling and controlling is actually conducted in construction projects.

1.5   Thesis outline

Figure 8 visualises and links the different Chapters of this dissertation. After the literature review in Chapter 2, the four research phases are reported in the subsequent Chapters. In Chapter 7, all elements come together in the discussion, conclusions and recommendations.

Figure 8 - Outline of the dissertation

Chapter 2	Literature review: Project Culture Partnering LPS
Chapter 3	PHASE I Case Studies 3 Cases
Chapter 4	PHASE II Survey and Workshop with Group Discussion 12 companies
Chapter 5	PHASE III Case Studies 6 cases
Chapter 6	PHASE IV Workshop with Group Discussion
Chapter 7	Discussion Conclusions Recommendations
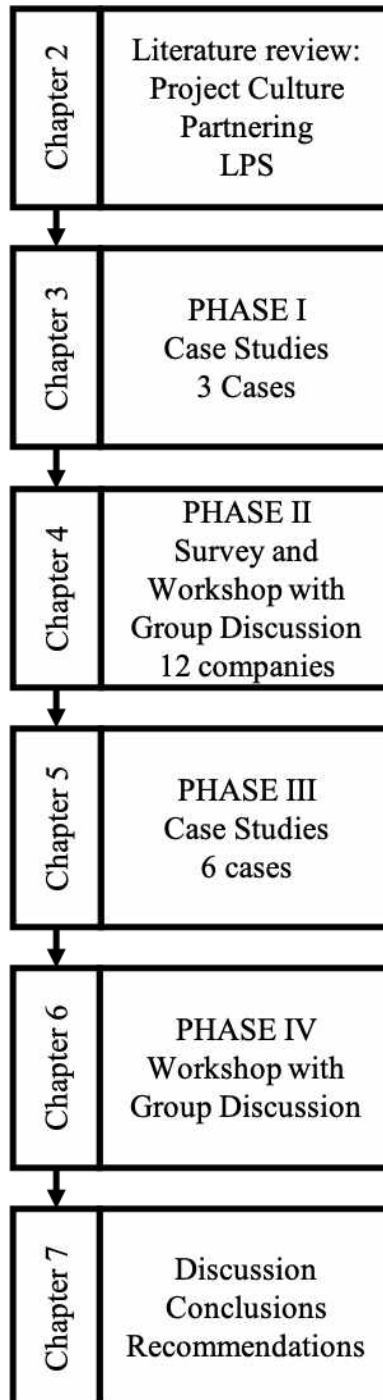
2 LITERATURE REVIEW

This chapter presents the literature review. Literature about the core topics of interest (project culture, partnering, scheduling, and controlling, and especially LPS) was reviewed. Similarities and interfaces between the major topics were identified (see Figure 5), as some sources gave information about the different topics. To follow these interfaces, the snowball technique was chosen with the idea to follow authors or sources, which are named within sources, if it can be assumed that they are of interest for the own research field (Ridley 2012, 56).

Section 2.1 includes general information about culture and is divided in the topics of organisational culture and construction project culture as a specific organisational culture. Furthermore, the dynamics of culture are presented, as this is a crucial topic for influencing and changing culture from traditional project cultures towards partnering project cultures.

Section 2.2 presents partnering as a management approach according to the presented concept, visualised in Figure 1 and as such as a special culture. As high levels of 'trust' and 'mutual understanding' are identified as crucial for a successful partnering culture, these cultural elements are investigated more in detail. Section 2.2 presents also issues of implementing partnering successfully.

Section 2.3 presents scheduling and controlling methods, which are integrated as traditional business approaches in accordance with Figure 1. Lean Construction principles, and especially LPS as alternative scheduling and controlling approaches (Figure 3) are introduced.

The literature review ends with Section 2.4 as a discussion about the leverages of scheduling and controlling approaches on project culture, formulating this dissertation's hypothesis that LPS as a Lean Construction principle can influence project culture in the direction of partnering as a management approach.

2.1 Culture

Multiple definitions of 'culture' exist. Referring the Cambridge Dictionary (2021), it is "the way of life, especially the general customs and beliefs, of a particular group of people at a particular time". This definition goes along with the definition of Hofstede (1984, 82), that culture is "the collective programming of the mind which distinguishes the members of one group or society from others". Consequently, all cultures are unique.

Cultures are frequently described as phenomenon with different layers (see for instance Erez and Gati 2004, 588; Sackmann 2009, 4; Hofstede et al. 2010, 8; Sackmann 2017, 67; Schein 2017, 18) which interact with each other in a dynamic way (Sackmann 2009, 4). Different

cultural models are introduced next, with their different cultural layers and their interaction, with the aim to describe project cultures as sub-cultures with its multiple variables and influences.

The model from Erez and Gati (2004, 583 ff.) (see Figure 9) focuses on various groups that differ in cultural ways, see Figure 9. One extreme is the global culture as the macro level with the entire world population, and the other extreme is the micro level as the culture of an individual. The larger a group of people, the more likely it is that sub-cultures will form (Sackmann 2009, 3). Not all members of the cultural groups need to share all cultural aspects entirely. There might be differences between sub-cultural groups and between individuals, but the definition of a culture can be seen as the collective accordance of specific cultural features (Hofstede 1984, 84). Figure 9 shows some cultural levels and outlines that all cultural levels continuously influence each other reciprocally as cultures are continuously developing (Hatch 1993, 658 ff.; Bresnen and Marshall 2000b, 9; Erez and Gati 2004, 583 ff.), through shared experiences and learning outcomes of the individual groups (Schein 2017, 6). Cultural patterns get transferred from one generation (Hofstede 1984, 82) of group members to the next if they are perceived as the correct way of feeling, thinking and behaving in specific situations (Schein 2017, 6). Thus, there is no "right or wrong culture" (Cameron and Quinn 2011, 29), as the different cultural characteristics are based on the individual circumstances and experiences from specific groups. Although cultures are dynamic, they are also relatively stable over a long time period (Taras et al. 2009, 358).

Figure 9 - Dynamic of top-down-bottom-up processes across levels of culture
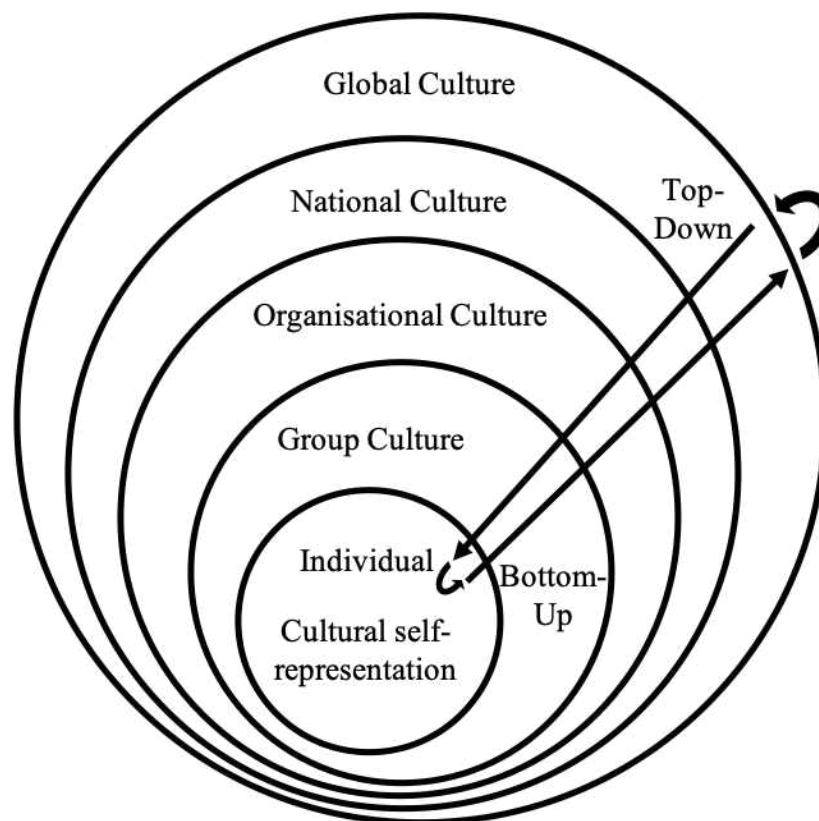
Source: Erez and Gati (2004, 588)

If foreign individuals enter a group, they face a foreign cultural environment and go through different stages of feelings, see Figure 10 by Hofstede et al. (2010, 384). After a time of euphoria, where the individual is excited through the new experiences, the culture shock comes where her own culture is confronted with the cultural differences. During the acculturation stage, the individual gets used to the cultural features of the new environments and slowly learns to function under the new circumstances. The stable state is the fourth stage of the model that the mind reaches after the earlier stages. The individual can either feel less, alike or more comfortable with the new culture in contrast to his "home culture" (Hofstede et al. 2010, 385). The duration of all phases differs due to the actual situation and it is dependent of the group participation. If the end of the participation is closer by, the acculturation time is shorter than at long expected affiliation times. The named acculturation periods can range between three months at short affiliation times, and several years, if longer assignments are expected (Hofstede et al. 2010, 385).

Figure 10 - The Acculturation Curve
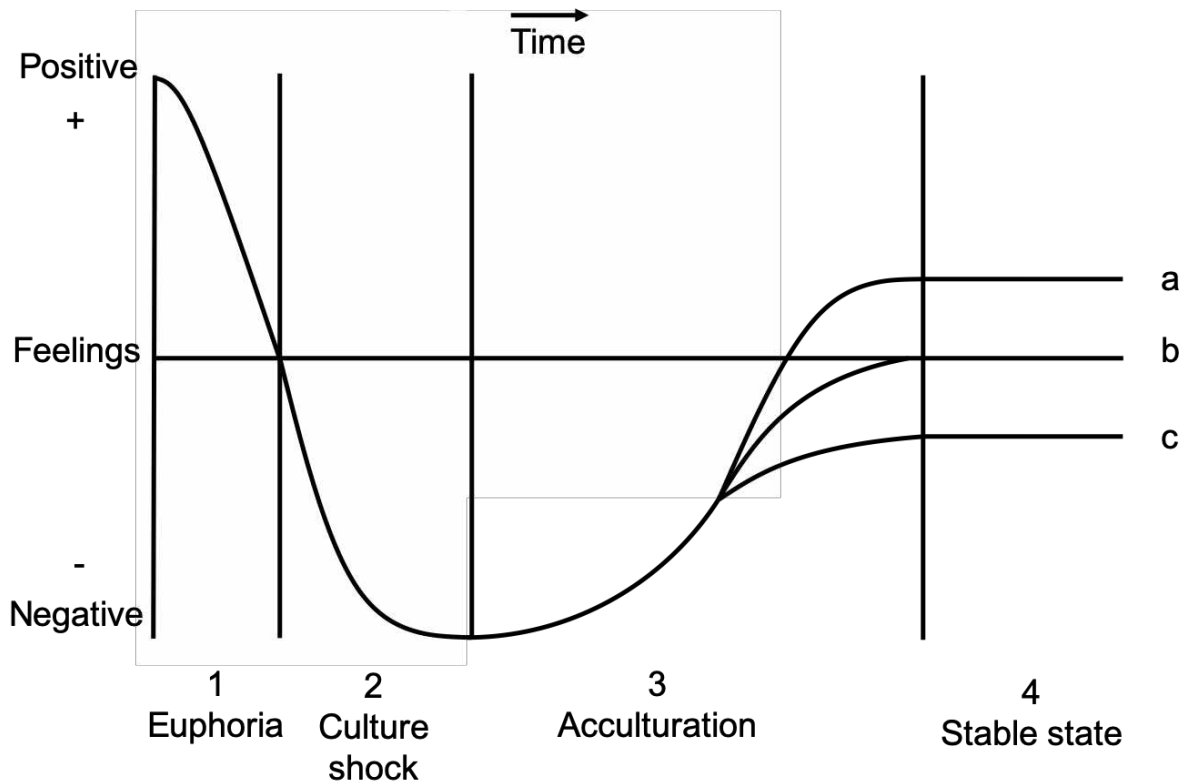
Source: (Hofstede et al. 2010, 385)

2.1.1 Organisational Culture

In a professional context, organisational cultures are of enormous interest, as scholars frequently present that an organisation's "everyday operations" (Sun 2008, 137) and therefore its success (Sun 2008, 140 - 141) is directly linked with its culture. As described earlier, there is no "wrong or right" culture (Cameron and Quinn 2011, 29), but if culture organisational culture is linked with an organisation's success, it is from strategic interest. As organisational culture is deeply rooted as the values and beliefs of its employees, and it cannot be 'invented' but evolves over time (Huber and Becker 2009, 119; Sackmann 2009, 3). Literature describes culture often as what an organization "is" instead of what is "has" (Smircich 1983, 344 - 345; Meyerson and Martin 1987, 623; Meek 1988, 470; Bate 1994, 9 - 11; van Marrewijk 2007, 291). Shaping organisational culture is a crucial management task that can be used to gain competitive advantage, for example through shaping a culture with a focus on efficiency, cooperation or control, (Sun 2008, 140 - 141) dependent on the organisation's circumstances and strategy. It is stated that a 'strong' organisational culture attracts, holds, and rewards the employees for performing their roles and achieving goals and that such cultures are characterised by dedication and cooperation to serve common values (Sun 2008, 137). Such common values are one ingredient of models about organisational cultures.

Whereas Figure 9 visualises different cultures with different layers regarding the size of the belonging groups and their reciprocal influence, Figure 11 presents a framework from Hofstede et al. (2010, 8 ff.) which clusters organisational cultures with different layers in terms of their visibility and comprehensibility for people that do not belong to the cultures. This framework is clustered from the outer layer 'Symbols' as vocabulary, gestures, and objects as the most superficial elements. These are easily changed and often copied by people and groups that do not belong to the culture. Cultural 'Heroes' are persons (real or imaginary) which are role models for behaviours. 'Rituals' are collective activities which are perceived as socially essential. Examples can be different types of meetings, or specific ways of communication. 'Practices' connect these three outer layers as all of them are visible for people that do not belong to the culture, even if they cannot understand their cultural value. "Values" are the core of cultures. These are feelings with two sides, as "evil versus good", "dangerous versus safe", "ugly versus beautiful" or "irrational versus rational" to name a few examples. This framework can of course not only be used to describe organisational cultures, but also cultures in general. It helps, however, to understand everyday operations and interactions within organisations and with external stakeholders on a professional level and it enables to focus on cultural aspects that can be influenced to shape a desired culture (Sun 2008, 139).

Figure 11 - The "Onion": Manifestations of Culture at Different Levels of Depth
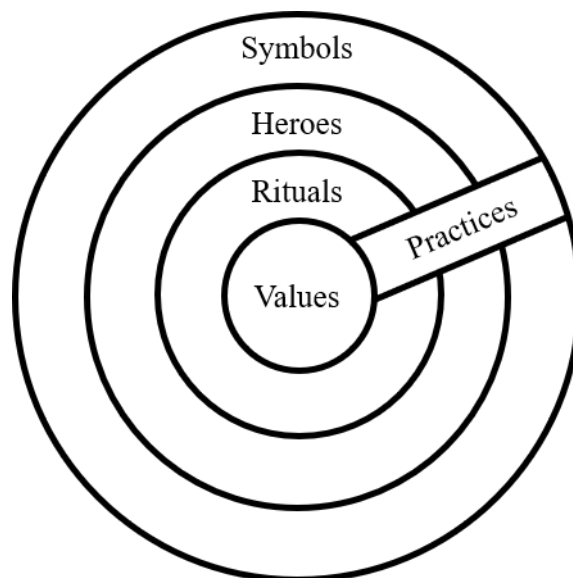
Source: (Hofstede et al. 2010, 8)

The onion model is with its principles very similar with the model of Schein (2017, 17 - 25) (see Figure 12), which describes organizational cultures with three levels, which range from tangible to embedded symbols and values. The layers describe 'artifacts', so visible and feelable phenomena, which are described as 'practices' in the model of Hofstede et al. (2010, 8);

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'espoused beliefs and values', like ideologies, ideals, values etc., which are similar to 'values' in the model of Hofstede et al. (2010, 8) and an additional, deeper layer, which are the individual 'basic underlying assumptions', so "taken-for-guaranteed beliefs and values". This deepest cultural layer contains thoughts and behaviours that are so deeply rooted in the culture that alternative behaviours are considered as inconceivable without knowing or challenging it (Schein 2017, 22). This differs to the definition of values, which are outlined as bipolar, so with two alternatives (Hofstede et al. 2010, 8). Within one culture, there is only little variation of this deepest layer of 'basic underlying assumptions' and "taken-for-guaranteed beliefs and values" (Schein 2017, 22).

Figure 12 - Schein's Model of Organisational Culture
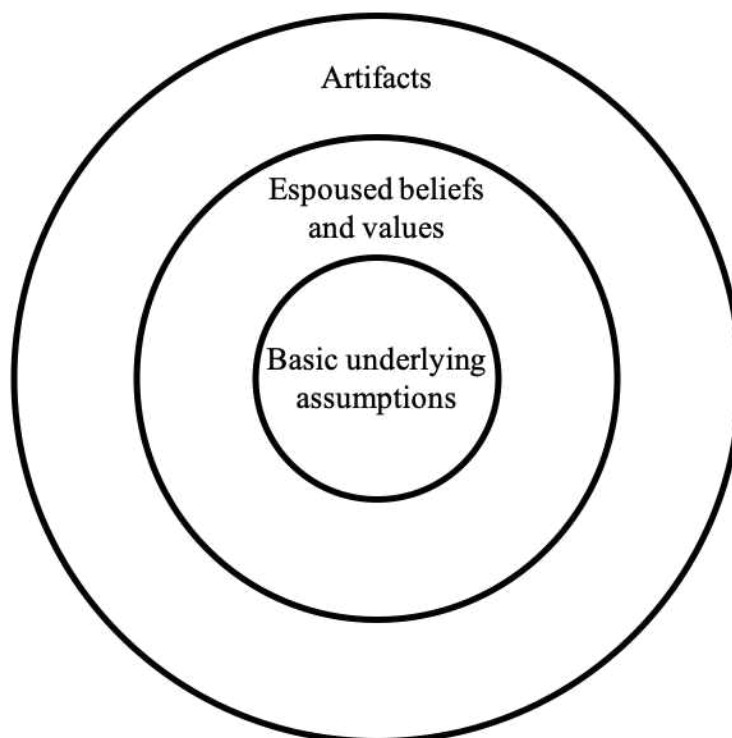
Based on Schein (2017, 18)

The model of Cameron and Quinn (2011, 39), see Figure 13, focuses on this inner layer of the presented model of (Hofstede et al. 2010, 8) and parts of the middle layer of Schein (2017, 22). It describes different bipolarities of 'values' with the "Competing Values Framework" (CVF). It is the most common framework to measure and describe culture in an organizational context (Yu and Wu 2009, 37; Cameron and Quinn 2011, 27; Ferreira 2014, 87).

Figure 13 - Competing Values Framework
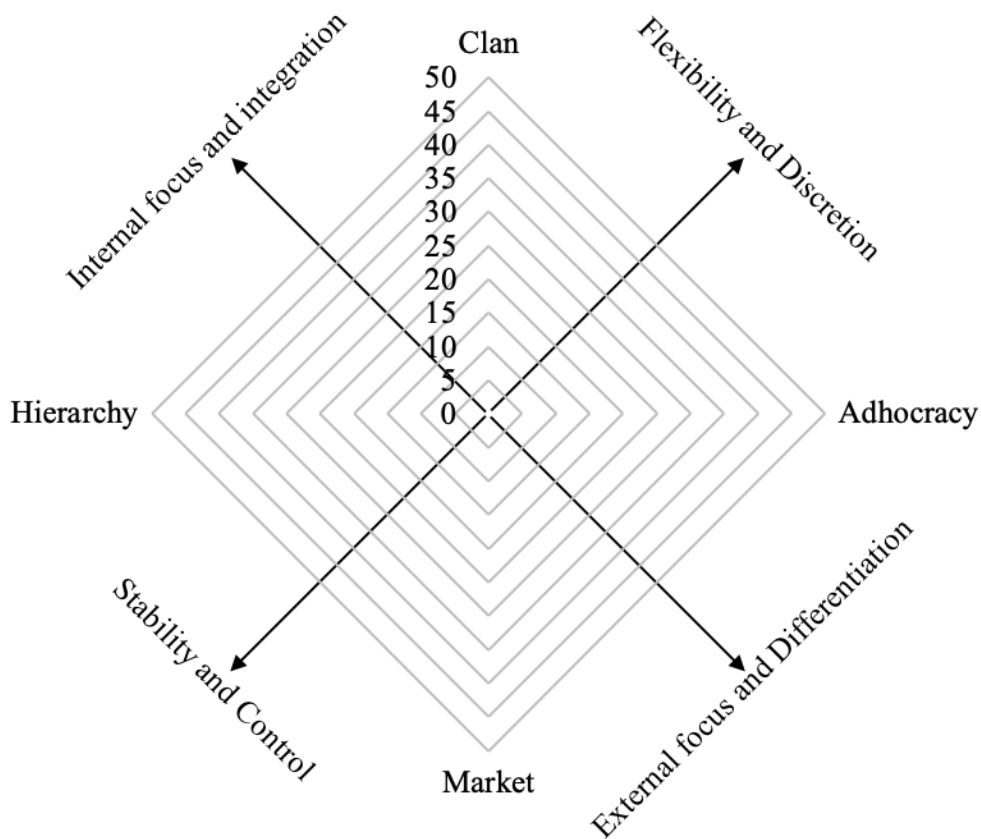
Based on Cameron and Quinn (2011, 39)

Figure 13 shows the framework with two dimensions and the four resulting quadrants. This layout can be described as a common circumplex model to describe cultures with their competing features (Strack 2012, 31). One dimension "differentiates effectiveness criteria that emphasize flexibility, discretion and dynamism from criteria that emphasize stability, order, and control" while "the second dimension differentiates effectiveness criteria that emphasize an internal orientation, integration, and unity from criteria that emphasize an external orientation, differentiation, and rivalry" (Cameron and Quinn 2011, 38 - 39).

The Clan (Cooperate) quadrant with flexible and internal focused characteristics represents a culture that is characterized by open and friendly conditions and the perception of family-like behaviours within the organization (Cameron and Quinn 2011, 46 - 48; Paro and Gerolamo 2017, 588). The relationships and the leadership style are especially characterized by employee empowerment (Cameron and Quinn 2011, 46 - 48).

The opposite Market (Compete) quadrant, which has distinct stability and external focus, represents the focus on external competitive advantage through economic Market mechanisms

and productivity. The general assumption in Market pronounced cultures is that the environment is hostile instead of benign (Cameron and Quinn 2011, 43 - 46).

The Hierarchy (Control) quadrant, which has characteristics that are especially internally focused, stabile, and controlled, represents cultures that are focused on efficiency through standardized and reliable conditions and behaviours (Cameron and Quinn 2011, 41 - 43).

The opposite Adhocracy (Create) quadrant represents cultures that especially "foster adaptivity, flexibility, and creatively if uncertainty, ambiguity, and information overload are typical" (Cameron and Quinn 2011, 49 - 51). These cultures are characterized by innovations, dynamic changes, and temporary decisions, while it is common for individuals to take risks.

To collect the necessary data for the CVF, the "Organizational Culture Assessment Instrument" (OCAI) as a standardised survey is conducted. The OCAI is clustered in the six items: (1) Dominant Characteristics, (2) Organizational Leadership, (3) Management of Employees, (4) Organization Glue, (5) Strategic Emphases, and (6) Criteria of Success. Each of these items consists of four statements that describe the characteristics of one of the four quadrants. Participants have to divide 100 points among the four statements as they perceive that these statements are similar to the project environment and its culture (Cameron and Quinn 2011, 29).

The analysis is conducted by calculating the mean scores for all categories for each participant. Next, the mean scores of all participants are summed and divided through the number of participants to gain the mean score for the whole project and thus the definition of the project culture in the CVF (Cameron and Quinn 2011, 33).

2.1.2 Construction Project Culture

Cultures are unique. This is especially true in the field of project organisations (Newcombe 2003, 842), as projects are characterised by their uniqueness, their temporal limitations and the multiple disciplines involved (IPMA 2015, 27)). The special circumstances in the construction industry like the one of a kind production; site production; temporary multi-organization and intervention of regulatory authorities (Koskela 1992, 44 - 49) lead to specific construction project cultures (Huber and Becker 2009, 119; Ranf 2010, 657). As the number of necessary stakeholders that need to cooperate to build construction projects grows with the project's complexity (Chen et al. 2019, 1) and has increased in the past decades (Ranf 2010, 657), the topic of managing project cultures has become more and more relevant to deliver construction projects successfully (Crawford and Anichenko 2018, 79; van Marrewijk 2018, 144).

The composition of teams changes due to the different tasks at different moments in time during the construction phase. Thus, the team and its culture face frequently new team members that have to be integrated in the existing group. Project cultures operate through this with "systems of multiple and often conflicting objectives" (Newcombe 2003, 842). An additional issue is that construction projects consist often, dependent on the amount of integrated individuals (Sackmann 2009, 3), of multiple sub-cultures (van Marrewijk 2018, 145) that need to be managed. The single participants form the culture, with their different individual cultural backgrounds like their : (1) professional discipline (and the corresponding sub-culture); (2) the length of their service within their organization; (3) their experiences in projects, project work and various organizations; (4) the length of their service within organizational units; (5) their functions and hierarchical levels; (6) their personal interests; (7) their gender; (8) their ethnical affiliation and their (9) regional; (10) national and (11) sociocultural origin (Sackmann 2009, 4). Such cultural diversities within project teams have an influence on the success of the projects (van Marrewijk et al. 2016, 1746) and can lead to both: "a productive advantage or a problematic challenge" (Pitfield et al. 2015, 9) due to the different perspectives on the current tasks (Ochieng and Price 2010, 451), different skills, beliefs and experiences (Ranf 2010, 662).

According to Cornick and Mather (1999, 31), the key stakeholders of construction projects consist of (see Figure 14):

- the client organization with representatives from a cost- and project management organizations,
- the designer organizations,
- the constructor organizations with both the main contracting or construction management organizations as well as the specialist contracting organizations, which act usually as (sub-) contractors.

As especially they interact frequently for the complication of the project, they create mainly the construction project culture. This constellation that a MC is commissioned is mostly the case (Hinze and Tracey 1994, 274). Nevertheless, there are also variations as without a MC (AHO 2020, 5), or with a main designer and various (sub-) designers (Kochendörfer et al. 2018, 115). The different organisations are connected through different direct or indirect contractual relationships which define tasks and responsibilities (Ballard and Howell 2003a, 3 - 4). Regardless of these contractual relationships, the different project parties interact with each other. These interactions lead to the unique construction project culture. Therefore, the contractual constellations are disregarded in this dissertation.

Figure 14 - The usual construction project organisation's key stakeholders
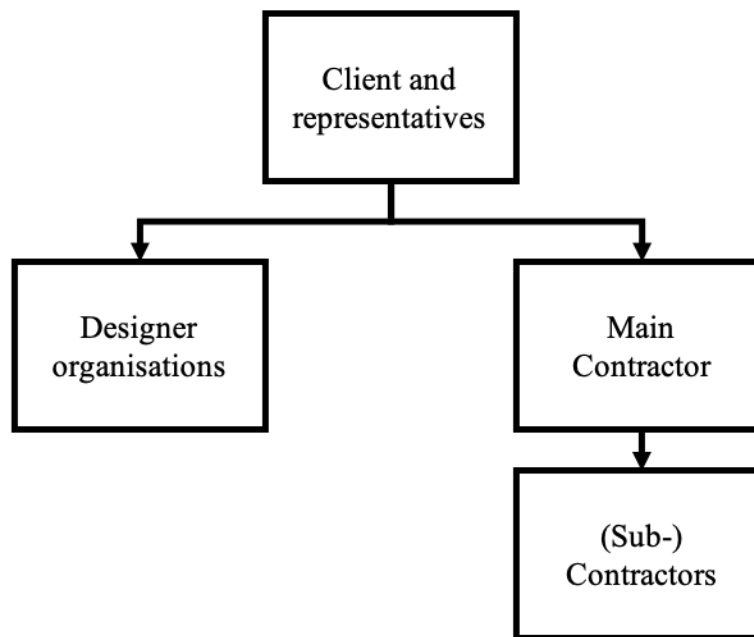
Based on Cornick and Mather (1999, 31); Kochendörfer et al. (2018, 115)

Also other stakeholders like consultants; suppliers; end-user or the community (Takim and Akintoye 2002, 553) have power on construction projects and thus an impact on the project team and its culture (Newcombe 2003, 842 - 843, 849).

Figure 15 and Table 2 show the average construction industries' culture and its particularities in the CVF, respectively, based on research in five different continents, dominantly the United States of America, conducted by Cameron and Quinn (2011, 90). The figure represents the construction industry's culture, and not the common project cultures, but as 80% of all tasks in this industry are conducted in projects (GPM 2015, 19), it should also represent the main characteristics of 'common' construction project cultures. As the source (Cameron and Quinn 2011, 90) does not give the detailed numbers for the scores, they are visually extracted for this dissertation. The shape of the figure confirms that the industry's culture is especially characterized by the competitive characteristics of the Market quadrant. This ranking goes along with the described culture with its focus on high competition. The opposite Clan quadrant shows medium waged scores. It can be argued that this represents the certain proportion of cooperation, which is necessary to fulfil the own tasks in cooperation with the other parties, in order to realize the construction project. The Hierarchy quadrant also shows medium waged scores, whereas the opposite Adhocracy scores are the least pronounced of all quadrants. This distribution can be explained through the clear (technical) rules and processes on construction sites, which leave little room for creative and spontaneous behaviours.

Table 2 - The construction industry's average culture

	Clan	Adhocracy	Market	Hierarchy
Construction industry's global culture	22	18	37	23

Based on Cameron and Quinn (2011, 90) – visually extracted

Figure 15 - The construction industry's global culture
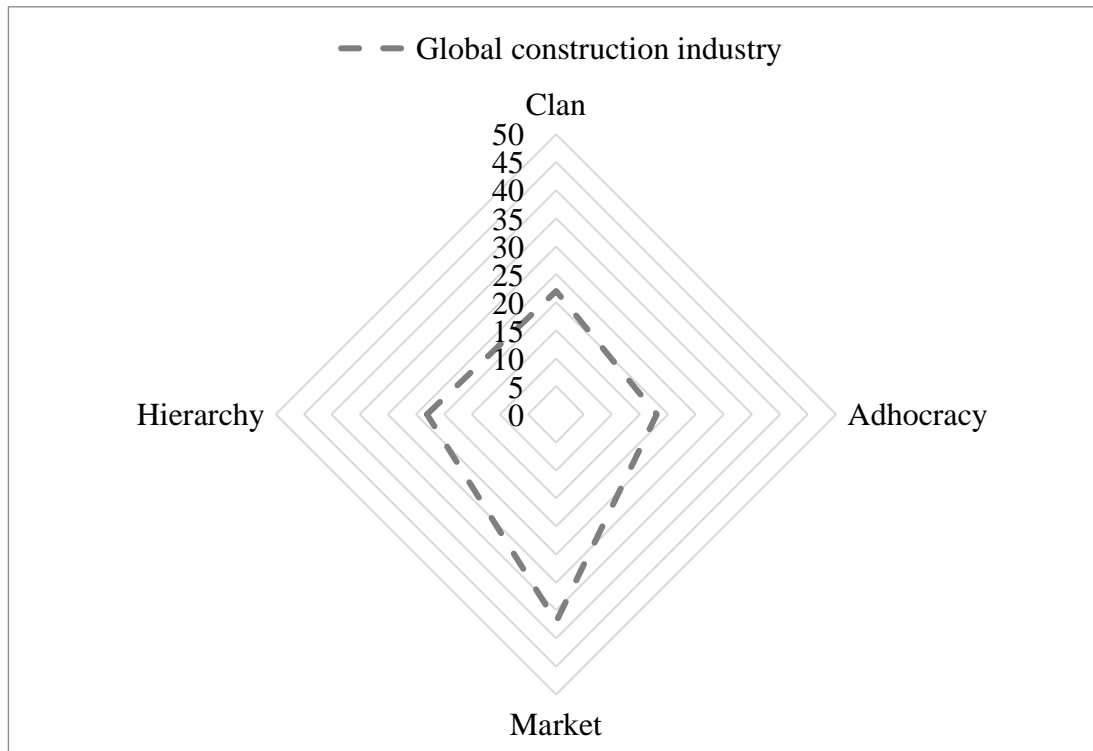
Source: Cameron and Quinn (2011, 90)

2.1.3 The complexity of construction project culture

The various models have shown the multiple and dynamic layers of cultures, that continuously influence each other (Sackmann 2009, 4). Each culture is formed by its individual members with their diverse cultural backgrounds (Goodman et al. 1999, 24; Sackmann 2009, 4) and their interactions through their individual, or shared experiences and learning outcomes of the individual groups (Schein 2017, 6).

Figure 16 visualises these diverse cultural backgrounds and the different sub-cultures within construction projects.

Figure 16 - Potential cultural diversity in construction projects

Global Culture
Continent's Culture
Nation's Culture
Construction industry's Culture
Region's Culture
Organisation's Culture
Construction Project's Culture
Sub-cultures
Ethnicity
Gender
Profession
Organisational unit
Project
Function
Hierarchy
Company affiliation
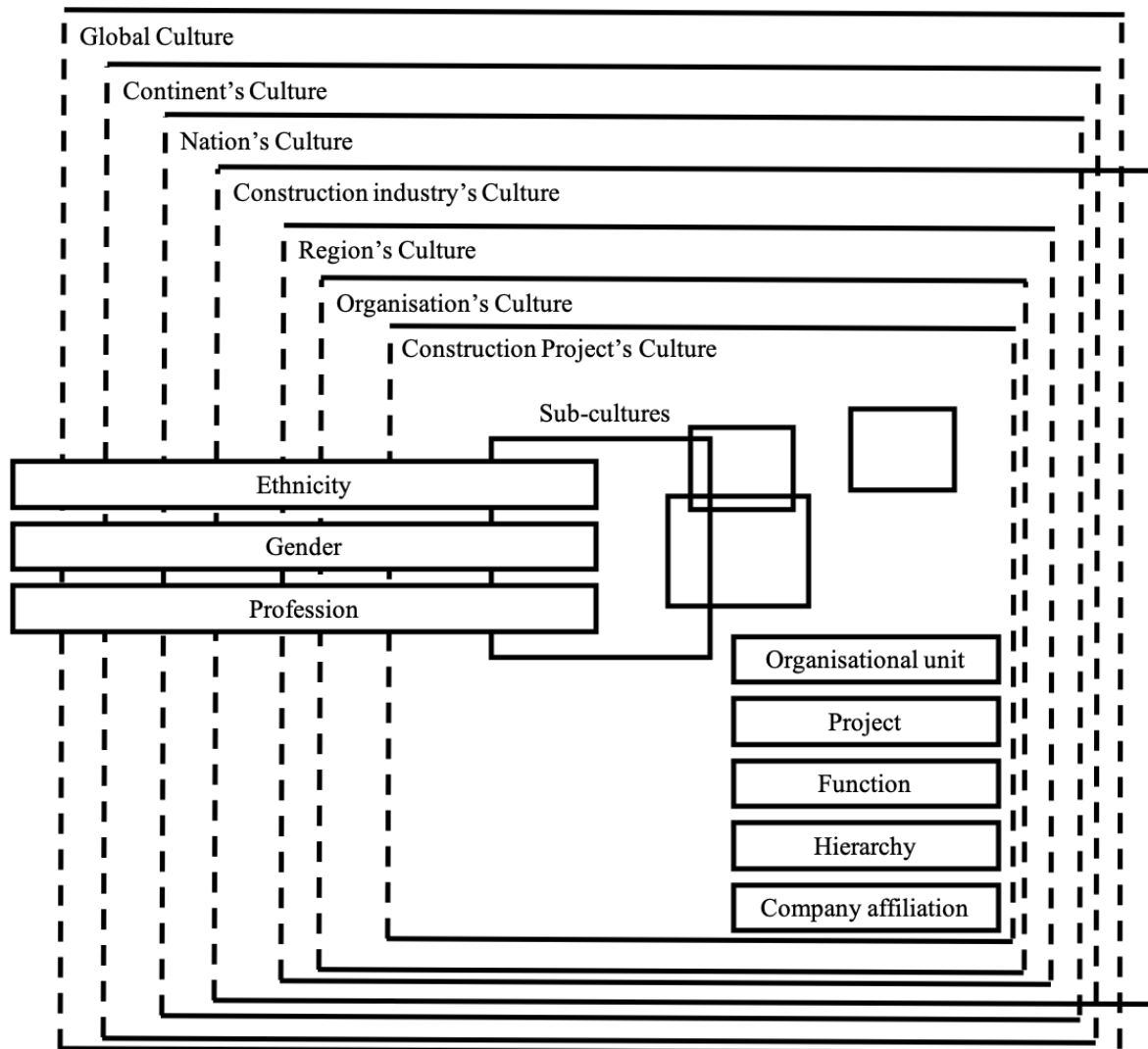
Based on Sackmann (2009, 4); Sackmann (2017, 67)

To deal with the complexity of projects, we need different parties and their special knowledge and equipment. Through this, projects are characterised by cultural diversity (Cheng et al. 2001, 62). Therefore, one of project management's main tasks is to manage this diversity towards a functioning 'project team' (Goodman et al. 1999, 24). A (project) 'team' is by definition characterized by an interrelating group of people, whose members share a common goal (Syer and Connolly 1996, 7), a clear shared vision, the main focus on team-needs instead of on individual needs, and the team's willingness to take ownership for its common problems (Foley and Macmillan 2005, 21). This task has become more and more relevant to deliver construction projects successfully (Crawford and Anichenko 2018, 79; van Marrewijk 2018, 144) due to increasing project complexities (Ranf 2010, 657; Bosch-Rekveldt et al. 2018, 1).

2.2 Partnering

As introduced earlier, the construction industry struggles with delivering projects, illustrated by low productivity, cost overruns, time overruns, poor safety conditions and quality issues (Hatush and Skitmore 1998, 1; Eriksson et al. 2008, 527; Smiley et al. 2014, 804; Sohi et al. 2016, 252). One reason for this situation is the focus on singular interests instead of common project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and the belonging culture (Johnston and Lawrence 1988, 98; Ng et al. 2002, 437; Beach et al. 2005, 612; Foley and Macmillan 2005, 19). The best project performances (from the respective point of view) can be only achieved if all participants are "fully integrated and aligned with project objectives" (Ochieng and Price 2010, 449). Accordingly, a paradigm- and cultural change in necessary to overcome the current situation (Larson 1995, 31; Ng et al. 2002, 437; Cheung et al. 2003, 333). One approach, called 'Partnering', aims to reduce the energy on conflicts but rather spend effort in value adding activities (Bayliss et al. 2004, 253). To implement partnering, paradigm and cultural changes are necessary (Larson 1995, 31; Ng et al. 2002, 437; Cheung et al. 2003, 333).

The most cited definition for partnering (partly or complete, see for example Loraine (1994, 5-6); Matthews et al. (1996, 119); Schultzel and Unruh (1996, 55); Thompson and Sanders (1998, 73); Conley and Gregory (1999, 320); Walker et al. (2002, 84); Chan et al. (2006, 1926)) is from the Construction Industry Institute (1991, vi):

"Partnering is defined as a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services."

The concept of 'partnering' can be divided into 'project partnering' – also called 'one-off partnering', where partnering conditions are intended for single projects, and 'strategic partnering', where the aim it to reach partnering conditions across multiple projects (Barlow et al. 1997, VI; Li et al. 2000, 82; Bygballe et al. 2010, 241). The choice for 'project partnering'

or 'strategic partnering' is dependent on the motivations of the involved parties. Some of these are listed by Crane et al. (1997, 58):

(1)   the expansion into global Markets and

(2)   the reduction of engineering costs,

Chan et al. (2006, 1929) adds the following:

(3)   improved relationships;

(4)   improved communication;

(5)   better productivity;

(6)   reduction in litigation;

(7)   improved conflict resolution methods;

(8)   a win-win attitude;

(9)   long-term trustful relationships;

(10)   more responsive to short-term emergency or changing project- or business needs

(11)   an improved corporate culture

The focus of partnering is on performance improvements through collaborative relationships (Kwan and Ofori 2001, 619; Alderman and Ivory 2007, 386; Eriksson et al. 2008, 528; Akintan and Morledge 2013, 2; Gibbons and Zolin 2016, 403), open communication, which leads to improved learning, a high level of effectiveness (Alderman and Ivory 2007, 386) and the integration of the various parties in a multidisciplinary project team (Bosch-Rekveldt et al. 2011, 28).

Partnering is a managerial approach (see Figure 1) and describes the relationship between persons or organisations where cooperation is in the centre of their relation with the objective that all parties increase their business value (Sochan 2018, 7) through this cooperative connection (Eschenbruch 2008, 1). With this focus on behaviours and relationships, partnering is often not described as the application of various tools or contracts, but as a culture (Phua and Rowlinson 2004, 913; Bygballe et al. 2010, 19). Its focus is to create conditions where all can win (Harback et al. 1994, 23) instead of where all lose (Larson 1995, 30), and as such a way to change the entire "unhealthy construction industry" (Nyström 2005, 473).

This correspondents with the partnering concept by Nyström (2005, 478) (see Figure 2), which describes partnering with (1) 'Trust' and (2) 'Mutual understanding' as 'soft factors' as necessities for the successful implementation of partnering whereas (3) Predetermined dispute resolution methods, (4) Economic inventive contracts, (5) a Facilitator, (6) Openness, (7)

Continuous and structured meetings, (8) the Choosing of working partners and (9) Relationship building activities, are 'hard factors', as helpful add-ons. Since 'Trust' and 'Mutual Understanding' are necessities, these two topics will be explained more in detail in the following Sections.

2.2.1 Trust

Trust is necessary for a partnering culture (Nyström 2005, 478). In general, obtaining trust is the most important strategy in minimising risks in construction projects (Cerić 2016, 93). It has been one of the most important subjects in construction project management since decades (Cerić 2016, 14). A high level of mutual trust leads to smooth construction processes and a high level of flexibility for facing uncertainty (Lau and Rowlinson 2010, 694).

Trust is a complex issue and influenced by multiple factors (Khalfan et al. 2007, 385), resulting in various definitions. For this thesis, the following definition was chosen (Mayer et al. 1995, 712):

> "Trust […] is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party".

The reason for this choice is the definition's distinction between trusting, irrespectively of the ability of monitoring and the contrary – high level of monitor and control. Such high level of monitor and control is facilitated by LPS through the clear visualization of work packages and the detailed reflection of fulfilment- of not fulfilment of commitments.

Cerić (2016, 4-5) describes trust as the backbone of the entire project. One reason is that trustful relationships lead to risk-taking actions whereas the accepted level of risk rises with the level of trust (Mayer et al. 1995, 709; Schoorman et al. 2007, 346). Thus, in terms of construction projects, the difference between distrust and trust could mean that actions be taken which are not explicitly contractually arranged, but which are in cooperative interests. The level of trust evolves over time and changes through different situations (Mayer et al. 1995, 726 ff.). Figure 17 shows these dynamics and visualizes that trust is fragile. At the beginning of relationships in construction projects, there is usually a positive level of trust between the project participants (Ostrom 2003, 27; Cerić 2016, 15). If something happens which affects the level in a negative

way, the slowly built level of trust (A-B) changes immediately towards distrust (B-C) and can only slowly be rebuilt (C-E) (Cerić 2016, 15).

Figure 17 - Dynamics of trust among project parties
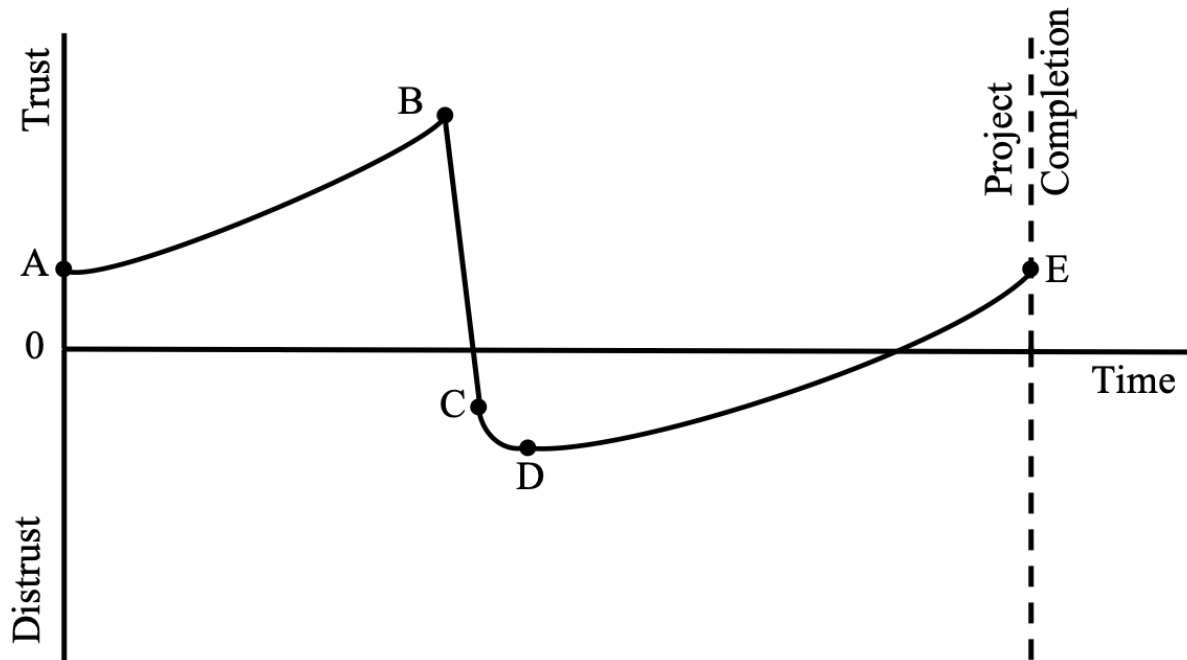
Source: Cerić (2016, 15)

In order to better understand the notion of trust, what contributes to trust and how to achieve it, several researchers have broken down the concept in certain categories (Mayer et al. 1995, 715; Kadefors 2004, 176 - 177; Wong and Cheung 2004, 440; Wong and Cheung 2005, 73; Khalfan et al. 2007, 388; Schoorman et al. 2007, 345; Pinto et al. 2009, 642). These models have many similarities and partially relate to each other.

Wong and Cheung (2005, 70 ff.) developed with their "Structural Equation Model of Trust and Partnering Success" a mathematical model which includes the most common ingredients of the other frameworks and allows to determine a total score (Eid et al. 2017, 954) that represents the level of trust in terms of partnering projects. Therefore, it is here described in more detail.

The framework is based on a literature review and clusters trust in three major categories, that contribute to one entire 'Partner's Trust Level'. These categories are (1) Partners' Performance, (2) Partners' Permeability and (3) System-based trust. The model is visualised in Figure 18.

Partners' Performance, Partners' Permeability and System-based trust are crucial whereas 'Relational Bondings', as another trust factor, which is based on long-term relationships and the compatibility of cultures and values between the participants, has almost no influence on the Partner's trust level, they are excluded from the model (Wong and Cheung 2005, 76 ff.).

This finding is crucial because it gives (construction) project managers the prospect to create trustful relationships at construction projects despite its temporal limitation and the continuous changing teams through the design of the other three trust categories. Not taking the length of the relationships into account when defining the level of trust can be challenged as other sources describe that only 'strategic partnering' programs, so efforts to create partner-like relationships over the duration of multiple projects, lead to the desired partnering cultures (Matthews et al. 1996, 120, referring to Bennett and Jayes, 1995).

Based on the literature review of Wong and Cheung (2005, 70 ff.), three categories include the following components:

(1) 'Partner's Performance' includes the other parties' competence and the reliance on given information (Mayer et al. 1995, 717; Khalfan et al. 2007, 385 ff.), its problem solving ability (Khalfan et al. 2007, 387), the unity through the understanding of the partner's actual requirements and difficulties (Khalfan et al. 2007, 387), the alignment of the receiving benefits and the respect for the mutual dependencies (Wong and Cheung 2005, 72 referring to Swan et al. 2002).

(2) 'Partners' Permeability' describes (Wong and Cheung 2005) especially honesty and openness like information sharing, open communication, an effective information flow and a secure financial situation of the party (Khalfan et al. 2007, 386, 388).

(3) 'System-Based Trust' shapes the system that creates the circumstances between the parties. It is influenced by contractual satisfactory terms (Khalfan et al. 2007, 388), dispute- and problem solving methods (Khalfan et al. 2007, 387) and the parties' social reputation (Khalfan et al. 2007, 388).

Figure 18 - Structural equation model of trust
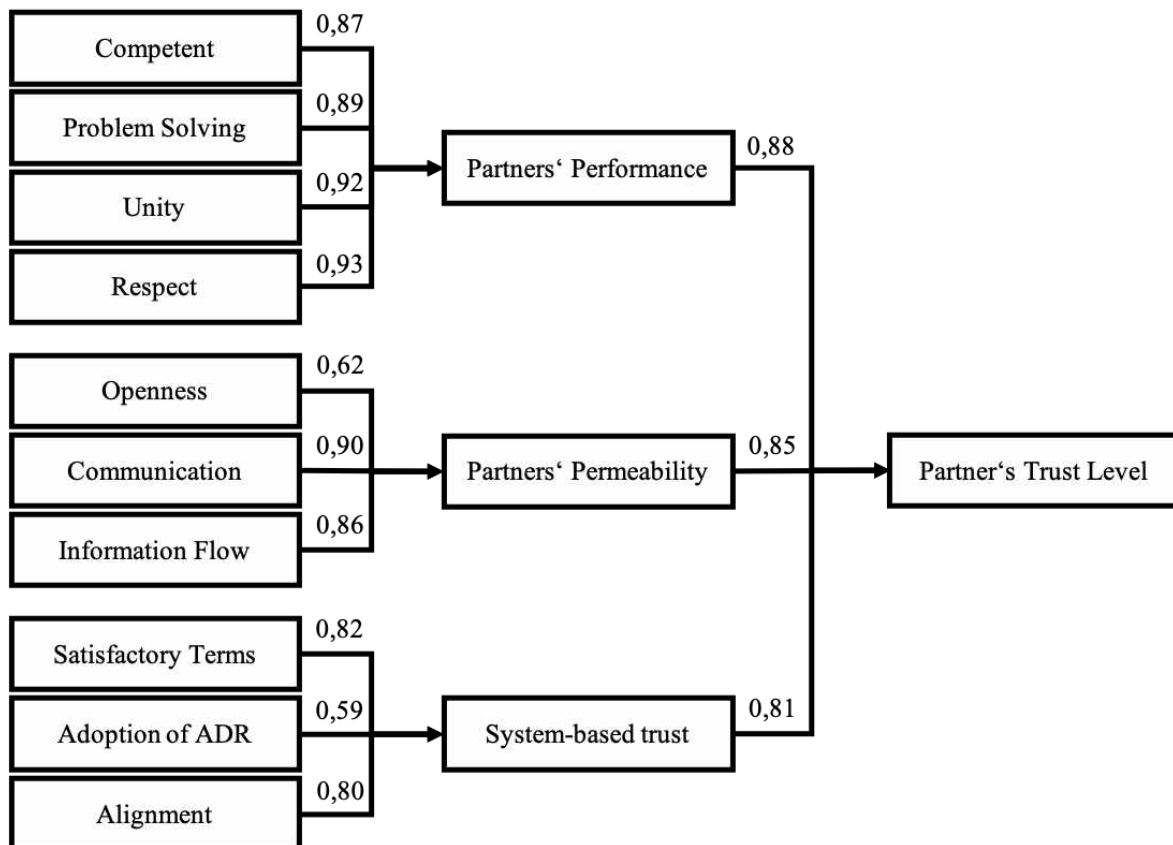
Source: (Wong and Cheung 2005, 73)

2.2.2 Mutual understanding

The second necessary element of a partnering culture is mutual understanding (Nyström 2005, 478). In terms of partnering, mutual understanding is often linked to the assumption that the individual goals are related to the common goals and that all parties always strive in the same direction. This assumption must be rejected as scholars show that each party and each individual try to reach their own project interests in first place (Nyström 2005, 476), these interests are subjective (Koops et al. 2016, 884) and are often directly conflicting (Newcombe 2003, 841; Olander 2006, 277). Mutual understanding is the reciprocal understanding and respect for interests of others parties, even if single components are not aligned to the own interests (Nyström 2005, 476). It improves the achievement of compromises as it is understood that achieving individual goals can lead to successful projects for all parties in the longer term (Nyström 2005, 476). A high level of mutual understanding about the perspectives of others can lead to more partner-like behaviours as project members understand the others' issues and behave more in the project's interests than following the individual contractual work specifications (Barlow 2000, 984).

An essential aspect to gain mutual understanding is the way of communication between the individuals (Hantho et al. 2002, 246, referring to Thomassen, 1985). Communication is always linked with social interaction (Bresnen et al. 2003, 157) and the design of the technologies for communication is crucial for the project outcomes (Gluch and Räisänen 2009, 165). How these technologies impact the level of mutual understanding is dependent on four variables which are visualised in Figure 19. (1) The framework is the environment, where the communication takes place and (2) the subject is the content about which is communicated. (3) The persons are the individuals that are involved in the communication and (4) the verbal, and non-verbal actions that take place during the communication (Hantho et al. 2002, 246, referring to Thomassen, 1985).

Figure 19 - Variables that influence the level of mutual understanding
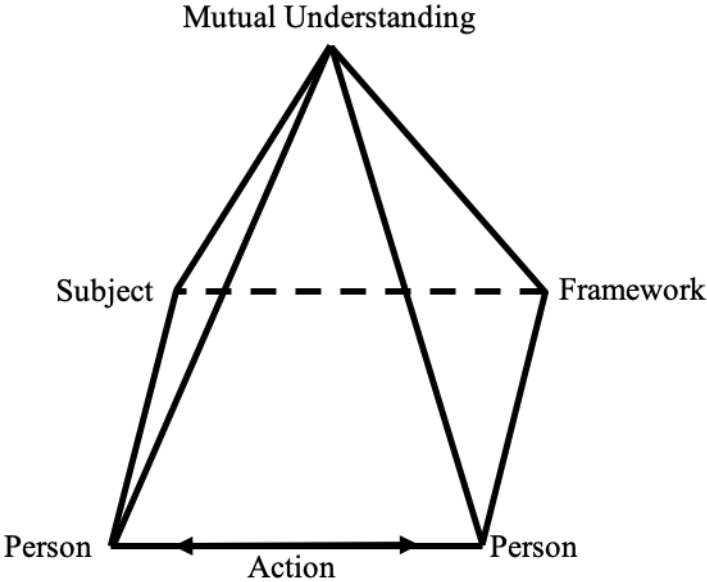
Based on: Hantho et al. (2002, 246, referring to Thomassen, 1985)

During these communications, a reflection of issues take place whereas diverse perspectives are involved. This process can change the initial individual perspective on these issues (Wiggins 1975, 44; Gutmann and Thompson 2009, 3; Pigmans et al. 2019, 2), as a learning process takes place and ideas can be expanded (Sunstein 2002, 3; Pigmans et al. 2019, 1).

To communicate in construction projects, commonly meetings are held where different stakeholders come together to discuss current issues. Possible kind of meetings are (1) 'Progress meetings', where the current progress is discussed, problems are identified contractual issues and requirements are reviewed, (2) 'Technical meetings' to solve technical issues, (3) 'Interim technical/cost reviews', where especially technical- and monetary issues are discussed, and (4)

'Strategy/problem-solving meetings', where risks and threats are discussed and which are used to discuss and negotiate different interests (Foley and Macmillan 2005, 23).

As the tasks on the sites are continuously changing during the construction period, the number of stakeholders and the individual participants vary constantly and so does the complexity of managing the communications (Hinze and Tracey 1994, 275). The project members have to decide how they want to communicate with the other stakeholders, who is involved in the different type of meetings, and which information they want to share with the others. These decisions are dependent of the individual project objectives and strategies. As described, conflicting project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) may lead to not-partner-like project conditions (Hinze and Tracey 1994, 274; Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Winch 2000, 144; Eschenbruch 2008, 4; Chen et al. 2019, 2) and through this towards a lack of information exchange and relationships on arm's-length (Johnston and Lawrence 1988, 98). If partnering is intended, open communication between the project participants would be the way to gain mutual understanding and through this partner-like behaviours (Chan et al. 2006, 1927).

Such different motivations influence the types of communication networks that are created in projects. Figure 20 by Cheng et al. (2001, 62) visualise four different types of such networks. (1) Contractual relationships are characterised by independent parties that are forced by contractual arrangements to organise their activities. The relationships are hierarchical and impersonal and they are independent of specific projects. The information diffusion is restricted and insufficient. (2) Project joint ventures are networks limited to a specific project, in the case of project-organisations even for specific sub-projects. The relationships and the coordination are also hierarchical and the communication is focused on controlling the activities of the other parties. (3) Formal partnerships are networks that are characterized by various parties, which are connected over multiple projects, or sub-projects. This network can be seen as a central operation unit with communication conduits between all parties. (4) Informal alliances are characterized by virtual and dynamic structures instead of solid structures. The relationships are horizontally and personally (Cheng et al. 2001, 62).

Figure 20 - Four basic types of construction network

Contractual relationship

Project joint venture

Formal partnership

Informal alliance
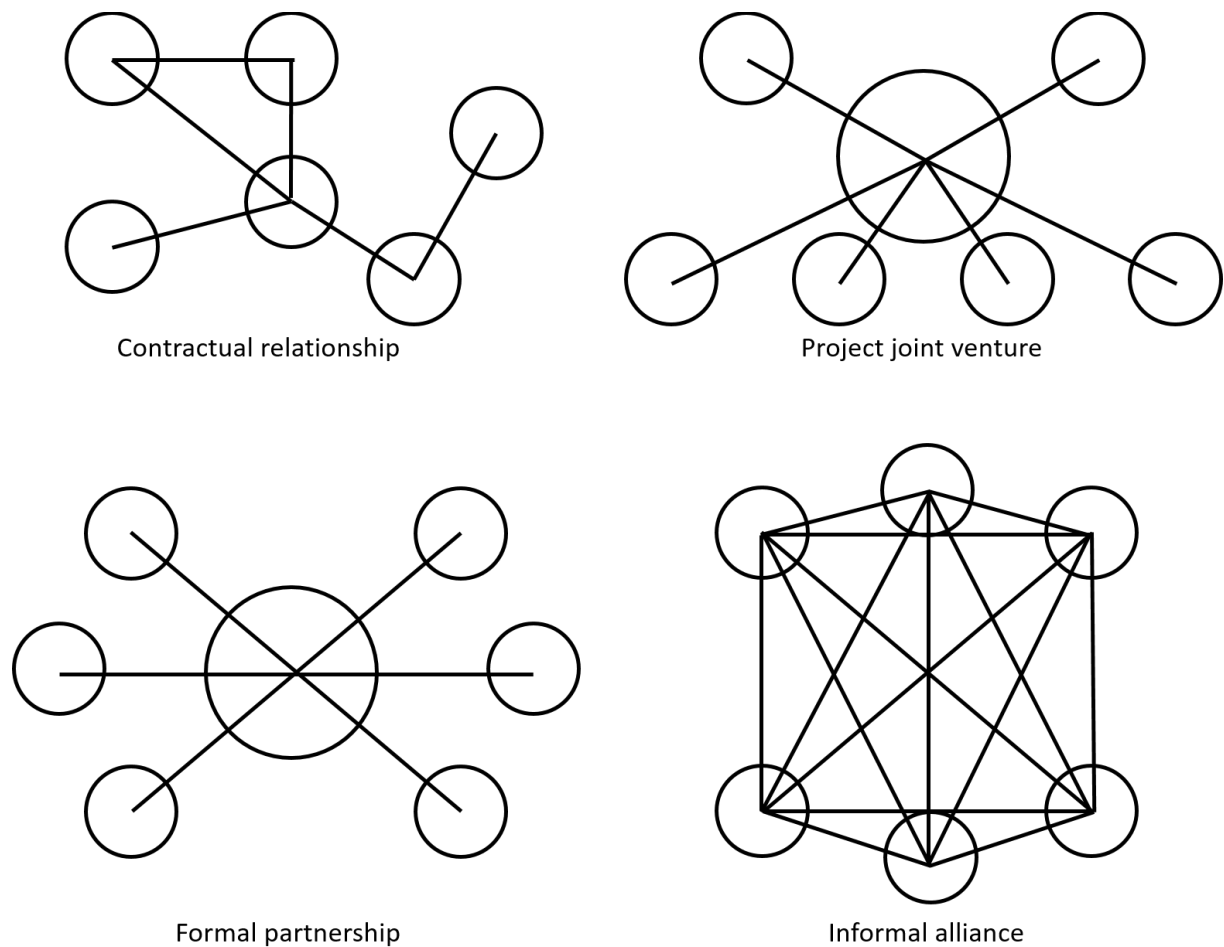
Source: Cheng et al. (2001, 62)

2.2.3   The Partnering Continuum

The level of partnering can be described in terms of the relationships between the parties under the named aspects of partnering. Thompson and Sanders (1998, 73 ff.) developed in this context the 'Partnering Continuum'. It uses the relation of the degree of objective alignment and the benefits of partnering to describe the type of relation between the parties. The framework divides the relations into the four groups of (1) Competition, (2) Cooperation, (3) Collaboration and (4) Coalescence.

Figure 21 - Partnering Continuum
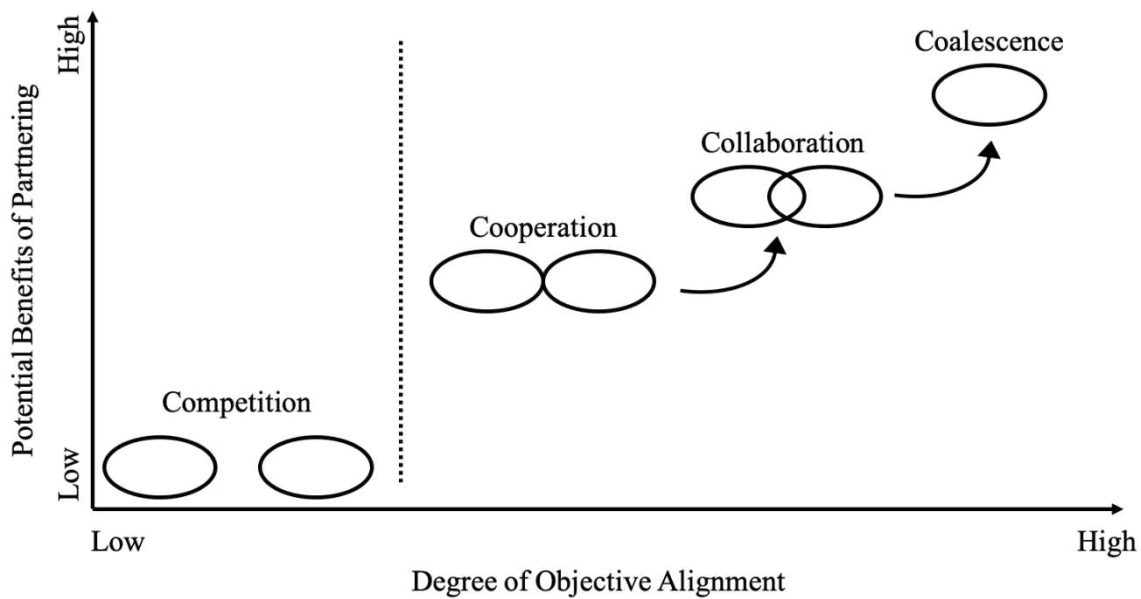
Source: Thompson and Sanders (1998, 74)

The competition relationship (1) describes the traditional form of relationship between the parties. The relationship is characterized by few, or even conflicting, objectives, and thus 'no partner-like', but adversarial behaviours. Figure 21 visualises this through the two ovals with a distance to each other and thus no overlap of interests or support. Competitive relationships are characterised by little trust, no sharing of risks and primarily defensive behaviours (Thompson and Sanders 1998, 74). It can be argued that competition is the logical consequence from neo-liberal Markets where each party focusses on their individual objectives (Dorée et al. 2003, 818). This is especially true if the offered services or products are similar and where organisations focus on a competitive advantage through lower costs than the competitor's offer (Grant and Jordan 2015, 131). A high level of competition, which is especially focused on 'price wars', is vulnerable for busting companies, and few improvements because of the prevention of costly service- or product developments (Dorée et al. 2003, 818) by focussing on the little budget and the necessity on parsimony.

The dashed line next to the competition relationship represents its disconnection to the other three stages. This dissociation is important because in contrast to pure competitive relationships, the other three relationships focus on common goals, albeit in different degrees (Thompson and Sanders 1998, 74), which are to a certain amount necessary to realize construction projects (Cheng et al. 2001, 62; Cheung et al. 2003, 339; Chen et al. 2019, 1), at least from a technical perspective.

(2) Cooperative relationships arise if traditional bidding processes form the contractual relationships for single projects and mutual objectives for this single project (Thompson and Sanders 1998, 73 - 74). The responsibilities for different tasks and their interfaces are clearly divided (Roschelle and Teasley 1995, 70). Through this, the efficiency of processes gets improved in contrast to competitive behaviours and the number of litigations gets reduced. Trust and respect for reaching other objectives than the own objectives increase in contrast to competitive relationships and the parties are willing to reach the general project's goals and objectives (Thompson and Sanders 1998, 73 - 74). To reach a cooperative relationship, control mechanisms must be relaxed in contrast to competitive relationships (Thompson and Sanders 1998, 75; van Marrewijk 2005, 92). Information must be shared and influence of others on the project must be accepted. Such behaviour allows the creation of trust. Projects with cooperative relationships are realised in shorter time frames and to less costs than projects with more competitive relationships (Thompson and Sanders 1998, 73 - 74).

(3) Collaboration relationships can arise if the parties have the willingness to improve each other's processes over time. Collaboration is the joint effort toward a shared goal and to solve issues together with another party (Roschelle and Teasley 1995, 70), which "implies that all participants make effort, combine it (joint) and direct (towards) to achieve a desired state or outcome (goal)" (Kolfschoten 2007, 3). Figure 21 visualises these joint goals as the overlap of the two ovals. Collaboration in construction projects is often seen as the natural way of working together to realise projects (van Marrewijk et al. 2016, 1750) as different tasks can only be fulfilled through shared processing. The improvement of processes goes at this stage further than reaching only objectives for single projects. The parties share information about their long-term business strategies and goals and support the others to reach these objectives. One party helps to improve the other party on a long-term – so, the mutual continuous improvement is reached. The parties share and take additional risks with the expectation to increase their rewards (Thompson and Sanders 1998, 76; Kent and Becerik-Gerber 2010, 815). Collaborative relationships could reduce the overall effort, due to reduced duplications of processes and improved processes, reduced project costs and duration, reduced sales expenses and reduced engineering rework (Thompson and Sanders 1998, 76).

The (4) coalescence relationships are described as the "ultimate stage of partnering" (Thompson and Sanders 1998, 76). The total alignment of objectives is reached and the mutual processed are not only improved, but the parties redesign joint processes to achieve joint objectives. The members of such a relationship do not see themselves as employed by their home organisation with individual objectives, but as a homogenous or integrated team instead. The people are

assigned to tasks, based on their skills instead of organisational affiliation (Thompson and Sanders 1998, 76). Such teams are also called 'truly integrated teams' (Bosch-Rekveldt et al. 2011, 1), whereas 'truly' emphasizes the full integration, but only needs to be mentioned as it is so hard to reach such a stage.

Whyte (2015, 69) describes sub-cultures from mega-projects in general as coalescences with own cultural particularities as artefacts and practices. Indeed, every culture can be seen as a coalescence as an individual community with unique cultural particularities. As the definition of a 'strong' culture is among other things a high motivation for performing in their roles and achieving the common goals of the community (Sun 2008, 137), it can be argued that the level of partnering is equivalent to the strengths of a project culture. The range is accordingly between weak cultures with competing characteristics and strong cultures with coalescence features.

The 'partnering continuum' with the range of competitive relationships until coalescence covers for sure all kind of relationships and belonging cultures. As presented earlier, there are various reasons why organisations or individuals decide more or less intentionally which kind of relationship types is desired, dependent on the individual strategic goals (Thompson and Sanders 1998, 78). For example, short-term, or medium-term goals such as the reduction of engineering costs (Crane et al. 1997, 58), better productivity or improved conflict solving methods (Chan et al. 2006, 1929) could be reached through a high level of cooperation. Long-term goals, such as the expansion in global Markets (Crane et al. 1997, 58) or long-term trustful relationships (Chan et al. 2006, 1929) require a higher degree of partnering, such as collaboration or coalescence. But there are also reasons as competitive tendering processes that lead to unprofitable contracts for the contractors with trim margins, where partnering is not intended as individual stakeholders focus on competition to still realize profitable projects rather than create partner-like project conditions (Hinze and Tracey 1994, 274; Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Winch 2000, 144; Eschenbruch 2008, 4; Chen et al. 2019, 2).

2.3 Scheduling and Controlling

Complex construction projects are realised since millenniums (Kozak-Holland 2011, 27). Nevertheless, project managers started developing and applying systematic and logical scheduling tools and techniques only since the 1950s, to manage construction projects (Olson 1969, 447; Seymour and Hussein 2014, 233) and to manage raising number of stakeholders (Chen et al. 2019, 1). Planning and scheduling approaches are ways to manage and structure the complexity of construction projects (Kenley 2004, 2) and have become one of the major

crucial project managing tasks (Benator and Thumann 2003, 29). Schedules are used to visualise the planned activities, to manage the relation between time, resources and costs (Ballard 2000, 2-7 - 2-8) and to analyse and control the actual status of the project progress (Yamin and Harmelink 2001, 375). It is important that the chosen planning and scheduling tool is easy to use, easy to update it, that it is a tool that facilitates the communication between the stakeholders and that it makes the planned activities understandable (Yamin and Harmelink 2001, 375). Developments in scheduling and controlling are discussed next.

2.3.1 Traditional Scheduling and Controlling

Benator and Thumann (2003, 29 ff.) present the 'Critical Path Method' (CPM), the 'Program Evaluation & Review Technique' (PERT), and the 'Gantt Chart' as the main tools for manage project schedules. Other methods are 'Line of Balance' and its adaption for the construction industry 'Vertical Production Method' and 'Linear Schedules' and the belonging 'Linear Scheduling Model' (Yamin and Harmelink 2001, 374).

CPM is the most common project management method to conduct traditional planning and scheduling (Yamin and Harmelink 2001, 374; Benator and Thumann 2003, 30; Kenley 2005, 246; Yassine et al. 2014, 789). CPM uses the knowledge about (1) the various types of work that need to be done to construct the project, (2) the necessary time for each of these work packages, and (3) the relationships between these tasks (Olson 1969, 447). CPM uses the logical connection of discrete construction activities (Yassine et al. 2014, 789) with the identification of the activity chain that defines the crucial construction chain, which is called the 'critical path'.

Usually, single planners and project managers (Mossman 2015, 15) apply the CPM-logic by connecting separate processes through logic connections in schedules before the construction processes start (Doloi 2013, 271) with the assumption that all these processes are to a certain degree predictable in terms of scope, targets, budgets, and risks (Poudel et al. 2020, 359). Schedules are usually used as the foundation for the different contracts between the different parties and are used to define responsibilities of the individual parties. This scheduling approach leads to a contracting mentality, with the focus on contracts and responsibilities instead of the production or work flow (Ballard 2000, 1-2).

The different roles in the belonging relationships are described in the 'Principal-Agent Theory', which describes the involved parties in such contractual arrangements and their individual interests (Braun and Guston 2003, 303; Cerić 2012a, 524). Figure 22 visualises that the principal hires the agent to fulfil certain tasks ('performs') and the belonging decision

competences, that both parties are dependent of each other and that each party acts following his self-interests (Schieg 2008, 48; Cerić 2012b, 767).

Figure 22 - Principal-Agent Theory
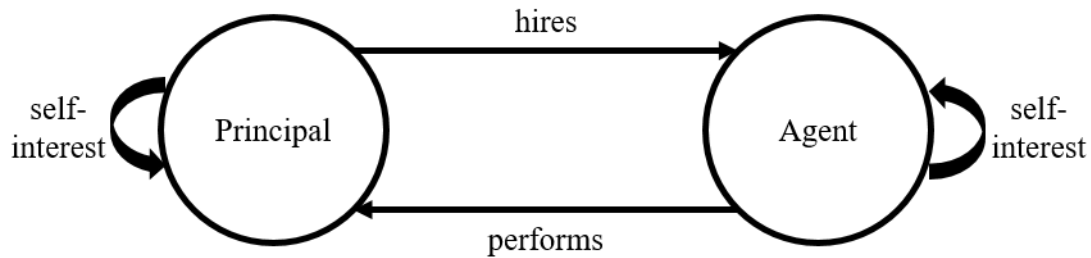
Sources: Cerić (2012a, 524; 2012b, 768) and Cerić (2016, 4)

The principal cannot watch all of the agent's actions, but control especially the results (Schieg 2008, 48; Chang 2014, 1). The different objectives and individual motivations lead to individual choices whether or not to share information, which in turn leads to information asymmetries (Cerić 2016, 29). According to the Principal-Agent Theory, this information asymmetry can be clustered into three variations: 'Adverse Selection', 'Moral Hazard', and 'Hold-up' (Schieg 2008, 48).

'Adverse selection' (Schieg 2008, 48), also called 'Hidden characteristics' (Cerić 2012a, 525), describes the principal's uncertainty about the agent's capabilities before the contract is closed (Moe 1995, 133; Braun and Guston 2003, 304; Schieg 2008, 48). To deal with the adverse selection issue, the agent can make himself attractive as a partner by signalling his competencies, for example through references or certifications (Schieg 2008, 50). Another way to deal with adverse selection is called 'screening', which means that the principal undertakes efforts to gain information about the agent's capabilities (Schieg 2008, 48) before the contract is closed.

'Moral Hazard' describes the principal's danger that the agent uses information asymmetries, that arise after the contract is closed, for opportunistic actions (Schieg 2008, 48) with the intention to reach their own project objectives instead of the principal's targets (Moe 1995, 133). One approach for the principal to deal with this issue is harmonization, which means that Moral Hazard risks are reduced through harmonizing project objectives between the two parties (Schieg 2008, 48). A second approach is 'monitoring', where the principal uses control systems to gain knowledge about the agent's information and actions (Schieg 2008, 48).

'Hold-up' describes the principal's danger that the agent could hold information back until the principal makes decisions and that the agent uses these information against the principal after

these decisions are made (Schieg 2008, 48). To deal with hold-up issues, the principal can try to arrange verifiable contracts, that reduce this risk (Schieg 2008, 48). Another way is to create relationships, which are characterised by mutual dependencies through mutual long-term objectives that motivate the agent to act cooperative (Schieg 2008, 48).

In construction projects, the principals use cost- and production controlling meetings as a monitoring approach to deal with Moral Hazards. These meetings take for instance place during the construction phases (Doloi 2013, 271) and next to the monitoring, it is mostly focused on managing unexpected changes, rather than verifying the conducted work (Ballard 2000, 2-6). Checking whether the planning is met, however, is necessary as construction projects are rarely proceeding as planned (Mubarak 2015, 156; Kochendörfer et al. 2018, 175). Others name it even 'naive' to think that activities are performed according their planning (Johnston and Brennan 1996, 368). Common reasons for interruptions that affect the planned processes are late design changes or delayed choices from CLs about the final designs and utilization concepts (VDI 2019, 9, 77). If the planned operations get disrupted by any reason, the planned system collapses (Ballard 2000, 1-2) which leads to a chain reaction, concerning also the other stakeholders (Ballard and Howell 1994, 2). According to Kenley (2005, 248), one drawback of CPM is that CPM's logic is activity based, rather than resource based. The drawback of activity based planning is that it does not consider the continuous utilization of work crews to achieve work flow (Kenley 2005, 248). For economic reasons, contractors need to ensure the staff's utilization and if the processes on one site get disturbed, they might take their staff to other construction sites. As a consequence, that staff might not be directly available when needed again, or they start working at areas 'out-of-sequence'. Both scenarios disturb the planned schedule, lead to chaos on site (Kenley 2005, 250) and unintentional adjustments of the schedule during the construction phase (Doloi 2013, 271).

Monitoring and updating progress are therefore seen as one of the most important project management tools (Doloi 2013, 271 - 272). Frequent progress meetings are usually held for this purpose (Foley and Macmillan 2005, 23), where all parties meet (Gorse and Emmitt 2009, 983). Who is present at the meeting is dependent on the decision of the person inviting, who structures usually the meeting through an agenda (Gorse and Emmitt 2009, 983). The purpose of progress meetings is that information is shared, resources are coordinated, the construction progress is monitored and issues and disputed are, if possible, solved (Gorse and Emmitt 2003, 234). By means of progress meetings, the different stakeholders share information on a regular basis, discussions between the participants are enabled and decision making is facilitated (Gorse and Emmitt 2009, 983).

Such interactions between the project members can be subdivided into social- and task-based interactions (Gorse and Emmitt 2007, 1197). The social interactions form the relationships, and thus the culture, between the parties (Gorse and Emmitt 2007, 1197). Effective interaction among all participants is crucial for interdisciplinary teamwork (Foley and Macmillan 2005, 34), the development of relationships and the ability of the group to manage project outcomes (Gorse and Emmitt 2009, 990).

2.3.2 Lean Production and the Last Planner® System of Production Control

Dynamic influences and their negative effects on the project outcomes are often underestimated and project management approaches must be appropriate to face these conditions more successful than conventional methods. Scholars argue that the traditional approaches (like CPM) are no longer suitable to face the current circumstances of increasing complexity (Hertogh and Westerveld 2010, 171; Sohi et al. 2016, 253) and that communication technologies and knowledge management get more and more important (Bosch-Rekveldt 2011, 15). Lean Management and Agile project management approaches are recommended to handle the increased project's complexity (Sohi et al. 2016, 258).

Lean Management or Lean production has its roots in the automotive industry. After World War I, especially the car industry moved industrial production from the age of craft production towards mass production (Womack et al. 1990, 9). The focus was on creating competitive advantage through scale and efficiency (Krafcik 1988, 42) and the reduction of fixed costs per product through a high assembled number of products in a possibly short time frame (Grant and Jordan 2015, 50, 132 ff.). Big batches of similar products with few variations led to high inventories with possibly repetitive errors and high carrying costs (Womack et al. 1990, 51 - 52; Ohno 2013, 34). The focus was on continuous production without stopping the assembly lines (Womack et al. 1990, 55). If error occurred, they were, if possible, rectified in a later rework area. The tasks for the line workers were predetermined, simple and repetitive (Womack et al. 1990, 54). After World War II, Toyota recognised the increasing global competition, reviewed the established mass production techniques and developed an alternative production philosophy to gain competing advantage that "Changed the World" to quote the famous title of Womack et al. (1990). "Lean Production" is their neologism on the Toyota Production System. It has evolved through observations and improvements of the mass production approach. It focuses on the individual customer's satisfaction and individual needs and the continuous reduction of waste (Liker and Morgan 2006, 5 ff.). Waste is defined as everything which does

not directly add value to the final outcome of the production, and therefore is not necessary for customer's satisfaction (VDI 2019, 9 - 10).

Figure 23 of Liker and Morgan (2006, 7) uses the metaphor of a house to visualise Lean Production's essential characteristics. This metaphor is common (see for example Liker 2004, 32; Liker and Morgan 2006, 7; Bicheno and Holweg 2009, 17) since Toyota started to name some ingredients as 'pillars' of the system (Ohno 2013, 37). It was chosen as a suitable metaphor as its main ingredients: the roof, the pillars and the foundations form together a stable system, where these ingredients are dependent of each other and only together ensure only a stable system (Liker 2004, 32).

Figure 23 - Toyota Production System House
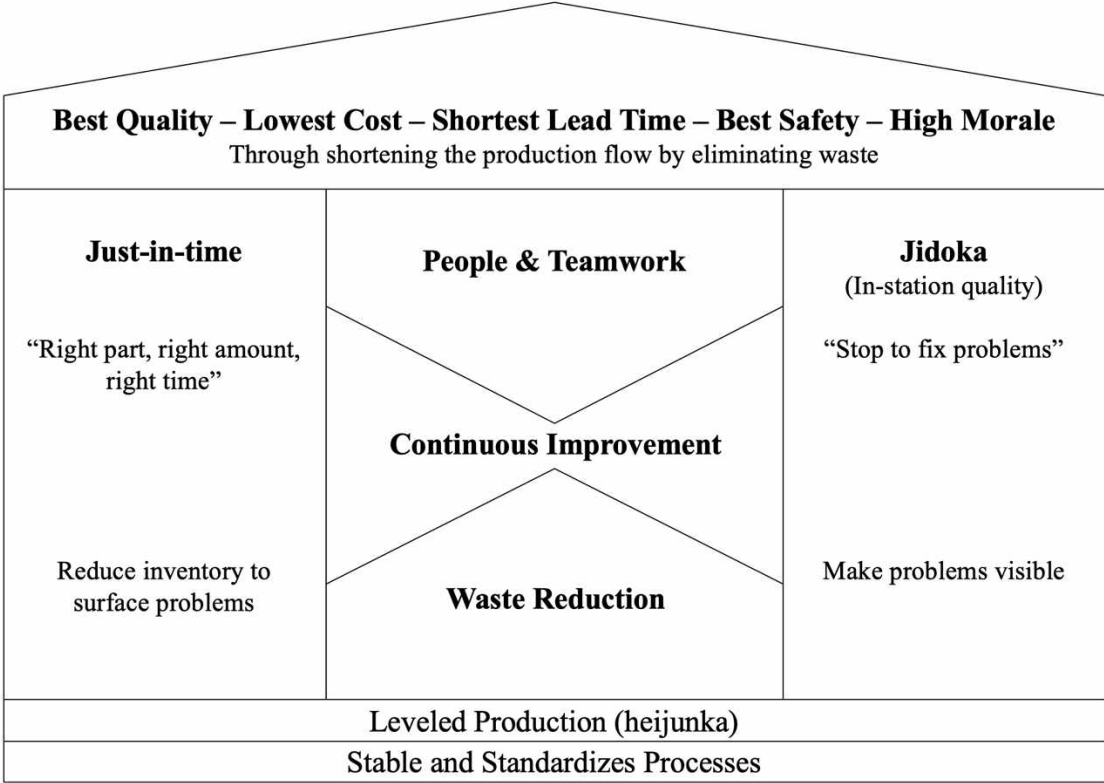
Source: Liker and Morgan (2006, 7)

The roof represents the targets, or the "True North" (Rother 2010, 45; Zollondz 2013, 207) of the system which are seen as desired conditions (Trent 2008, 3 ff.) and as a strategical vision (Rother 2010, 45). Rother (2010, 45) refines this vision more measurable with the targets of zero defects, 100% added value (so production without any waste), which is accomplished through an one-piece flow and a high level of security for all employees.

These targets are realised through the underlying pillars 'Just-in-time' and 'Jidoka'. Just-in-time means the use of the right part (or other resource) and the right amount to the right time

(Liker and Morgan 2006, 7). The other pillar, 'Jidoka', represents the philosophy to enable everybody to stop production if problems occur and to fix the origin of the problem to prevent repetition. This is a large contrast to the mass production's philosophy of continuous production without stopping the production progresses. Stopping production if errors occur or if production improvements are possible is what the Lean Production philosophy intends (Womack et al. 1990, 55).

In the centre of the house is the 'Continuous Improvement' philosophy, which is enabled through 'People & Teamwork', and 'Waste Reduction'. This focus on the connection between people, teamwork, continuous improvement and waste reduction is based on the assumption that continuous improvement and waste reduction are possible through the involvement of members of all hierarchies and the use of their specific knowledge (Liker and Morgan 2006, 6; Rother 2010, 175 ff.; Schwarz and Lindner 2016, 6). During the development of Lean production, the following types of waste were identified: (1) overproduction, (2) wasting times, (3) transport, (4) waste of processing, (5) stocks, (6) motions, (7) faulty products (Liker 2004, 28 - 29; Ohno 2013, 54) and (8) unused employee creativity (Liker 2004, 28 - 29). Even if these types of waste were originally defined in mass production processes, they can similarly be found in the construction industry (VDI 2019, 12).

The House is founded on Levelled Production and Stabile and Standardized Processes. The levelled production is the attempt to avoid production peaks and valleys to keep the number of employees constant (Womack et al. 1990, 154) and to establish through this a save working environment with high morale.

The adaption of Lean Production to the construction industry's circumstances and particularities, such as one-of-a-kind production, site production, temporary multi-organization, and intervention of regulatory authorities (Koskela 1992, 49) is called 'Lean Construction' (Fiedler 2018, XV). The "Last Planner® System of Production Control" (Ballard 2000, 3-1), or in short "Last Planner System" (LPS) (Ballard 2000, 3-1) is the most common Lean Construction practice (Babalola et al. 2019, 37; Poudel et al. 2020, 3) (see Figure 3) that follows the Lean Construction philosophy.

LPS is a an active, regular, integrative, cooperative (VDI 2019, 78) and pro-active (Mossman 2015, 5) planning and controlling process (Ballard and Howell 2003b, 9) with the focus on the

management of relationships and collaboration at the lowest possible hierarchical level (Mossman 2015, 2).

The 'Last Planner' is preferably the last person in the value chain. The role of the Last Planner is usually executed by a foreman or site manager of the appropriate trade or for planning tasks or the specialist planner or team leader of a discipline (Ballard and Howell 2003b, 4; Fernandez-Solis et al. 2013, 354; VDI 2019, 77). Note that it should be the appropriate craftworker that carries out the production or planning processes. LPS's idea is that these last planners must be involved in the planning and reviewing processes as they are the persons that can determine most precisely what can be actually done as they have the most accurate information for specific work packages, the working conditions and actual issues (Ballard and Howell 1994, 3 ff.). The understanding of LPS is that only the Last Planners can plan and commit to the needed processes that "will" be done" and assess if the work that "should" be done, actually "can" be done (Ballard and Howell 1994, 5). The Last Planners define and check the requirements that enable them to begin with their specific tasks. The order of planning is conducted backwards, so from the final milestone (the project completion) towards the beginning of the project (Jin 2013, 1788; Davidson 2015, 7), as the last planner from the last trade of a value chain first defines all necessary starting conditions (Frandson and Tommelein 2015, 176). This approach is called 'Pull Scheduling' (Ballard and Howell 2003b, 9).

In LPS, the work packages get usually visualized through sticky notes in different colours, whereas one colour represents one discipline. These various sticky notes are taped on scheduling walls (Ballard and Howell 2003b, 9). The Last-Planners place their work packages on sticky notes on the schedule walls and coordinate and discuss them with the other Last-Planners, guided by a facilitator (VDI 2019, 78). Figure 24 shows a Last Planner planning his next work packages.

Figure 24 - A Last Planner planning his upcoming work packages
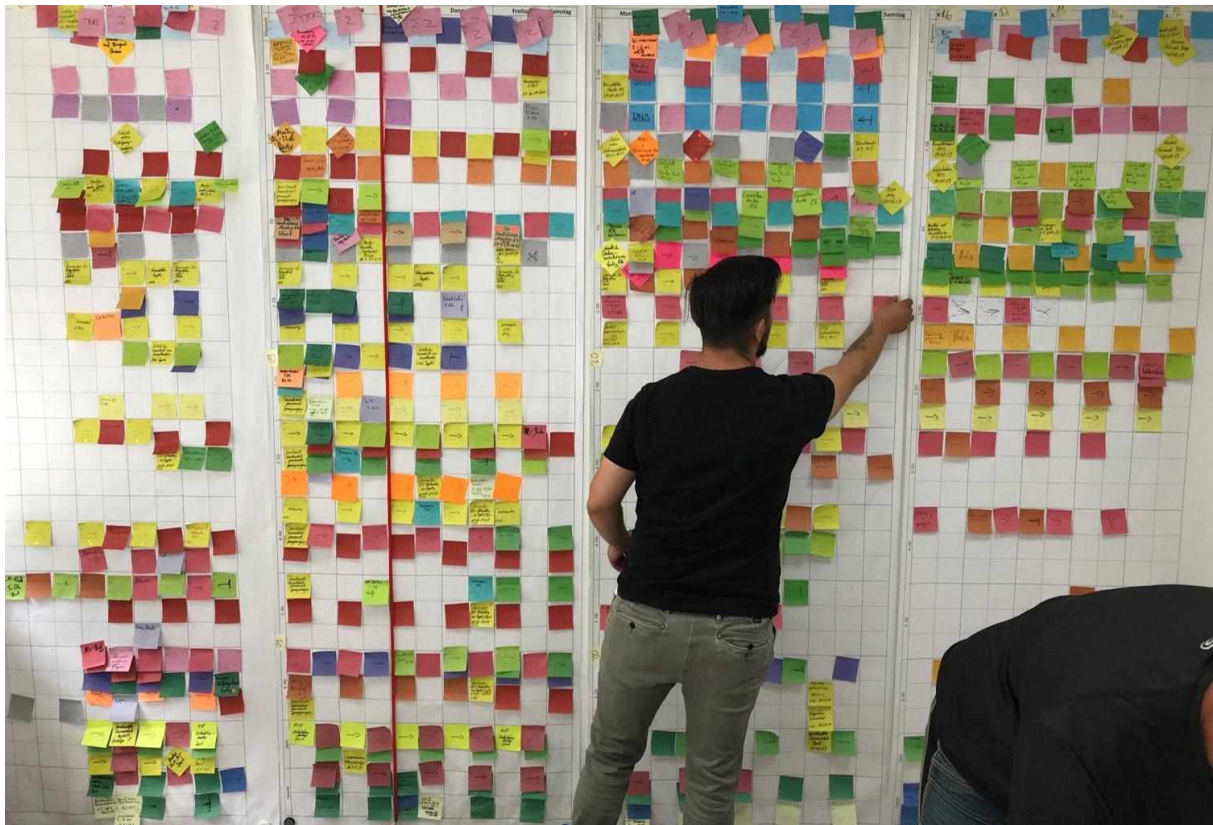
(Photo by author)

To plan the upcoming tasks, the project is divided into various scheduling hierarchies with different levels of detail whereas the preciseness gets refined at each level, as the time gets closer to the start of the task (Frandson and Tommelein 2015, 175 - 176). These hierarchies are, from coarse to fine: (1) the master schedule, (2) look ahead schedule and (3) weekly work plan (Jin 2013, 1788 ff.).

The master schedule (1) covers the entire project and usually only contains the milestones. These are planned according to the pull-planning approach backwards, from the last one (the project completion) towards the beginning of the project (Jin 2013, 1788). Instead of master schedule, some sources name phase schedules that describe the work packages between the single milestones as the starting point (i.e. Ballard and Howell 2003b, 9; Frandson and Tommelein 2015, 176).

The look ahead schedule (2) includes the various work packages that need to be completed to realise the milestones of the master schedule. The scope of the look ahead schedule is usually between six and eight weeks (Jin 2013, 1788 ff.).

The weekly work plan (3) is the schedule for the next week and includes all upcoming tasks. All necessary resources for these tasks must be available and all obstacles must be eliminated

to enable the upcoming tasks (Jin 2013, 1779). The weekly work plan meeting is also used to reflect on the past week and to learn through the mismatches between the planned- and the actual conducted tasks, to prevent repetition of failures (Ballard and Howell 2003b, 7). It is discussed and checked whether the entire planned work for that week is either done, or not done. The motivation for the strict definition, without percentages of how much of the planned work is done, is that the next "customer" needs all necessary starting criteria to conduct his work without barriers or restrictions (Frandson and Tommelein 2015, 176). Determining the reasons for failures is used for developing improvements (VDI 2019, 79) and to prevent the repetition of failures.

According to Davidson (2015, 7), other ingredients of LPS are 'daily huddles' where the weekly work plan gets controlled on a daily basis, a statistic called 'Percent Plan Complete' (PPC) which expresses the percentage distribution of the amount of commitments that got fulfilled respectively not fulfilled in the last week and an evaluation chart of the reasons for not fulfilling the planned tasks that help to focus on improvements. Through the implementation of LPS, the PPC score can get raised from 30 - 60%, which is the common number of construction projects with conventional conducted project management approaches, to over 70% or even 80% (Ballard 1999, 276; Jin 2013, 1780).

Next to this improved reliability of statements that are attributed to the system's implementation, some other benefits are a smooth workflow, reduced costs, reduced time of project delivery, improved productivity, and the collaboration with field personnel (Fernandez-Solis et al. 2013, 359).

Lean Production's origin becomes apparent in different aspect's from LPS. Starting with the centre of Figure 23 ('People & Teamwork', 'Continuous Improvement' and 'Waste Reduction'), the most noticeable match is the involvement of the Last Planners in the reviewing, planning and controlling process. As the aim is to jointly perform these three tasks, the desired teamwork of all participating people is clear. Through the structured reflection of the past fulfilled- or not fulfilled work packages and the evaluation of reasons for issues to avoid their repetition, LPS strives for continuous improvement and the reduction of waste.

The intrinsic and economic motivation of the Last Planners to level the work forces' workload to avoid utilization peaks covers Figure 23's part of the foundation 'Levelled Production (heijunka)'. Similarly, the stability of processes is intrinsically met. The standardisation of processes, however, seems not covered explicitly by LPS.

The pillars from Figure 23 'Just-in-time' and 'Jidoka' can be recognised in the pull planning processes as they lead towards clearly defined necessary starting conditions and the direct connection of work packages without waiting times. The weekly schedule updates support this process as all current information can continuously be included in the schedule.

If LPS would lead towards the strive for the roof 'Best Quality – Lowest Cost – Shortest Lead Time – Best Safety – High Morale'' of Figure 23 can be challenged. The reasons for this critical consideration are the named individual and conflicting interests between the participating parties that hinder collaboration (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1; Akintan and Morledge 2013, 1). Even if 'collaboration' is often named in the context of LPS (Aslesen and Bertelsen 2008, 333; Porwal et al. 2010, 549; Fauchier and Alves 2013, 559; Mossman 2015, 2) and it seems to be implemented through the joint reviewing, planning and controlling processes, it cannot be guaranteed that all last planners share all available information and indeed strive for common project goals as the named ingredients of Figure 23's roof. This is especially true if the contracts are not designed for collaboration (Fernandez-Solis et al. 2013, 359).

2.4 Discussion

The literature review has shown project culture's complexity, with different individual cultural layers and influences that continuously affect each other. Partnering was portrayed as a management approach, and as such as an intended culture, based on the strategical motivation of creating an environment which is characterised cooperation, collaboration, or coalescence, enabled through mutual understanding about the individual situations and mutual trust between all participating parties. LPS was presented as a planning approach which focuses on joint reviewing and scheduling processes with all project members. As such, it is a Lean Construction practice that aims, as partnering, to improve construction effectiveness through collaboration between the stakeholders.

Both approaches, LPS and partnering, seem to be desirable at first glance, as successful collaboration is described as a state where everybody can win (Harback et al. 1994, 23). Nevertheless, the literature review has shown that there are also issues in implementing both approaches. One issue is the required cultural change (Chan et al. 2003, 128; Eriksson et al. 2008, 528; Viana et al. 2010, 506; Hamzeh 2011, 388) from adversarial and distrustful relationships, antagonistic behaviours (Johnston and Lawrence 1988, 98; Ng et al. 2002, 437; Beach et al. 2005, 612; Foley and Macmillan 2005, 19) and escalating relationships (Eschenbruch 2008, 4) towards cooperation, collaboration, or even coalescence as these

approaches differ from traditional behaviours, rules and processes (Eriksson et al. 2008, 534 ff.). A cultural change would be required, but such change may be a challenge. Such change may lead to a feeling of uncertainty, especially if individuals get aware of the intended change and they are persistently and partly aggressively sticking to old patterns (Lüschow 2009, 26).

According to Figure 11, LPS as a planning approach, with its mutual and interactive reviewing and scheduling processes, can be defined as a 'routine' or as a 'practise' with conspicuous 'symbols', such as the big schedules on walls and the coloured sticky notes in meeting rooms. As such, LPS impacts especially the outer layer of project culture from the framework of Hofstede et al. (2010, 8) (see Figure 11), which is easier to influence than the inner layers – the values of the individual project members. Partnering represents, as a management philosophy and with the focus on cooperation / collaboration or even coalescence, the values of the project participants, and as such the inner cultural layers.

LPS differs in terms of the communication network to traditional progress meetings in terms of communication networks, which were presented in Figure 20. Traditional progress meetings follow the contractual chains, through which the participants are forced by contractual arrangements to organise their respective activities and interfaces (Cheng et al. 2001, 62). This definition represents 'Cooperation' from the 'partnering continuum' by Thompson and Sanders (1998, 74), as visualised in Figure 21 with clear definitions of tasks, responsibilities and interfaces between the different stakeholders.

By contrast, LPS leads through its processes towards more horizontal communication between the stakeholders as everybody has to communicate interactively with the others by actively reviewing, planning and discussing the issues and tasks with the others. LPS's communication can therefore be described as a 'project joint venture' or even as a 'formal partnership' according to the communication network from (Cheng et al. 2001, 62), as presented in Figure 20. Both represent high stages in the range of collaboration in the 'partnering continuum' by Thompson and Sanders (1998, 74) which is visualised in Figure 21, with overlapping and joint planning and activities.

Interestingly, such 'project joint venture' communication networks are also used to control the other parties (Cheng et al. 2001, 62). Monitoring and controlling of others, which is executed at LPS meetings through the interactive and detailed review and planning processes, is a clear signal of distrust (Mayer et al. 1995, 712; Kadefors 2004, 177). This however seems to contrast to a partnering culture, as trust is next to mutual understanding one of its necessities (Nyström 2005, 478).

Open communication, which is aimed at with LPS, can reduce risks (Cerić 2016, 13). And if risks can be reduced to a certain level, trust can overtop the residual risk (Schoorman et al. 2007, 346). LPS's direct and open communication, within flat hierarchical structures and on the lowest possible Hierarchy level, promotes a trustful project culture (Barlow 2000, 984). And shown cooperation, for example visible through LPS's interactive review and planning processes, would improve trust reciprocity (Kadefors 2004, 177).

Summarised: applying LPS seems to come with a contradiction: the openness and resulting mutual understanding and trust on the one side, and the high level of controlling which comes along with openness and mutual understanding representing distrust on the other side.

The question arises if mutual openness is perceived as a mutual control mechanism, so a clear signal for distrust, or if the resulting improved mutual understanding leads to a higher level of mutual trust. Through LPS, and the mutual openness, the control mechanisms become reciprocal. The core question is specifically: Does LPS's openness and mutual understanding lead to a higher trust level within the project team and through this towards a more partner-like project culture?

Following the determined similarities of partnering and LPS, presented in Chapter 1.1.3 and in Figure 5, the hypothesis of this dissertation is:

LPS improves project culture under the aspects of partnering.

To test this hypothesis, the main research question and several research sub research questions were determined, as presented in Chapter 1.2. The remaining chapters present the investigations as summarized in Chapter 1.3.3.

3 MEASURING PROJECT CULTURE

Parts of this Chapter were published in Lühr and Bosch-Rekveldt (2019) and Lühr et al. (2020, 2021)

3.1 Introduction

To identify the current state and the desired organisational culture (Cameron and Quinn 2011, 28), and to fulfil a change towards the desired culture, a cultural measuring instrument is necessary (Paro and Gerolamo 2017, 585).

In particular for this dissertation, the ability of measuring project culture is necessary to define the common project culture and the intended partnering project culture in the German turnkey construction industry, and to investigate how the application of the "Last Planner® System of Production Control's" (LPS) (Ballard 2000, 3-1) impacts project culture from a traditional project culture towards a partnering culture. Under these aspects, especially the cultural levels of cooperative vs. competitive are from interests. Therefore, the sub-research question (SRQ1) which is answered in this Chapter is:

"How to measure project culture?"

Taras et al. (2009, 357, 358) identified 121 instruments to do so and almost all use multidimensional survey instruments (Taras et al. 2009, 360). The multiplicity of surveys to measure culture reflects the scholars' general interest in this topic but makes the choice for the right tool also difficult. By choosing the suitable model for such a complex topic as culture is, the balance between comprehensiveness and parsimony must be respected (Taras et al. 2009, 362). The named tools differ by their numbers of dimensions; the definitions of the dimensions and by the choice for an emic or an ethic approach (Taras et al. 2009, 361 - 362).

There is only little knowledge about specific measuring instruments for project cultures (Zell 2009, 161), and especially for the field of interest from this dissertation: the partnering project culture in construction projects. Differences between the organization- and project cultures occur due to the projects' characteristics like their uniqueness, their temporal limitation and their multidisciplinary character (IPMA 2015, 27). Additionally, the unique circumstances of the construction industry must be considered, like the one of a kind production, site production, temporal multi-organization and interventions of regulatory authorities (Koskela 1992, 49).

In the next Section 3.2, the research design is presented, including a description of the data gathering instrument used. Section 3.3 shows the results of the investigations of the different cases. In Section 3.4, the survey's reliability is examined. Section 3.5 compares and discusses

the findings from the cases and compares them additionally with the 'theoretical ideal Lean culture' by Paro and Gerolamo (2015, 56) to put them in the context of Lean production. Section 3.6 presents the conclusion about the applicability of the 'Competing Values Framework' (CVF) and the 'Organizational Culture Assessment Instrument' (OCAI) by Cameron and Quinn (2011, 35 ff.) for the next steps in this PhD research.

3.2 Research design

As project culture is such a dynamic and complex (Sackmann 2009, 4) topic, a case study approach with triangulation between quantitative and qualitative data is chosen to verify the applicability of the chosen quantitative framework for project cultures instead of organizational cultures. Case study research is suitable as it is used to investigate questions, causal links and relationships that are too complex for single alternative methods like surveys or controlled experiments (Brookes et al. 2016, 370; Yin 2018, 18). Case study research is a qualitative research approach (Weber 2015, 97) and there are different methods available at case study research to gather data: documents; archival records; interviews; direct observations; participant-observations and physical artefacts (Yin 2018, 110 ff.). Yin (2018, 129) merges structured interviews with survey whereas other authors name explicit surveys (Gable 1994, 112 ff.).

3.2.1 Selection of cases and participants

Three cases with overall 21 participants with different functions, like foremen, site manager, site manager, designer and invest-manager technique, were chosen as a multiple case study approach which allows to identify similarities and variations between the cases (Maylor et al. 2017, 208). The selected cases differ in multiple ways in terms of team size, the stakeholder types and the construction activities. These variations allow to obtain information about a phenomenon within various circumstances in the individual contemporary circumstances of the cases and therefore enhance the generalizability of this study's results (Flyvberg 2006, 34; Yin 2018, 15). Three months of minimum involvement time in the projects was defined as minimum duration time for all participants as Hofstede et al. (2010, 385) named especially for short assignments, as projects are by definition, an experience time of three months for the acculturation processes.

3.2.2 Quantitative data: CVF and OCAI

One of the most common frameworks for measuring organizational culture (Yu and Wu 2009, 37; Cameron and Quinn 2011, 27; Ferreira 2014, 87) is the CVF by Cameron and Quinn (2011, 35 ff.), which was already described in Chapter 2 and shown in Figure 13. As this framework

is the most common, and as it distinguishes on one axis cultural values (see Figure 11), and specifically between competition, which represents traditional project cultures, and collaboration, which represents features from partnering, it seems to be best fitting for measuring LPS's impact on project culture.

Because especially competition and collaboration are the topics of interest in this dissertation, the expressions on the framework's Clan-Market axis can be interesting, given that the Clan-quadrant is associated with trust (Cameron and Quinn 2011, 31, 32) as one of the necessities of partnering (Nyström 2005, 478). Since presented literature has shown that the construction industry is characterized by distrust (Johnston and Lawrence 1988, 98; Beach et al. 2005, 615) and the CVF describes cultural characteristics through competing poles, it is assumed that high scores in the Market quadrant represent a high level of distrust. This goes along with a global study about the construction industry's culture which indeed shows that this culture is dominated by features from the Market-quadrant (Cameron and Quinn 2011, 90), see Figure 15.

The OCAI is standardised, but little adjustments had to be conducted to adjust it for project circumstances, instead of organisational circumstances. The wording was changed from organisations towards project organisations and the applied survey is shown in ANNEX A.

The global construction culture by Cameron and Quinn (2011, 90), as presented in Figure 15, will be used as a reference point and the results from the three cases will be compared to that global culture to investigate if there are significant differences between the global construction industry's culture and the Cases' cultures in the German environment.

To evaluate the data, a mean score for each axis is calculated and its position is determined. To interpret the position, each axis in the OCAI is evenly divided in three sections (Clan / Balanced / Market respectively Hierarchy / Balanced / Adhocracy). To interpret the cultures according to this distribution, the framework is divided as following:

100 points must be divided over the four quadrants with two axes. Each axis gets 50 points. Then, each axis was divided by three respectively each side of the axis from 0 to 1/3 * 25 is equivalent to a balanced evaluation and scores of the mean above 1/3 * 25 represent a score that represents pronounced characteristics of this side of the axis. This division is visualised in Figure 25.

The corresponding formulas for the Clan-Market axis are:

$$Mean_{C-M} = -Market + \frac{|Market| + |Clan|}{2}$$

Distribution:

$$Mean_{C-M} < -\frac{25}{3} \triangleq Market$$

$$-\frac{25}{3} < Mean_{C-M} < \frac{25}{3} \triangleq Balanced$$

$$Mean_{C-M} > +\frac{25}{3} \triangleq Clan$$

The corresponding formulas for the Hierarchy-Adhocracy axis are:

$$Mean_{H-A} = -Hierarchy + \frac{|Hierarchy| + |Adhocracy|}{2}$$

Distribution:

$$Mean_{H-A} < -\frac{25}{3} \triangleq Hierarchy$$

$$-\frac{25}{3} < Mean_{H-A} < \frac{25}{3} \triangleq Balanced$$

$$Mean_{H-A} > +\frac{25}{3} \triangleq Adhocracy$$

If the mean score on one axis is in the range between zero and the balance-line, it is interpreted as balanced. Even if the mean score is evaluated as balanced, there might be a slightly dominant and a remarkable characteristic from the other side of the axis. If this is the case, it will be described accordingly. If the mean score is between the balance-line and the mean-line, it is interpreted as dominant by the respective side of the axis.

Figure 25 - Division of the CVF to interpret the mean scores for each axis
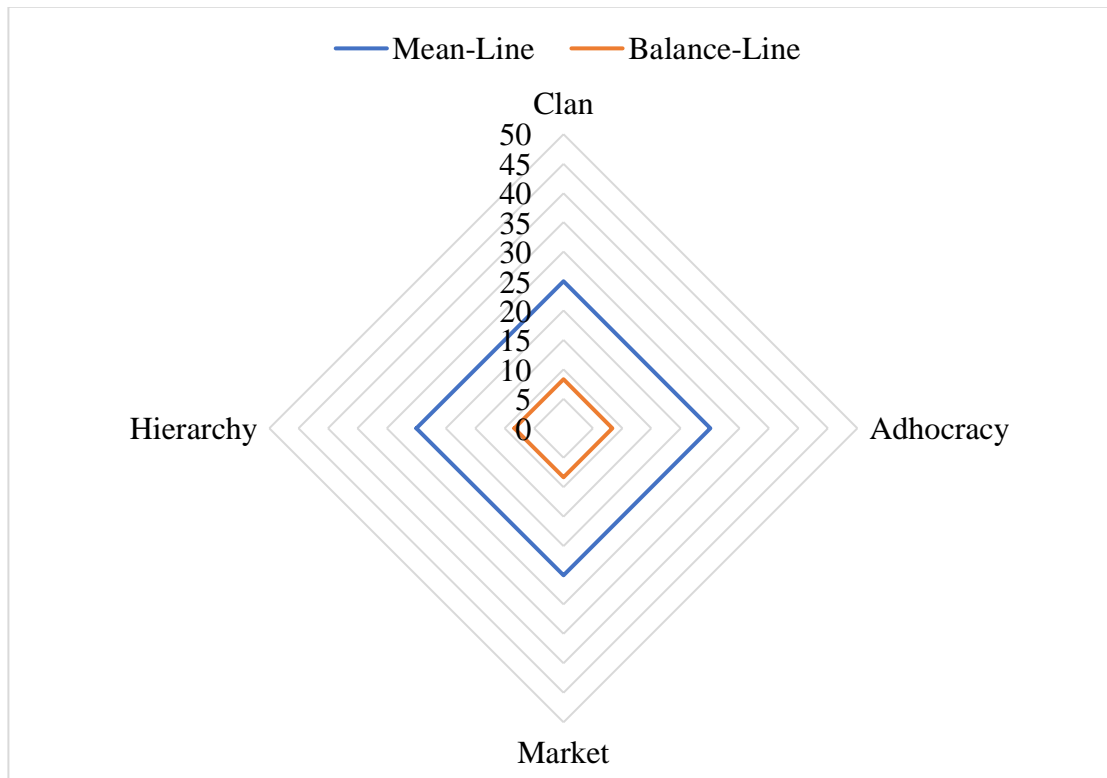
3.2.3 Qualitative data: Observations

One drawback of quantitative survey research is that its results only provide a 'snapshot' of the actual situation (Gable 1994, 113). So, the outcomes must be put in the temporal context. This is especially true for culture, which is continuously changing. Therefore, additionally, observations and open interviews were conducted over several weeks to get a deeper understanding about the contemporary situation and the circumstances of the survey (Yin 2018, 15). At the time of the case studies, the author of this dissertation was responsible to implement LPS for the MC. This included facilitation of the appropriate meetings, which enabled the data gathering processes. The triangulation between the analysis of respondents input, the results of the OCAI, and the participating observations allow to gain insights about systematic interdependencies (Weber 2015, 97).

3.3 Results

3.3.1 Project culture Case 1

The first project is the construction of an office building with parts of a historical façade and high-grade rental area for office areas and gastronomy. The CL has divided the project into two contracts with two different contractors: one for the reinforced concrete construction activities and one for the technical building equipment and the interior work (which is a joint venture of

two organizations). The participating stakeholders at the regular LPS meetings are the CL (investment managers technique), the contractor for the reinforced concrete construction activities (mostly one senior site manager and one site manager), the joint venture for technical building equipment- and interior work (various site managers and foremen), various specialist planners (commissioned by the CL) and various SCs (site-managers and foremen - commissioned by the joint venture).

At the time of the survey, the project was in the late construction phase of the reinforced concrete construction activities and in the early construction phase of the technical equipment- and interior work. The detailed design was not finished for all disciplines because not all areas were already rent and the final use could not be defined. The LPS has been implemented for about four months and the current PPC was 83%, much higher than scores from usual construction projects (50%) and relatively high, but comparable (70-80%), in contrast to other projects that apply LPS (Ballard 1999, 276; Jin 2013, 1780).

Table 3 shows the results from the OCAI and Figure 26 visualises them in the CVF.

Table 3 - OCAI results Case 1 and global construction culture

	Case 1	Global construction industry (Cameron and Quinn 2011, 90)
Clan	28.1	22.0
Market	28.3	37.0
$Mean_{C-M}$	-0.1	-7.5
Evaluation	Balanced	Balanced
Hierarchy	27.9	23.0
Adhocracy	15.7	18.0
$Mean_{H-A}$	-6.1	-2.5
Evaluation	Balanced	Balanced

Figure 26 - CVF Case 1
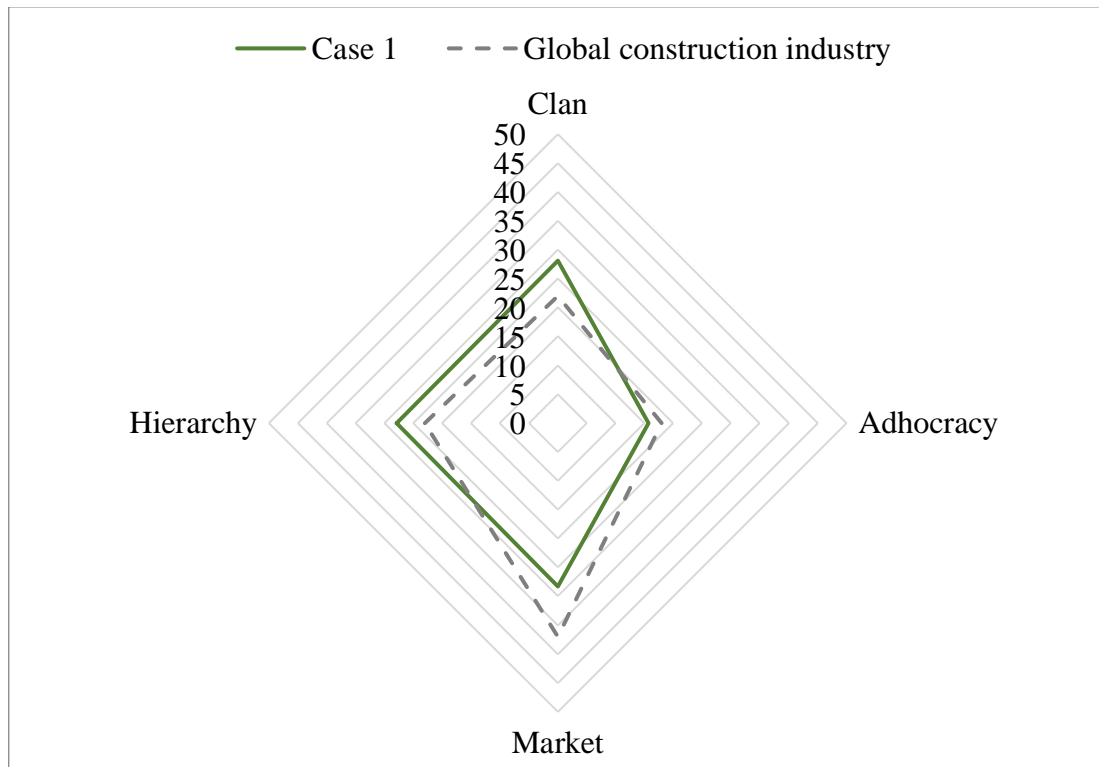
The Clan- and the Market sectors are evenly divided. The Hierarchy sector is more pronounced than the Adhocracy quadrant.

In comparison to the global construction culture, Case 1's project culture is less characterised by features from the Market quadrant and more pronounced by the features from the Clan quadrant. Thus, is it more cooperative and less competitive. This fits also to interviews and observations, that have shown that the participants see LPS as a team building activity and that it has increased the feeling of trust, especially within the joint venture in comparison to the early project phases, where LPS was not implemented.

Looking at the Hierarchy-Adhocracy axis, Case 1's project culture is more pronounced by hierarchical features than the global construction culture, so more through clearer responsibilities and processes. The participants report that particularly the detailed scheduling of the processes during LPS meetings helps to structure their tasks, as it is continuously discussed which tasks and areas are finally planned and which are still in the planning phases.

The pronunciation from the Adhocracy quadrant is very similar to the global construction industry and represents a project culture with few creative and spontaneous features. This is striking as the project team struggled at the time of data gathering with uncertainties as the

designs for various areas were not finished and the project team had to continuously change the production strategy and the schedule.

Some weeks after the survey was conducted, the CL had decided that he and his specialist planners would not anymore participate at LPS meetings. His explanation was that their participation was no longer necessary. The joint venture's interpretation of this decision hinted at contractual reasons as a result of unclearness of the later use, hence tactically motivating the non-participation at LPS meetings. This change affected the project culture noticeably and it became obviously more competitive and less trustful between all stakeholders, even within the joint venture. Unfortunately, the project participants did not agree to measure the project culture once again.

3.3.2 Project culture Case 2

Case 2 is a construction project, which is still in its design and engineering phase. The participants in LPS meetings are the CL, various specialist planners and the design manager of the MC. The system has been implemented three months and the current PPC is 51%, which is similar to usual construction projects, but a low score for projects applying LPS (Ballard 1999, 276; Jin 2013, 1780). Four of the specialist planners from different companies participated in the survey to measure the project culture.

Table 4 shows the results from the OCAI and Figure 27 visualises them in the CVF.

The Clan – Market axis shows that the project culture is pronounced by features from the Market quadrant and few characteristics from the Clan quadrant. Thus, the project culture is competitive and less cooperative. The distribution of the Market- and the Clan quadrant from the survey is similar to the observations from LPS meetings and the arrangements outside the meetings – a lack of collaboration between the various stakeholders and an assumed focus on other projects than on this case. The designers report that the root for these conditions is that they are already contracted for a long period, and that continuous changes from the CL led to many uncertainties and to issues to keep track on the singular responsibilities. Through this, each trade tries to protect their single interests instead of striving for common project objectives. As PPC tracks the reliability of the statements about the different stakeholders' interfaces that were made, and expresses through this the level of collaboration, the low PPC is not surprising.

Figure 27 clearly shows that the project culture is conspicuously pronounced by features from the Hierarchy quadrant, so especially by clear responsibilities and structures and a hierarchical leadership style, also in contrast to the global construction industry's culture. This goes along with observations and the results of interviews that have shown that especially the design

manager from the MC, who coordinates the different designers, defines highly structured procedures and ensures through written correspondence and continuous calls that the processes are adhered. This hierarchical and clearly structured environment goes along with few cooperative behaviours, as the design manager attempts to lead the necessary cooperation and to coordinate the different interfaces through this clearly structured and continuously controlled environment.

The opposite Adhocracy quadrant shows little lower scores than the global construction culture. Nevertheless, a bigger gap could have been expected with such a highly pronounced Hierarchy focus.

Table 4 - OCAI results Case 2 and global construction culture

	Case 2	Global construction industry (Cameron and Quinn 2011, 90)
Clan	12.4	22.0
Market	32.4	37.0
$Mean_{C-M}$	-10.0	-7.5
Evaluation	Market	Balanced
Hierarchy	40.5	23.0
Adhocracy	14.7	18.0
$Mean_{H-A}$	-12.9	-2.5
Evaluation	Hierarchy	Balanced

Figure 27 - CVF Case 2
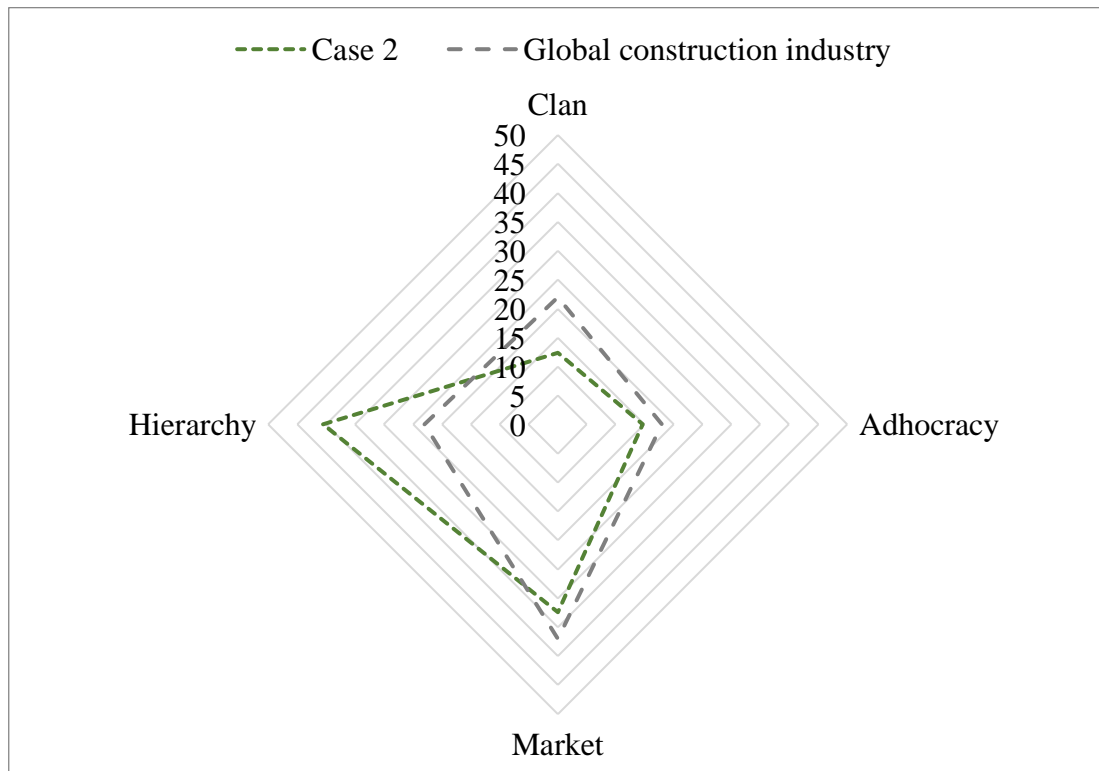
3.3.3 Project culture Case 3

Case 3 is a construction project in its early construction phase. The current activities are formwork-, reinforcement and concrete activities. The participants in the LPS meetings are the MC's foremen, one senior site manager and one junior site manager. These three persons participated in the survey to measure the project culture. LPS was implemented at this early stage because the team members did not know each other before and had significantly different pools of experiences. The system has been implemented three months before the survey. The PPC is 71% and accordingly better than at conventional construction projects (50%) not applying LPS and similar to other projects that apply LPS (70-80%) (Ballard 1999, 276; Jin 2013, 1780).

Table 5 shows the results from the OCAI and Figure 28 visualises them in the CVF.

The distribution on the Clan-Market axis is balanced and in comparison to the global study, the project culture is slightly more pronounced by cooperative, than on competitive features. This is striking as all survey's participants belong to the MC, so it could have been assumed that the results are even more pronounced by cooperative behaviours than the results from the OCAI indicate as at least the common company's objectives should be similar. However, emotional disputes during the LPS meetings have shown the team struggled to define their different

hierarchical positions, which could explain the balanced pronunciation on this axis instead of a more cooperative project culture. Nevertheless, the project team describes that the LPS meetings are helpful to discuss and clarify the individual tasks and responsibilities.

The Hierarchy-Adhocracy axis is pronounced by features from the Hierarchy quadrant. The Hierarchy score is more pronounced than the global construction culture, so the culture is more characterised by clear processes and responsibilities. The Adhocracy score is almost equal to the global construction culture. The high pronunciation of the Hierarchy quadrant can be explained as the design for the current tasks is finished. The necessity for features from the Adhocracy quadrant can be explained as the project team needs to adjusts relatively often the sequence of the building activities due to the changing reliability of resources from the SC.

Table 5 - OCAI results Case 2 and global construction culture

	Case 3	Global construction industry (Cameron and Quinn 2011, 90)
Clan	27.2	22.0
Market	26.9	37.0
$Mean_{C-M}$	0.1	-7.5
Evaluation	Balanced	Balanced
Hierarchy	30.6	23.0
Adhocracy	15.3	18.0
$Mean_{H-A}$	-7.6	-2.5
Evaluation	Balanced	Balanced

Figure 28 - CVF Case 3
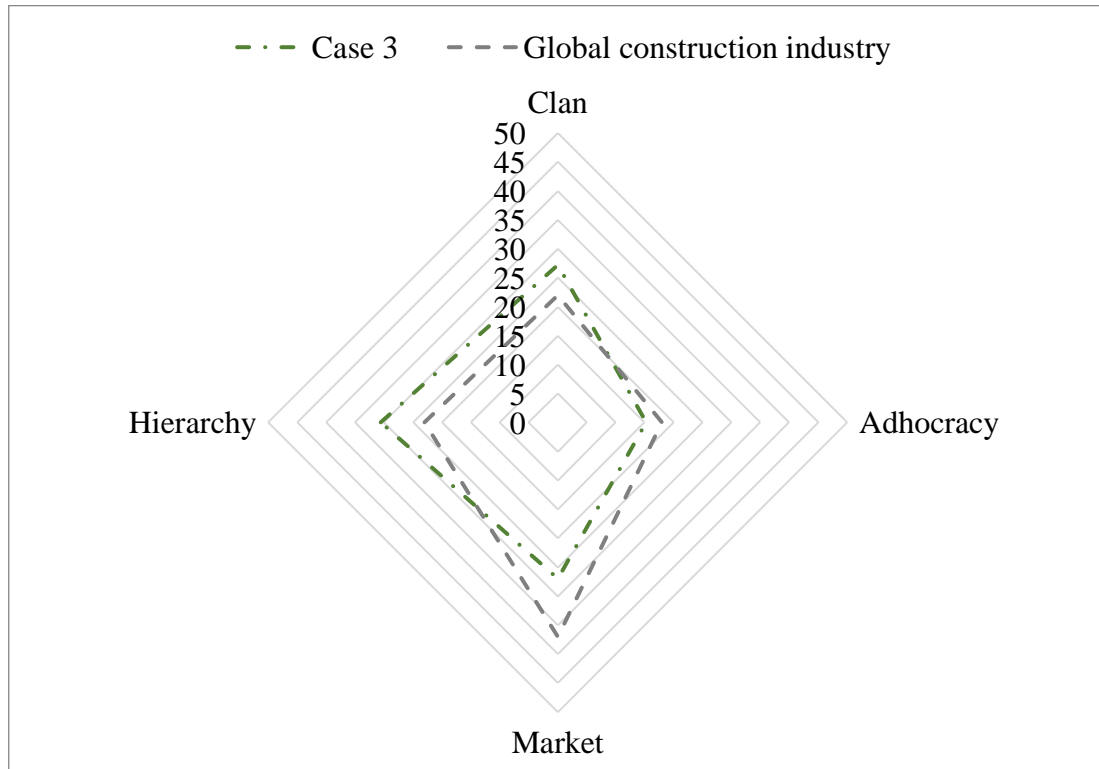
3.4 OCAI's statistical reliability

Cameron and Quinn (2011, 176) suggested checking the reliability through Cronbach's alpha coefficients to examine the correlation between the different items (Eid et al. 2017, 863). The Cronbach's alpha score should be at least 0.7 (Field 2018, 823) to confirm that the multiple items are measuring the same characteristics. Table 6 shows the coefficients of the Cronbach's alpha test from the determined survey, indicating relatively low values for Cronbach's alpha for particularly the Market quadrant.

Table 6 - OCAI's Cronbach's Alpha coefficients for Case 1-3

	Clan	Adhocracy	Market	Hierarchy
Cronbach's Alpha	0,72	0,56	0,11	0,64

Earlier studies that used the OCAI also showed mixed results: Some reported Cronbach's alpha scores above 0.7 (as Quinn and Spreitzer 1991; cited by Cameron and Quinn 2011, 176; Sandrk Nukic and Huemann 2016, 248), others calculated similar Cronbach's alpha scores as those in our study (for example Helfrich et al. 2007, 7; Strack 2012, 36). According to Strack (2012, 38), these low scores arise from the limited number of questions of the OCAI and the simplicity

of the CVF through the classification of the two dimensions and four quadrants without any sub-scales. Strack (2012, 38) argues that many other frameworks to measure and describe culture as interpersonal circumplex models use eight axes, which leads to more precise outcomes and, consequently, more reliable surveys. Despite, Strack (2012, 38 - 39) concludes that especially OCAI's and CVF's simplicity, brevity, transparency, and its imagination of cultural values on two axis are the framework's assets.

As the qualitative investigations of the three Cases could confirm the project cultures as they were measured through the OCAI, it is concluded, that the OCAI is a suitable tool to measure project culture despite its weakness regarding the survey's reliability, but that additional methods must be added to investigate project cultures more in depths.

3.5 Discussion

The presented results from the cases have shown the individual project cultures compared to the global construction industry culture. All differ in different ways and individual particularities could be explained through the background information of the cases, gathered through observations and open interviews with the project team members.

Table 7 shows the results from the OCAI and Figure 29 visualises the project cultures from the three cases and the global construction culture, and additionally the shape of the 'Theoretical ideal Lean Culture', which is based on the study from Paro and Gerolamo (2015, 56) and their interpretation of the '14 Principles of the Toyota Way' by Liker (2004, 35 ff.), which belong also to the shown framework in Figure 23. The motivation for adding and comparing the theoretical ideal Lean Culture is to put the findings in the context of Lean Production, as this is the root for Lean Construction as a management approach with the same targets, and therefore LPS.

Table 7 - OCAI results Case 1, Case 2, Case 3, global construction culture and Theoretical ideal Lean's cultures

	Case 1	Case 2	Case 3	Global construction industry (Cameron and Quinn 2011, 90)	Theoretical ideal Lean Culture (Paro and Gerolamo 2015, 56)
Clan	28.1	12.4	27.2	22.0	25.0
Market	28.3	32.4	26.9	37.0	25.0
$Mean_{C-M}$	0.1	10.0	-0.1	7.5	0.0
Evaluation	Balanced	Adhocracy	Balanced	Balanced	Balanced
Hierarchy	27.9	40.5	30.6	23.0	46.0
Adhocracy	15.7	14.7	15.3	18.0	4.0
$Mean_{H-A}$	-6.1	-12.9	-7.6	-2.5	-21.0
Evaluation	Balanced	Hierarchy	Balanced	Balanced	Hierarchy

Figure 29 - Comparing Case 1's, Case 2's, Case 3's, global construction's and Theoretical ideal Lean's cultures
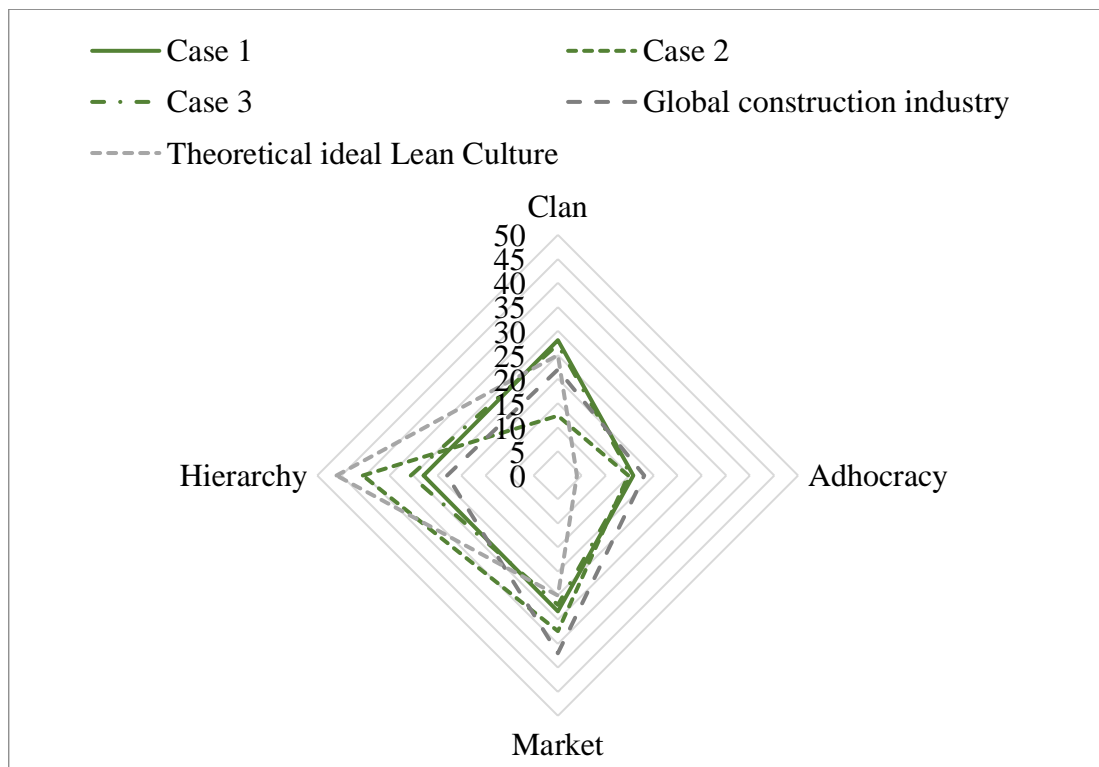
The theoretical ideal Lean culture shows balanced and medium ranked pronunciations on the Clan-Market axis. Accordingly, it is focused on internal and external interests and stakeholders. The ideal theoretical Lean Culture is pronounced by the features from the Hierarchy quadrant

and very few characteristics of the Adhocracy quadrant. Thus, it is characterised by very clear processes and responsibilities and few spontaneous and creative decisions and behaviours.

It is striking that the shape from Case 1's project culture with a PPC of 83% is nearly similar to the shape of Case 3's project culture with a PPC of 71%. The CVF's shape of Case 2 with a low PPC of 51% differs considerably to the other two cases, especially regarding the Clan- and the Hierarchy scores. On the other hand, it could be argued that with the highest PPC score of 83%, the optimum is not reached in any of the cases and that if the behaviours would be even more strictly fulfilled and the Adhocracy behaviour would be less pronounced, the PPC, and thereby the reliability of the construction processes, could be improved. Indeed, the opposing Hierarchy quadrant shows that the project cultures of Case 1 and Case 3 with relatively good PPC scores are very similar but lower than the theoretical ideal Lean Culture or the project culture from Case 2.

Both the theoretical ideal lean culture and the project culture from Case 2 show highly pronounced features from the Hierarchy quadrant, but Case 2 represents with this culture also the lowest PPC score of the three cases. Therefore, it can be suggested that a partial focus on hierarchical characteristics is not a guarantee for reliable processes. Rather, the Clan quadrant seems to be relevant. The relatively successful projects Case 1 and Case 3 correspondent in this quadrant with the theoretical ideal Lean Culture whereas the scores of Case 2 are much lower.

3.6 Conclusion

The aim of this Chapter was to investigate if the CVF is a suitable tool to measure the project cultures in construction projects under the aspects of competitive, respectively cooperative project cultures.

The similar shapes of the relatively successful LPS projects (Case 1 and Case 3) and the distinctive shape of the less successful LPS project (Case 2) suggest that there is a relation between the measured project culture and the project's success under the LPS success definition of collaboration and process reliability. This assumption needs further investigation through determining the ideal project culture under partnering aspects to investigate if the application of LPS leads towards this intended culture. It can be assumed that this definition differs to the theoretical ideal Lean Culture as it is mainly based on the theoretical definitions for Lean from the automotive industry, which might differ to the intended partnering culture, as it is not focused on partnering, but on reliable processes which is focused at line productions.

This chapter has also shown that the measurement of project cultures represents only a snapshot of the current situation within projects. Especially Case 1 has shown that the project culture is

continuously developing and that the LPS is only a method to enable best project performances when all participating parties define these equally and as long as they want to collaborate.

Regarding OCAI's reliability, Strack (2012, 39) concludes that OCAI, even with low Cronbach's alpha scores, is a practical tool due to its simplicity, applicability, and transparency with a focus on easily describing organizational culture. The main value of the framework is to measure a current state and to identify an intended culture (Strack 2012, 39). The observations and interviews of the three cases could confirm the project cultures which were measured through the OCAI. So, it is concluded, that the OCAI is a suitable tool to measure project culture despite its weakness regarding the survey's reliability. Nevertheless, this conclusion has the following implications for the upcoming Sections: For defining the common German project culture, and the theoretical intended partnering project culture under the perspectives from different stakeholder groups (Chapter 4), the OCAI will be applied and a workshop-setting with an additional group discussion will be held. Such a group discussion is a qualitative method to gain multiple data, based on the outcome of the dynamic discussion of various individual experts (Weber 2015, 100; Maylor et al. 2017, 190). For investigating LPS's impact on project culture (Chapter 5), semi-structured interviews are added to the OCAI to investigate project cultures at 'real' projects more in depth. Such interviews allow especially investigations about human affairs, actions and personal views (Yin 2018, 114, 121), which are crucial to define project culture and LPS's impact on it.

The SRQ1"How to measure project culture?" can be answered as following:

The 'Competing Values Framework' and the belonging 'Organizational Culture Assessment Instrument' are simple and suitable tools to measure and describe common project culture and intended project cultures. As they lack in terms of inner test reliability, additional qualitative methods should be added to measure various aspects of interest (as 'trust' and 'mutual understanding') more in detail.

4 THE COMMON - AND THE INTENDED PARTNERING PROJECT CULTURE

Parts of this Chapter were published in Lühr et al. (2020)

4.1 Introduction

The literature review in Chapter 2 has shown that the construction industry is known for a culture which is characterised by the focus on singular interests instead of common project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and the belonging adversarial, distrustful and antagonistic project culture (Johnston and Lawrence 1988, 98; Ng et al. 2002, 437; Beach et al. 2005, 612; Foley and Macmillan 2005, 19).

Partnering strives for a cultural change to overcome the current situation (Larson 1995, 31; Ng et al. 2002, 437; Cheung et al. 2003, 333). The management approach aims to reduce the energy on conflicts but rather spend effort in value adding activities (Bayliss et al. 2004, 253).

To fulfil the cultural change from the traditional construction project culture towards a partnering project culture, both cultures must be defined. If these two cultures are defined, academics and project managers can measure and compare their actual project cultures and put them in the context of the usual industrial project culture and the idealized partnering project culture. Furthermore, they can measure whether efforts to change project culture towards partnering are effective or not. Such definitions of the two project cultures are currently missing and this Chapter aims to close this gap. Therefore, the dissertation's sub-research question (SRQ2) which will be answered in this Chapter is:

What are the characteristics of the common project culture and the intended partnering project culture in the German turnkey construction industry?

As partnering is an approach focused on forcing cooperation among all parties toward the success of the projects (Black et al. 2000), the perspectives on project culture of different stakeholders should be included in this definition. As especially some key-stakeholders form the project culture with their individual views on project culture, they must be involved in defining the common project culture and the intended partnering project culture. Therefore, the named research question is sub-divided into the following questions to investigate the differences and similarities between the key-stakeholder groups:

- SRQ2.1: How do the key stakeholders consider the common project culture in the German turnkey construction industry?

- SRQ2.2: How does the ideal project culture for the German turnkey construction industry look like from the key stakeholders' perspectives if partnering is intended?

- SRQ2.3: Which characteristics of project culture should be changed to improve it in the direction of the defined ideal project partnering culture?

- SRQ2.4: What are the differences between the stakeholder perspectives of the actual and the desired partnering project culture?

4.2 Research Design

The key stakeholders of construction projects are as follows: (1) the Clients (CL)/investors; (2) Main Contractors (MC); (3) consultants (Doloi 2013, 627), such as Designers and Structural Engineers; and (4) (Sub-) Contractors (SC) (Hinze and Tracey 1994, 274). Three companies for each stakeholder group, all working in the German turnkey building construction industry, were invited to participate in this study. Participants were selected to include a mix of functions, such as blue-collar workers, engineers, merchants and managing directors of the appropriate discipline. This diversity is so crucial as project culture is shaped by all project members, who belong to different parties and functions and have different interests. The research was organized in workshop settings: three workshops for each stakeholder group, in each workshop only one company was present. In total 12 workshops were held with 72 participants.

A combination of quantitative and qualitative investigation was chosen to gather in depth-information about the various stakeholder's perceptions about the common project culture and intended partnering cultures.

4.2.1 Quantitative data - the Organizational Culture Assessment Instrument

First, each participant was asked to complete a quantitative survey individually. This approach was chosen to define the common project culture and the intended partnering culture in the 'Competing Values Framework' (CVF) by Cameron and Quinn (2011) after it was evaluated as suitable for this purpose in the previous research phase (see Chapter 3).

The participants were told that the focus of the research was on the cultural aspects of the common project culture and the intended partnering project culture. They were asked to quantify the characteristics of the common project culture and the desired culture in terms of partnering through the standardized questionnaire of the 'Organizational Culture Assessment Instrument' (OCAI), which belongs to the CVF, see also Section 3. The survey was translated

into German, and few wording changes were carried out to adjust the survey for projects instead of corporate organizations – see ANNEX A.

In terms of analysis, the mean scores for the common and desired culture per stakeholder group were calculated to answer SRQ2.1 and SRQ2.2. The Wilcoxon Signed Ranks test was performed in order to compare these two cultures and to answer SRQ2.3 (Eid et al. 2017, 343). Subsequently, statistically relevant differences between the stakeholder groups were investigated using the Kruskal–Wallis Test and the pairwise comparison of the relevant stakeholder groups (Eid et al. 2017, 454 - 455) to answer SRQ2.4.

To interpret the data, the same pattern was applied as described in Chapter 3. So, each axis in the OCAI is evenly divided in three sections (Clan / Balanced / Market respectively Hierarchy / Balanced / Adhocracy). Even if the mean score is evaluated as balanced, there might be a slightly dominant and remarkable characteristics from the other side of the axis and the results will be described accordingly.

4.2.2   Qualitative data - Group discussion

Thereafter, the workshop setting was used for group discussion to gain more cultural relevant information from the different stakeholders' perspectives and the German turnkey construction sector about common project cultures and intended partnering cultures. Such a group discussion is a qualitative method to gain multiple data, based on the outcome of the dynamic discussion of various individual experts (Weber 2015, 100; Maylor et al. 2017, 190). The outcomes of such group interviews are strongly subjective and attitudinal (Weber 2015, 53) and the facilitator of such a research workshop has an active role in the process of the discussion (Weber 2015, 100 ff.).

First, the participants were asked to discuss the reasons for the common cultural project conditions. Section 1.1 has shown that especially the project parties' individual and conflicting interests with those of other stakeholders (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) is one reason for the common conditions. An additional identified reason for common adversarial project cultures is the general barrier to change cultural aspects like traditional rules and processes, the shift of competences or traditional procurement procedures, the availability of resources, functioning processes or routines (Eriksson et al. 2008, 534 - 537).

Second, the motivations for partnering were discussed to validate the named Crane et al. (1997, 58) and Chan et al. (2006, 1929), see Section 2.2.

Third, the necessary ingredients of a partnering project culture were discussed to validate the framework from Nyström (2005, 478) with 'trust' and 'mutual understanding' as its necessary ingredients, see also Section 2.2.

To analyse these results, qualitative content analysis (QCA) was applied as this is suitable to analyse data in terms of cultures and their attributes in specific contexts (Krippendorff 1989, 403).

4.3 Research Results

Table 8 shows as OCAI's results the mean scores of the project culture dimensions from each stakeholder group. Each row represents the mean scores from all three stakeholder groups' workshops. These are visualized in Figure 30 - Figure 33 and described in the corresponding Subsections of this Section to answer SRQ2.1 and SRQ2.2. The global construction industry culture from Cameron and Quinn (2011, 90) is also presented in these figures to enable a comparison between the global culture, the actual German project culture, and the desired partnering culture. First, the quality of the data is investigated, followed by an explanation of the data per stakeholder group.

Table 8 - Mean scores of the common project culture and the intended partnering project culture

	Common (is)				Intended Partnering (should)			
	Clan	Adhoc.	Market	Hierarchy	Clan	Adhoc.	Market	Hierarchy
CL	19.0	19.7	36.2	25.1	30.4	23.4	21.4	24.8
MC	20.4	16.5	34.8	28.3	35.4	17.2	17.8	29.7
SC	16.1	18.1	35.9	29.9	28.6	19.6	23.3	28.5
Designer	19.8	15.3	32.8	32.2	30.5	22.4	20.1	27.0
Entire sample	18.8	17.3	34.9	29.0	31.2	20.5	20.7	27.6

To investigate the distributions of the data and to decide which further tests are appropriate to compare the results from the stakeholder groups, the Shapiro–Wilk test was conducted for all cultural dimensions and stakeholder groups, see Table 9. The results indicate that the data are not normally distributed in all categories, and this condition influences the subsequent analyses, i.e., it implies the use of the Wilcoxon Signed Ranks test and the Kruskal–Wallis test (Eid et al. 2017, 343, 454). Table 10 and Table 28 present the results of these tests.

Table 9 - Results of the Shapiro–Wilk test of normality

	Common (is)				Intended Partnering (should)			
	Clan	Adhoc.	Market	Hierarchy	Clan	Adhoc.	Market	Hierarchy
CL	0.165	0.697	0.639	0.197	0.095	0.422	0.651	0.080
MC	0.882	0.589	0.054	0.752	0.780	0.610	0.377	0.104
SC	0.261	0.232	0.512	0.882	0.008*	0.243	0.439	0.368
Designer	0.048*	0.530	0.571	0.725	0.023*	0.071	0.575	0.656
Entire sample	0.033*	0.715	0.418	0.077	0.031*	0.458	0.160	0.057

significant at the 0.05 level

The Wilcoxon Signed Ranks test was performed to investigate the significant differences between common project culture and intended partnering project cultures, using combined data from all individual stakeholder groups. Table 10 shows the results: a significant score implies a significant difference. These results are discussed per stakeholder group in the subsequent sections.

Table 10 - Results of the Wilcoxon Signed Ranks test to investigate the differences between is and should cultures from the various stakeholder groups

	Is-Clan vs. Should-Clan	Is-Adhoc. vs. Should-Adhoc.	Is-Market vs. Should-Market	Is-Hierarchy vs. Should-Hierarchy
CLs	0.000*	0.078	0.001*	0.265
MCs	0.001*	0.623	0.003*	0.538
SCs	0.000*	0.765	0.000*	0.337
Designers	0.003*	0.003*	0.001*	0.044*
Entire Sample	0.000*	0.001*	0.000*	0.090

Significant at the 0.05 level

4.3.1 The common project culture and the intended partnering project culture from the Client's perspective

The following sections show first the quantitative, and second the qualitative results, based on the three workshops with respectively one CL organisation.

The global construction industry's culture and the OCAI's results from the CL's perspective are shown in Table 11 and Figure 30 visualises them in the CVF. The CLs rate the common German project culture very similar to the global study conducted by Cameron and Quinn (2011, 90). From their perspective, the common project culture is especially is focused on competition and their own interests. This is represented by the high scores of the Market quadrant, whereas the remarkable scores of the Clan quadrant represent a certain necessary degree of cooperation, but not distinctively. The scores of the Hierarchy quadrant are higher than those of the Adhocracy quadrant, and both assessments ('common' and 'intended') are very similar to the numbers of the global study, representing a culture that is more focused on clear standards and processes and less on spontaneous and creative decisions.

The CLs define the intended partnering project culture as especially characterized by features from the Clan quadrant, with balanced features on the axis between the Adhocracy and the Hierarchy quadrants and the least characteristics from the Market quadrant. Thus, they define it as cooperative with levelled behaviours between clear roles and processes, spontaneity and creativity, and competing aspects - to a limited extent.

The results of the Wilcoxon Signed Ranks test for this stakeholder group (Table 10) show that there are no cultural changes on the Hierarchy-Adhocracy axis required; however, changes on the Market-Clan axis in the direction of the Clan quadrant are necessary if partnering is intended. Furthermore, there is a desire for more cooperation and less competition within the projects.

Table 11 - OCAI Scores Clients: Common project culture and intended partnering culture

	Common (is)	Intended (should)	Global construction industry (Cameron and Quinn 2011, 90)
Clan	19.0	30.5	22.0
Market	36.2	21.3	37.0
$Mean_{C-M}$	-8.6	4.6	-7.5
Evaluation	Market	Balanced	Balanced
Hierarchy	25.1	24.7	23.0
Adhocracy	19.7	23.5	18.0
$Mean_{H-A}$	-2.7	-0.6	-2.5
Evaluation	Balanced	Balanced	Balanced

Figure 30 - CVF CLs: Common (Is) - and intended Partnering (Should) Culture
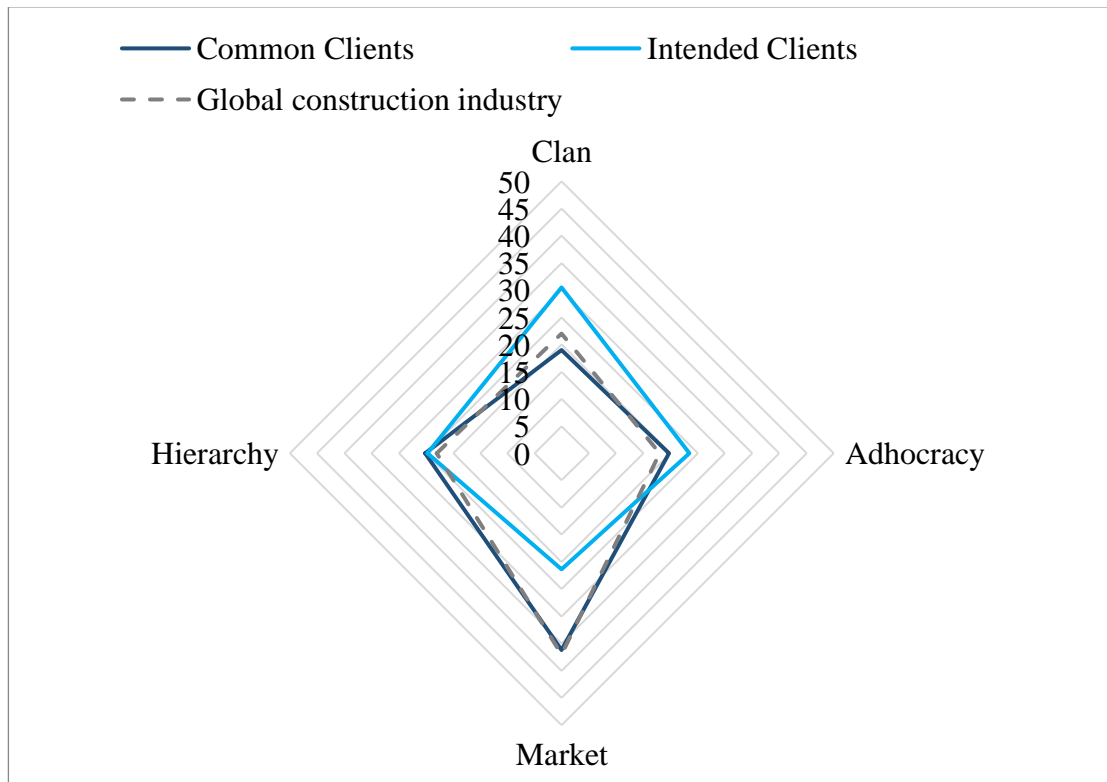
QCA results

Table 12 shows the CL's perceptions about the reasons for the common project cultures. They perceive especially different and contrary objectives, general mistrust within the construction industry and antipathy between individual project members as the reasons for the common project cultures. So, literature's main reason – the different and contrary objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and sticking on traditional cultural patterns (Eriksson et al. 2008, 534 - 537) are confirmed. In addition, the antipathy between individuals is from the Client's perspective a significant factor for adversarial behaviours within project teams.

Table 12 - Client's perceptions about the reasons for the common project cultures

Reasons for the common project cultures	Number of statements
Different and contrary project objectives	3/3
General mistrust within the construction industry	2/3
Antipathy between individuals	2/3
Continuously changing project teams	1/3
Continuously changing project cultures	1/3
Missing overview about schedule and stakeholder's interfaces	1/3
Missing understanding about the other stakeholder's interests	1/3
Culture of overregulation of technical and contractual aspects, especially in Germany	1/3
A "I stand by my word" culture is missing	1/3
Unclear structures and responsibilities	1/3
Lack of qualified work	1/3
Unrealistic schedules and too much time pressure	1/3

Table 13 shows the CL's perceptions about the motivations for partnering. They name especially better project results and more efficiency, which leads to better project results, and the opportunity for long-term relationships between the stakeholders for multiple mutual projects as reasons to strive for partnering, which confirms some aspects from literature Chan et al. (2006, 1929).

Table 13 - Client's perceptions about the motivations for Partnering

Motivations for Partnering	Number of statements
Better project results	3/3
Efficiency	3/3
Long-term relationships	2/3
Usage of the individual strengths of the different stakeholders	1/3
To make yourself and your projects attractive as a partner for projects	1/3
Early identification of issues	1/3
High motivation of own staff	1/3

Table 14 shows the necessary ingredients of a partnering culture from the CL's perspective. They name especially mutual trust, open communication, the ability to accept compromises, structured communication, the intend to have a partnering relationship from high hierarchies, clear distribution of tasks and responsibilities and mutual project objectives as necessary.

These aspects confirm the partnering framework from Nyström (2005, 478) and adds the clear distribution of tasks and responsibilities and the importance of mutual compromises and the partner-like behaviours from higher hierarchies, which was also named by (Bresnen and Marshall 2000a, 822).

Table 14 - Client's perceptions about the necessary ingredients to enable Partnering

Necessary ingredients to enable Partnering	Number of statements
Mutual trust	3/3
Open communication	3/3
Accepting compromises	2/3
Structured communication	2/3
The highest (project) hierarchies must claim and exemplify partnering	2/3
Clear distribution of tasks and responsibilities	2/3
Mutual project objectives	2/3
Fairness	1/3
Rely on the commitments of the other stakeholders	1/3
Flexibility	1/3
Creating an identification with the project for all stakeholders	1/3
Team building activities	1/3
Mutual sympathy	1/3

4.3.2 The common project culture and the intended partnering project culture from the Main Contractor's perspective

The following sections show first the quantitative, and second the qualitative results, based on the three workshops with respectively one MC organisation.

OCAI results

The global construction industry's culture and the OCAI's results from the MC's s perspective are shown in Table 15 and Figure 31 visualizes them in the CVF. The MCs rate the common project culture in terms of the Market and the Adhocracy characteristics similar to the global study. It differs in terms of the Hierarchy scores; the MCs rate Hierarchy as more pronounced than the global study does. Accordingly, they perceive that their projects are characterized by more structure and standardized behaviours than the global study describes. Fitting to the high scores of the opposite Market quadrant, the MCs rate the common features of the Clan in a very similar manner as the global study.

The intended partnering culture is strongly pronounced by the features from the Clan quadrant and with few features from the Market quadrant. The shape of the intended culture on this axis is more pronounced towards the Clan quadrant than in all other stakeholder groups. Thus, especially cooperative behaviours are intended. On the Hierarchy-Adhocracy axis, the MCs prefer more features from the Hierarchy quadrant, so clear processes and responsibilities and less creativity and unpredictability. From the Wilcoxon Signed Ranks test (Table 10), it has been shown that the MCs do not see any motivation to change project cultures on this axis, but only in terms of a cultural change on the axis Clan-Market quadrant in the direction of the Clan quadrant.

Table 15 - OCAI Scores MCs: Common project culture and intended partnering culture

	Common (is)	Intended (should)	Global construction industry (Cameron and Quinn 2011, 90)
Clan	20.4	35.4	22.0
Market	34.8	17.8	37.0
$Mean_{C-M}$	-7.2	8.8	-7.5
Evaluation	Balanced	Clan	Balanced
Hierarchy	28.3	29.7	23.0
Adhocracy	16.5	17.2	18.0
$Mean_{H-A}$	-5.9	-6.3	-2.5
Evaluation	Balanced	Balanced	Balanced

Figure 31 - CVF MCs: Common (Is) - and intended Partnering (Should) Culture
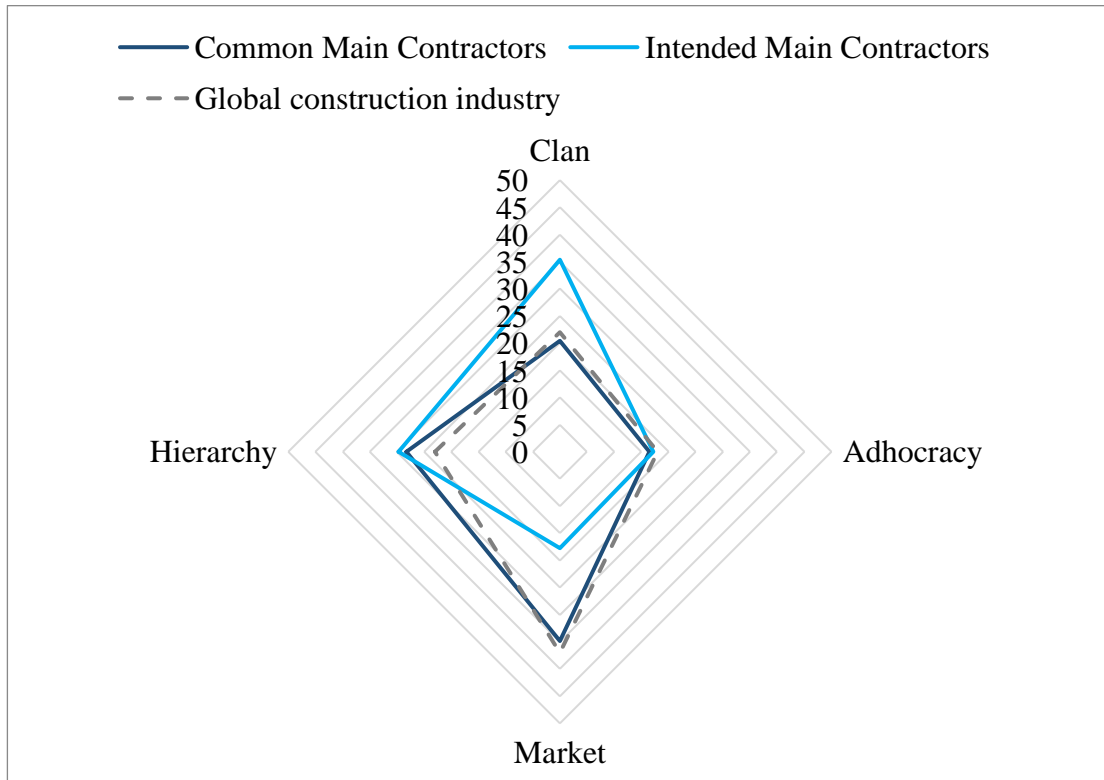
QCA results

Table 16 shows the MC's perception about the reasons for the features from the common project cultures. They name especially different and contrary project objectives, a traditional understanding of adversarial roles and antipathy between individual project members as reasons for the described competitive conditions.

So, literature's main reason – the different and contrary objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and sticking on traditional cultural patterns (Eriksson et al. 2008, 534 - 537) are confirmed and antipathy between individuals was added as a significant factor for adversarial behaviours within project teams.

Table 16 - Main Contractor's perceptions about the reasons for the common project cultures

Reasons for the common project cultures	Number of statements
Different and contrary project objectives	3/3
Traditional understanding of adversarial roles	2/3
Antipathy between individuals	2/3
Bad communication	1/3
Poor client's project management	1/3
Resistance against transparency	1/3
Unclear structures and responsibilities	1/3
Lack of qualified work	1/3
Unrealistic schedules and too much time pressure	1/3
General mistrust within the construction industry	1/3

Table 17 shows the necessary ingredients of a partnering culture from the MC's perspective. They perceive especially less stressful working conditions, better project results and efficiency, long-term relationships between the various project stakeholders as desirable, which confirms some aspects from literature Chan et al. (2006, 1929).

Table 17 - Main Contractor's perceptions about the motivations for Partnering

Motivations for Partnering	Number of statements
Less stressful working conditions	2/3
Better project results	2/3
Efficiency	2/3
Long-term relationships	2/3
Less controlling of others	1/3
Unique selling point through partner-like behaviours	1/3

Table 18 shows the necessary ingredients of a partnering culture from the MC's perspective. The MCs don't perceive mutual understanding as so necessary as the framework by Nyström

(2005, 478) presents it, but agree with the importance of mutual trust, mutual objectives and long-term relationships. Furthermore, they describe as a specific tool feedback meetings about the mutual behaviours as necessary to implement partnering.

Table 18 - Main Contractor's perceptions about the necessary ingredients to enable Partnering

Necessary ingredients to enable Partnering	Number of statements
Regular feedback meetings about the mutual behaviours	2/3
Long-term relationships	2/3
Mutual trust	2/3
Mutual project objectives	2/3
Mutual support	1/3
Cost+Fee contracts	1/3
Team building activities	1/3
Knowing and understanding the objectives of others	1/3
Allowing other stakeholders their individual project success	1/3
Early involvement of other stakeholders	1/3
Structured communication	1/3
Mutual sympathy	1/3
Forming interpersonal relationships	1/3
Clear distribution of tasks and responsibilities	1/3
Open communication	1/3

4.3.3 The common project culture and the intended partnering project culture from the (Sub-) Contractor's perspective

The following sections show first the quantitative, and second the qualitative results, based on the three workshops with respectively one SC organisation.

OCAI results

The global construction industry's culture and the OCAI's results from the SC's perspective are shown in Table 19 and Figure 32 visualises them in the CVF. The SCs perceive the common

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project culture in terms of the features from the Market and the Adhocracy quadrants very similar to the global study. In terms of the features from the Hierarchy quadrant, their perception is that the projects are more characterized by clear processes and standards. In terms of cooperative behaviours, represented by the Clan quadrant, their perception is that these features are less pronounced than those described in the global study.

Their definition of an ideal partnering culture is especially pronounced by the features from the Clan and the Hierarchy quadrants. So, they intend a culture that is characterized by cooperation, clear procedures, and strict planning. The SCs show a desire for medium waged behaviours from the Market quadrant, thus an appreciable sense for competition, and only some characteristics like flexibility from the Adhocracy quadrant.

The SCs do not see reasons to change the cultural aspects on the Hierarchy and Adhocracy axis to improve the culture in a partner-like way, as shown in the results of the Wilcoxon Signed Ranks Test in Table 10. As the other stakeholder groups, they see the Clan-Market axis as the necessary direction for a cultural change.

Table 19 - OCAI Scores (Sub-) Contractors: Common project culture and intended partnering culture

	Common (is)	Intended (should)	Global construction industry (Cameron and Quinn 2011, 90)
Clan	16.1	28.7	22.0
Market	35.9	23.3	37.0
$Mean_{C-M}$	-9.9	2.7	-7.5
Evaluation	Market	Balanced	Balanced
Hierarchy	29.9	28.5	23.0
Adhocracy	18.1	19.6	18.0
$Mean_{H-A}$	-5.9	-4.5	-2.5
Evaluation	Balanced	Balanced	Balanced

Figure 32 - CVF SCs: Common (Is) - and intended Partnering (Should) Culture
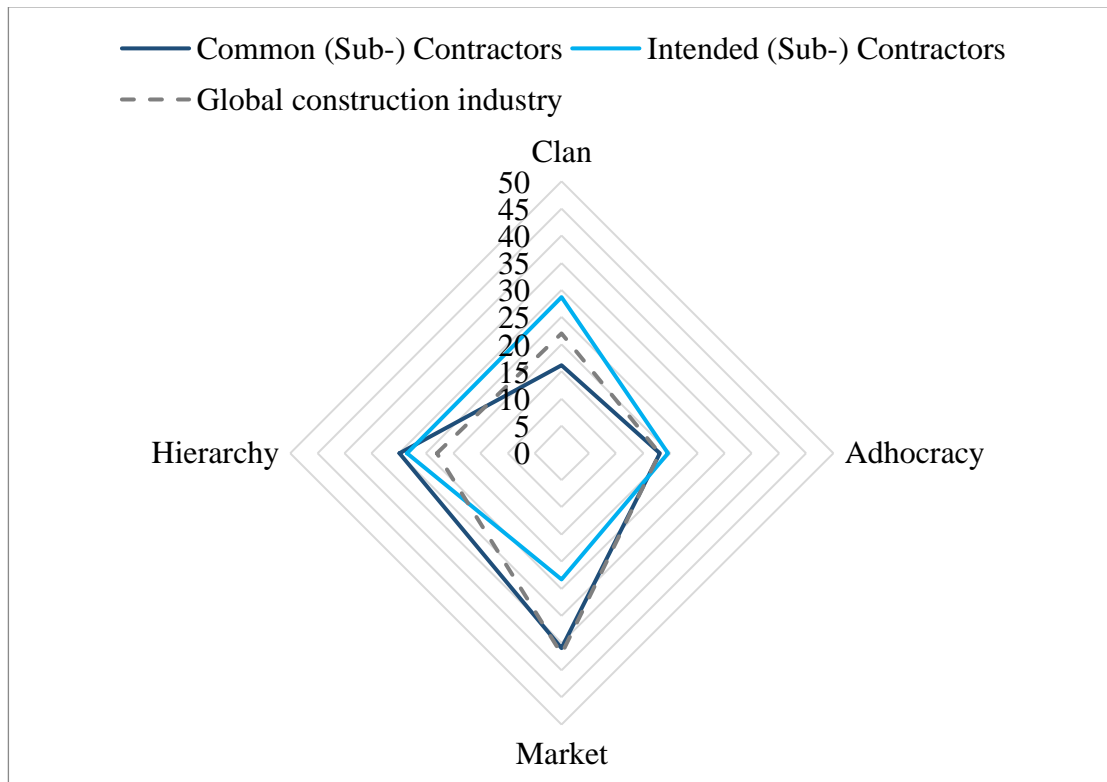
QCA results

Table 20 shows the SC's perception about the reasons for the features from the common project cultures. They confirm the traditional understanding of adversarial roles (Eriksson et al. 2008, 534 - 537) and different and contrary project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) as the reasons for common project cultures.

Table 20 - (Sub-) Contractor's perceptions about the reasons for the common project cultures

Reasons for the common project cultures	Number of statements
Traditional understanding of adversarial roles	2/3
Different and contrary project objectives	2/3
Unclear structures and responsibilities	1/3
Lack of qualified work	1/3
Unrealistic schedules and too much time pressure	1/3
General mistrust within the construction industry	1/3

Table 21 shows the necessary ingredients of a partnering culture from the SC's perspective. They perceive especially reliable processes and a high motivation of the own staff, and long-term relationships with multiple projects as reasons to strive for partnering. The importance of reliable processes and the high motivation of own staff is hereby an aspect that was not named by literature before.

Table 21 - (Sub-) Contractor's perceptions about the motivations for Partnering

Motivations for Partnering	Number of statements
Reliable processes	2/3
High motivation of own staff	2/3
Long-term relationships	2/3
Mutual support	1/3
Successful projects for all stakeholders	1/3
Less stressful working conditions	1/3
Efficiency	1/3

Table 22 shows the necessary ingredients of a partnering culture from the SC's perspective. It is striking that both: trust and open communication, which can lead towards mutual understanding, are not as significantly perceived by the SCs as presented in the partnering framework by Nyström (2005, 478). Nevertheless, they confirm the partnering framework's supportive ingredients long-term relationships, relationship building activities and add the importance of clear distributions of tasks and responsibilities.

Table 22 - (Sub-) Contractor's perceptions about the necessary ingredients to enable Partnering

Necessary ingredients to enable Partnering	Number of statements
Long-term relationships	2/3
Forming interpersonal relationships	2/3
Clear distribution of tasks and responsibilities	2/3
High quality and reliable work	1/3
Early identification of issues	1/3
Allowing other stakeholders their individual project success	1/3
Early involvement of other stakeholders	1/3
Mutual sympathy	1/3
Mutual trust	1/3
Open communication	1/3
Mutual project objectives	1/3

4.3.4 The common project culture and the intended partnering project culture from the Designer's perspective

The following sections show first the quantitative, and second the qualitative results, based on the three workshops with respectively one Designer organisation.

OCAI results

The global construction industry's culture and the OCAI's results from the Designer's perspective are shown in Table 23 and Figure 33 visualises them in the CVF. The Designers perceive the common project culture as much more characterized by features from the Hierarchy quadrant of the CVF than the global study does. Matching this evaluation, they see only few peculiarities from the opposite Adhocracy quadrant in the common project culture. They perceive the features on the Clan-Market axis to be almost similar pronounced as those in the global, whereas they perceive less characteristics from the Market quadrant.

Their definition of the ideal partnering culture differs from all stakeholder groups in terms of their perception of the common culture. The ideal partnering culture is especially characterized by features from the Clan and the Hierarchy quadrant, showing medium waged scores in the

Adhocracy quadrants and moderate pronounced features from the Market quadrant. Thus, the ideal partnering culture, according to the Designers, is characterized by clear procedures, cooperative behaviours, a certain focus on the Market, and space for creativity.

Accordingly, the Designers desire two cultural shifts from the common project culture towards a partnering culture. First, as the other stakeholders, from features of the Market quadrant towards features from the Clan quadrant, and second, a cultural shift on the Hierarchy-Adhocracy axis towards more spontaneous decisions and creativity. This is reflected in the results of the Wilcoxon Signed Ranks test shown in Table 10.

Table 23 - OCAI Scores Designers: Common project culture and intended partnering culture

	Common (is)	Intended (should)	Global construction industry (Cameron and Quinn 2011, 90)
Clan	19.7	30.4	22.0
Market	32.7	20.0	37.0
$Mean_{C-M}$	-6.5	5.2	-7.5
Evaluation	Balanced	Balanced	Balanced
Hierarchy	32.3	27.1	23.0
Adhocracy	15.3	22.5	18.0
$Mean_{H-A}$	-8.5	-2.3	-2.5
Evaluation	Hierarchy	Balanced	Balanced

Figure 33 - CVF Designers: Common (Is) - and intended Partnering (Should) Culture
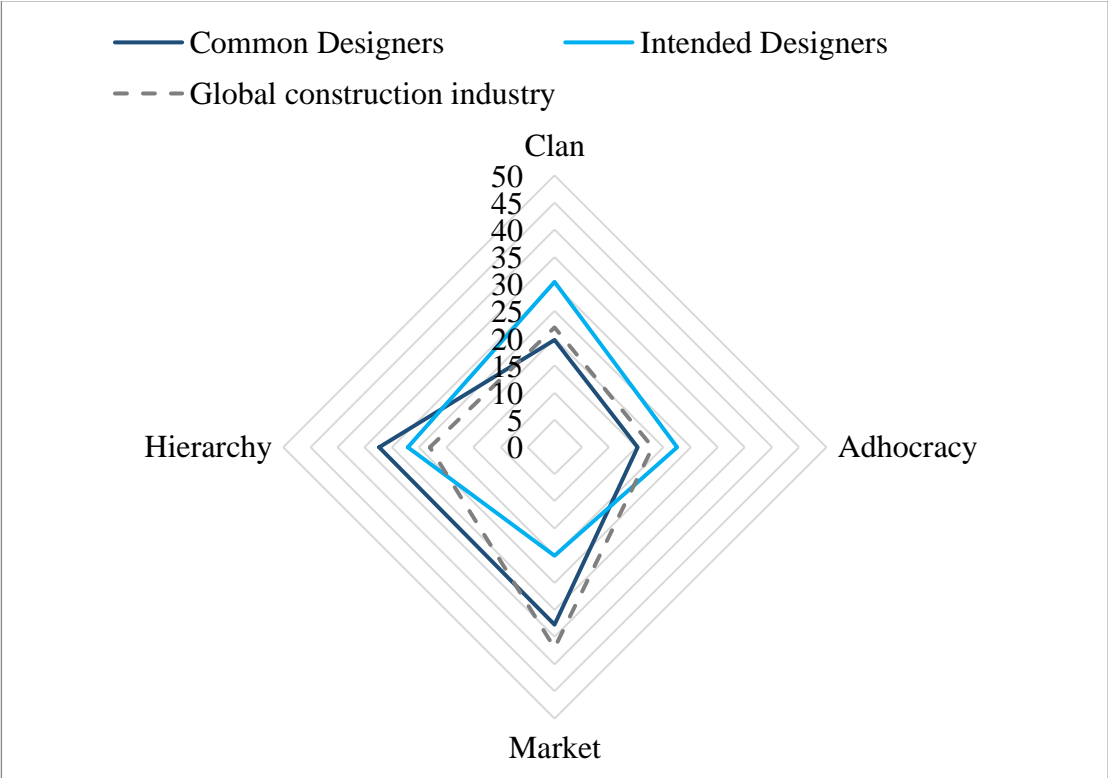
QCA results

Table 24 shows the Designer's perception about the reasons for the features from the common project cultures. They name especially third parties as lawyers or project controllers that try to keep their reason for existence within the projects as a reasons for the common adversarial project cultures. This is striking as this aspect was not mentioned by another stakeholder group or the literature. They add, as the CL and the MC, that antipathy between individual project members is a common reason for the competitive project cultures. Additionally, they confirm the main aspect from the literature review: different and contrary project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1).

Table 24 - Designer's perceptions about the reasons for the common project cultures

Reasons for the common project cultures	Number of statements
Third parties that try to keep their reason for existence (Lawyers, Project Controllers)	2/3
Antipathy between individuals	2/3
Different and contrary project objectives	2/3
A "I stand by my word" culture is missing	1/3
Lack of qualified work	1/3
Unrealistic schedules and too much time pressure	1/3
General mistrust within the construction industry	1/3
Traditional understanding of adversarial roles	1/3

Table 25 shows the necessary ingredients of a partnering culture from the Designer's perspective. They confirm especially efficiency from the list of Chan et al. (2006, 1929), and a high motivation of own staff as a reasons to strive for partnering.

Table 25 - Designer's perceptions about the motivations for Partnering

Motivations for Partnering	Number of statements
Efficiency	3/3
High motivation of own staff	2/3
Less stressful working conditions	1/3
Better project results	1/3
Long-term relationships	1/3

Table 26 shows the necessary ingredients of a partnering culture from the Designer's perspective. In contrast to the framework by Nyström (2005, 478), the Designers don't mention trust as necessary for a partnering culture. Nevertheless, they confirm mutual objectives, long-term relationships and open communication, if this is equated with mutual understanding.

Table 26 - Designer's perceptions about the necessary ingredients to enable Partnering

Necessary ingredients to enable Partnering	Number of statements
Mutual project objectives	3/3
The highest (project) hierarchies must claim and exemplify partnering	2/3
Forming interpersonal relationships	2/3
Open communication	2/3
Creating an identification with the project for all stakeholders	1/3
Knowing and understanding the objectives of others	1/3
Early identification of issues	1/3
Allowing other stakeholders their individual project success	1/3
Early involvement of other stakeholders	1/3
Structured communication	1/3
Mutual sympathy	1/3
Clear distribution of tasks and responsibilities	1/3

4.4 The common project culture and the intended partnering project - culture all responses

The global construction industry's culture and the OCAI's results from the entire sample are shown in Table 27 and Figure 34 visualises them in the CVF.

Table 27 - OCAI Entire Sample: Common (Is) - and intended Partnering (Should) Culture

	Common (is)	Intended (should)	Global construction industry (Cameron and Quinn 2011, 90)
Clan	18.7	31.2	22.0
Market	34.9	20.7	37.0
$Mean_{C-M}$	-8.1	5.3	-7.5
Evaluation	Balanced	Balanced	Balanced
Hierarchy	29.0	27.6	23.0
Adhocracy	17.3	20.6	18.0
$Mean_{H-A}$	-5.9	-3.5	-2.5
Evaluation	Balanced	Balanced	Balanced

Figure 34 - CVF All Stakeholders: Common (Is) - and intended Partnering (Should) Culture
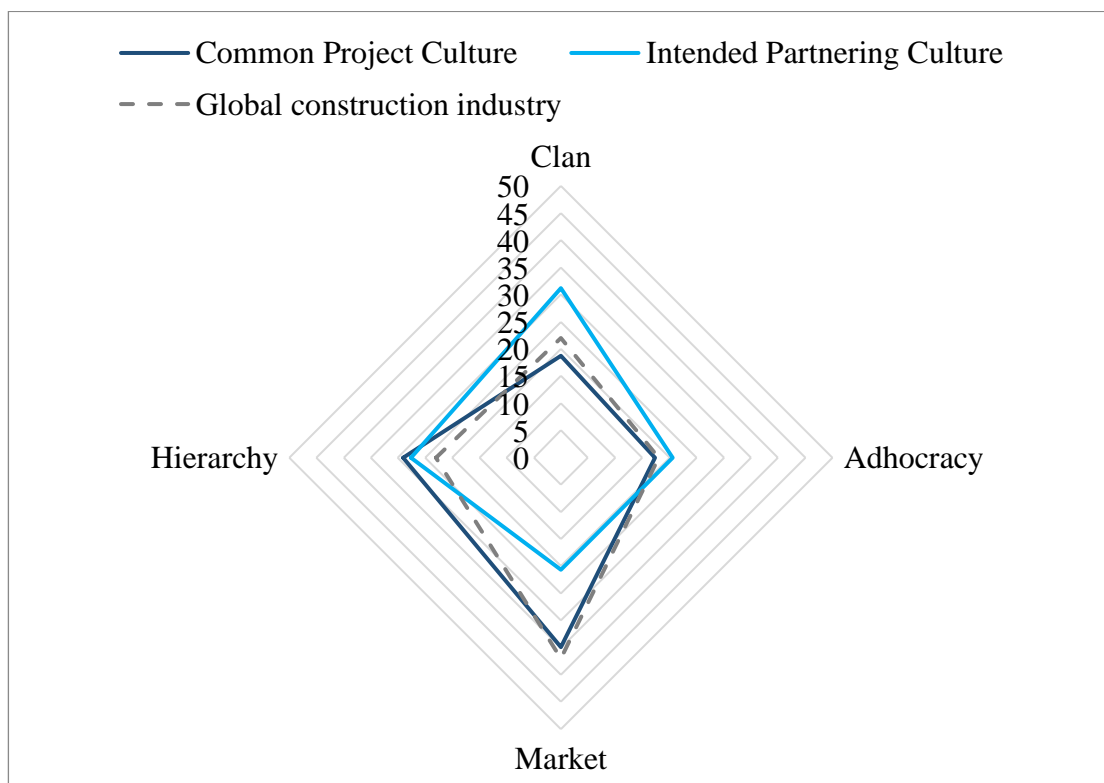
The perceptions about the common project culture show that the Market and Adhocracy scores are very similar to those of the global study. This confirms that the common culture is especially focused on high competition and the stakeholders' respective interests (Eschenbruch 2008) and less focused on creativity or spontaneous decisions. The common study's participants rank the Hierarchy features higher than in the global study. This means that they perceive a culture that

is more characterized by formalisms, standards, and clear procedures compared to the global evaluations of Cameron and Quinn (2011). The scores of the Clan characteristics indicate that the participants perceive even less cooperation in the German project culture than the global study does.

The mean scores for the desired culture in terms of partnering show that it is especially characterized by cooperative features from the Clan quadrant. Moreover, the features from the Hierarchy quadrant are more pronounced, indicating a desire for clear tasks and responsibilities. The scores from the Adhocracy and Market quadrant are less pronounced, but still remarkable as both axes show balanced scores. Hence, spontaneity and creativity as well as competing behaviours are only little desired, but still necessary.

Based on the results per stakeholder group presented earlier, agreement seems clear about a desired shift from Market to Clan. In comparison, less clear agreement is seen in the findings of the Hierarchy-Adhocracy quadrants. Including the entire sample, the results of the Wilcoxon Signed Ranks test (Table 10) show that the Hierarchy quadrant is the only one that does not require a change to shift the project culture towards partnering. The biggest necessary shift is from the Market quadrant towards the Clan quadrant. In terms of the characteristics from the Adhocracy quadrant, there should be a little cultural shift towards greater flexibility and creativity.

QCA results

The following Figures (Figure 35, Figure 36 and Figure 37) shown the main results for the three investigated categories (reasons for the common project cultures / motivations for partnering / necessary ingredients to enable Partnering) that were gathered by the twelve workshops. The figures are limited to the aspects that were at least two times mentioned and the variables that were mentioned at least five times are mentioned more in detail in the following investigations.

Figure 35 summarises the reasons that the different stakeholders name for the characteristics of common project cultures. The study's participants from all stakeholder groups confirm especially different and contrary objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) as reasons for the traditional competitive project cultures.

As the second most reason for these project cultures, individual antipathy between project members is named by the CL, MC and the Designers. This aspect was not mentioned in the literature before.

Additionally, the traditional understanding of competitive cultural patterns (Eriksson et al. 2008, 534 - 537), which is also expressed through a general lack of trust between the individual project members, is perceived as the main reasons for the common project cultures from all stakeholder groups.

Figure 35 - QCA All stakeholders: Reasons for the common project cultures
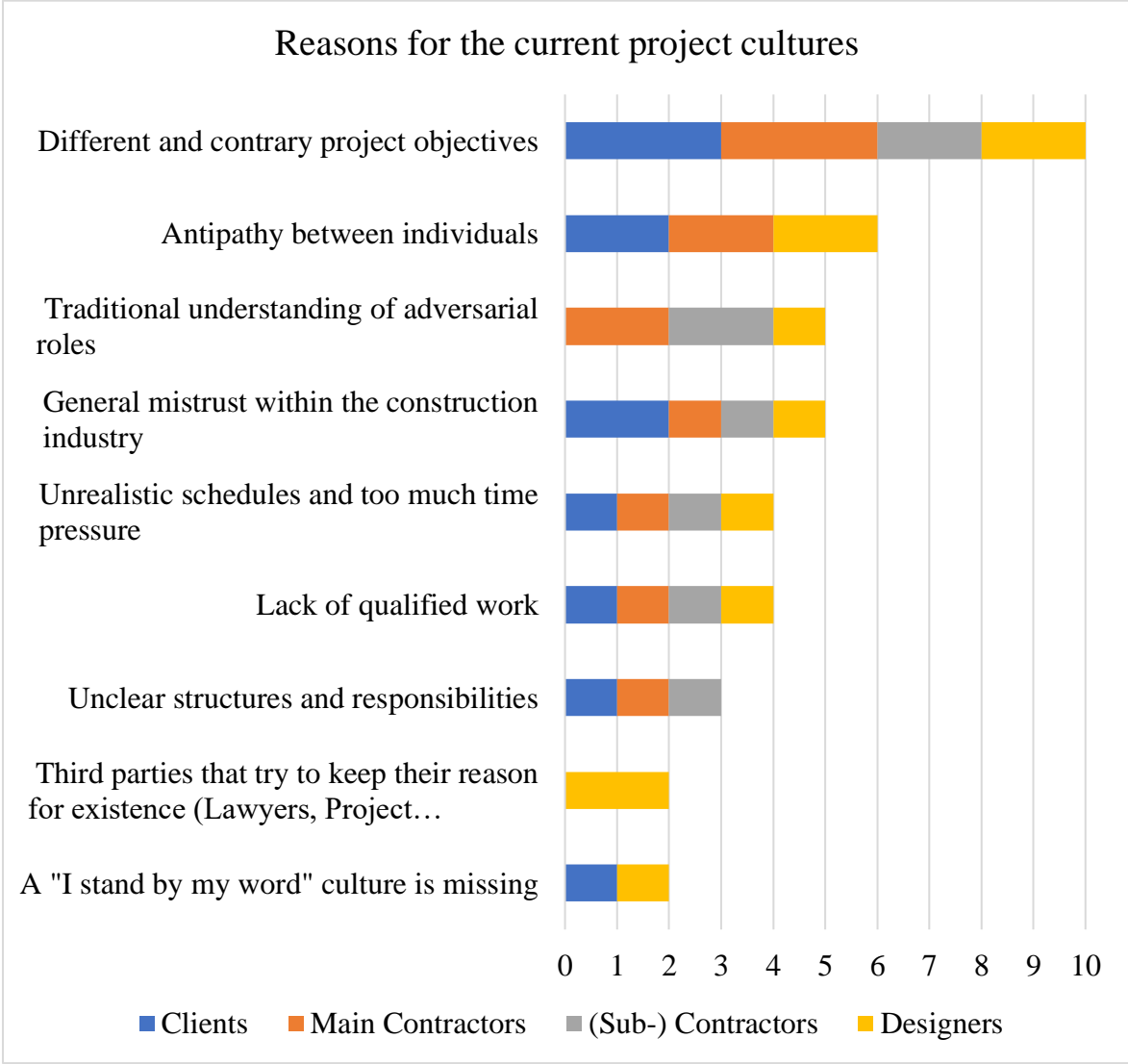
Figure 36 summarises the motivations to strive for partnering from the different stakeholder perspectives. The most, and from all perspectives, named motivation is a higher degree of efficiency, which is also expressed by the named improved efficiency. The second most named motivation are long-term relationships, that end in multiple mutual projects. The higher degree of efficiency and long-term relationships confirm aspects to strive for partnering, based on the literature review (Chan et al. 2006, 1929), see Section 2.2. In addition to literature, the investigations from this study show that the high motivation of the own staff is a remarkable aspect for CLs, MCs and Designers to strive for partnering.

Figure 36 - QCA All stakeholders: Motivations for Partnering
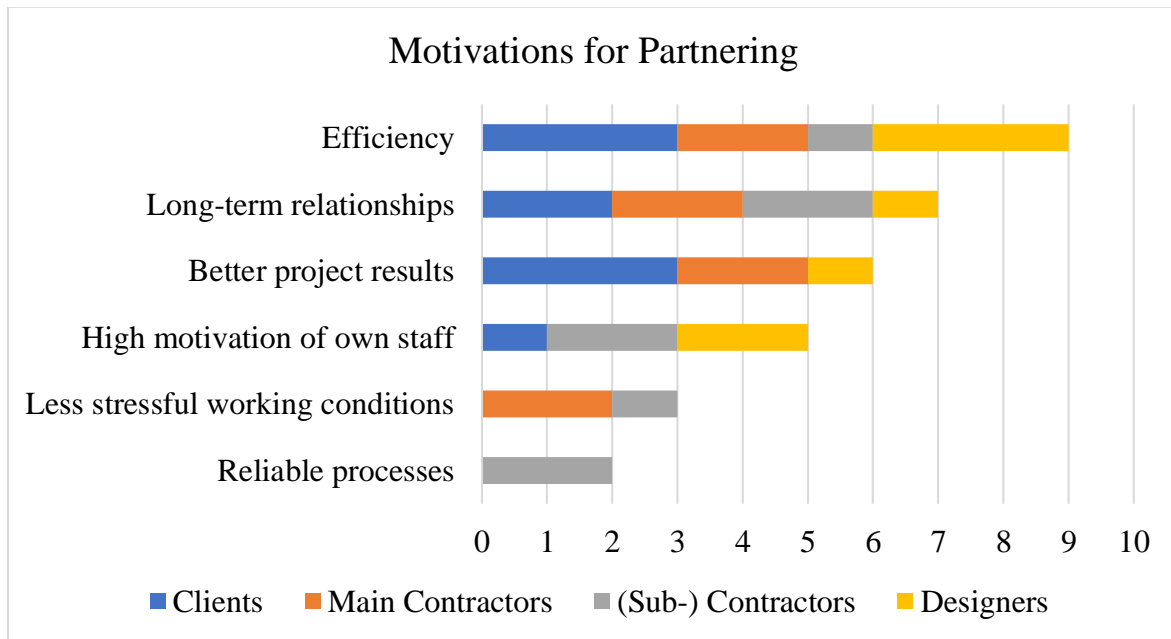
Figure 37 summarises the necessities to implement a partnering project culture from the different stakeholder perspectives.

The participants name especially mutual project objectives, open communication, clear distribution of tasks and responsibilities, interpersonal relationships on a partnering level and long-term relationships as necessary to implement a partnering project culture.

Thus, the findings confirm trust, mutual understanding (expressed through open communication), openness, mutual objectives (equivalent to economic incentive contracts), relationship building activities as necessities ingredients from the partnering framework by Nyström (2005, 478), even if this does only define trust and mutual understanding as necessary and the other ingredients as helpful. In addition to the framework by Nyström (2005, 478), this study has shown that the MC and SC perceive the long-term relationships as necessary.

Figure 37 - QCA All stakeholders: Necessary ingredients to enable Partnering
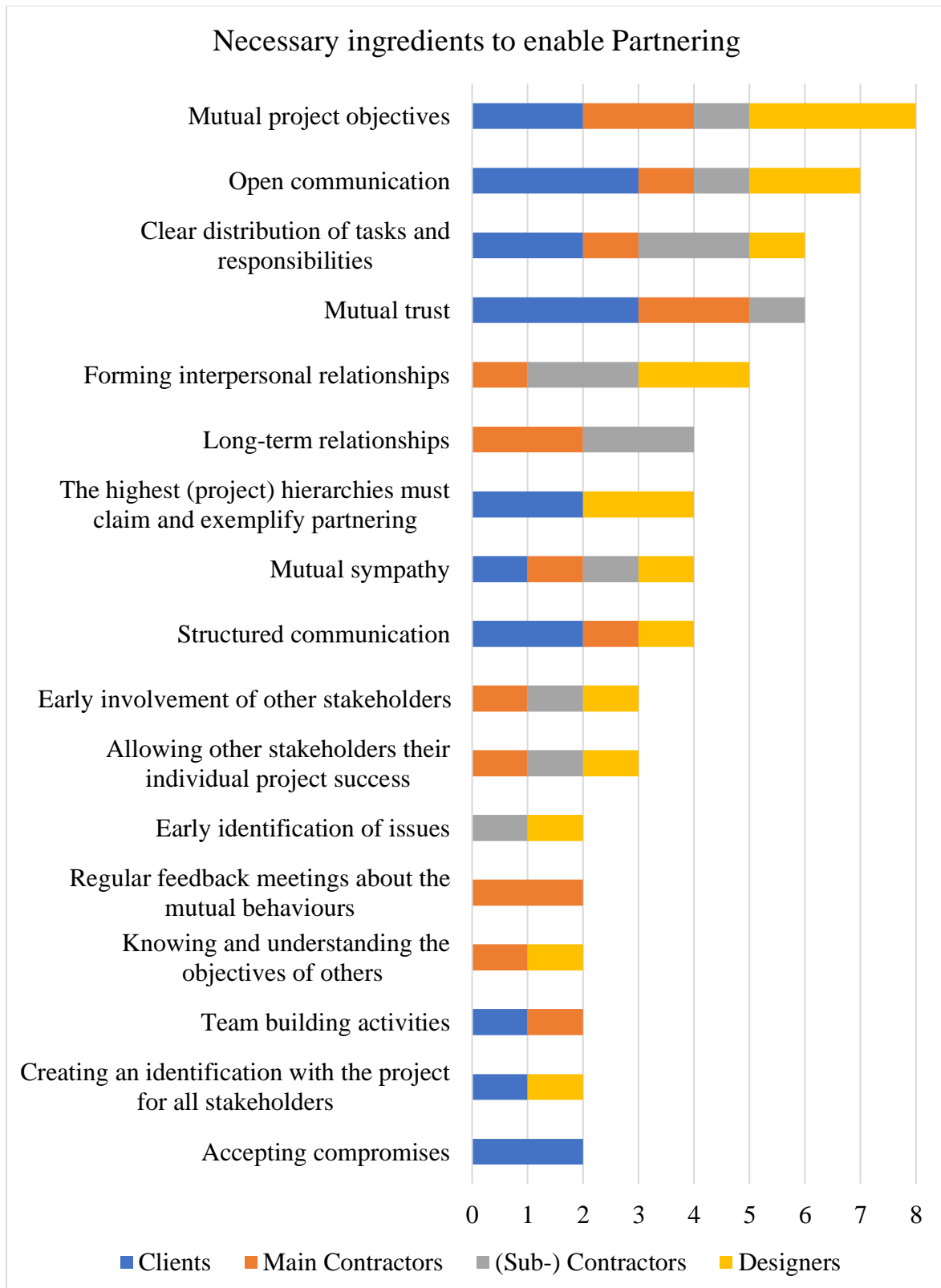
4.5 Further stakeholder groups' perceptions and interpretations

As shown, differences exist between the stakeholders regarding the perception of the common project culture in the German construction industry and the idea of an ideal partnering project culture. To compare the perceptions of the stakeholder groups, Kruskal–Wallis tests were performed. Table 28 shows statistical relevant differences between the quadrants (1) Is-Adhocracy, (2) Should-Clan and (3) Should-Adhocracy. It also shows that the valuations of the other quadrants can be interpreted as similar from the perspectives of all stakeholder groups. To investigate which stakeholder groups differ at each of the three statistically differing quadrants, pairwise comparisons of the various stakeholder groups were conducted. These are described next.

Table 28 - Results from the Kruskal–Wallis tests

	Is-Clan	Is-Adhocracy	Is-Market	Is-Hierarchy	Should-Clan	Should-Adhocracy	Should-Market	Should-Hierarchy
Kruskal-Wallis H	3.473	8.172	3.209	7.410	7.946	11.28	6.391	3.522
Asymp. Sig.	.324	.043*	.360	.060	.047*	.010*	.094	.318

*Significant at the 0.05 level

4.5.1 Adhocracy quadrant - common culture

Table 29 shows that the differences of the perceptions regarding the actual features of the Adhocracy quadrant from the common culture differ between the Designer and the CLs. In particular, the CLs evaluate the actual project culture with more pronounced features from the Adhocracy quadrant than the Designers.

Table 29 - Pairwise comparison of the stakeholder perceptions of the actual Adhocracy scores

Sample1 – Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
Designer - MC	4.861	6.969	.698	.485	1.000
Designer - SC	10.856	6.793	1.598	.110	.660
Designer - CL	19.462	7.184	2.709	.007	.040
MC - SC	-5.994	6.793	-.882	.378	1.000
MC - CL	14.601	7.184	2.032	.042	.253
SC - CL	8.606	7.013	1.227	.220	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
[a.] Significance values have been adjusted by the Bonferroni correction for multiple tests.

Thus, the CLs perceive the common project cultures as a spontaneous and creative environment, whereas the Designers perceive the opposite. It could be argued that CLs are often responsible for design changes during all project phases. This is because they have to deal with uncertain and changing customer demands, which can lead to necessary design and planning changes. As they are in the lead, they have the freedom to direct changes and define the final project. Due to this freedom, they experience flexibility. All other parties have to deal with these changes and decisions, which do not allow the pursuit of their 'own' creativity and freedom of decision. Especially, the Designers are confronted with this situation and often have to realize the arrangements precisely as prescribed without becoming involved in the decision-making processes.

4.5.2 Adhocracy quadrant – intended partnering culture

Table 30 shows that the differences of the perceptions regarding the desired features of the Should-Adhocracy quadrant differ between the MC and the CLs. In particular, the MCs show a lower desire for features from the Adhocracy quadrant than the CLs.

Table 30 - Pairwise comparison of the stakeholder perceptions of the Should-Adhocracy scores

Sample1 – Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
MC -SC	–6.150	6.792	–.905	.365	1.000
MC - Designer	–18.222	6.968	–2.615	.009	.054
MC - CL	20.188	7.183	2.810	.005	.030
SC - Designer	–12.072	6.792	–1.777	.076	.453
SC - CL	14.038	7.012	2.002	.045	.272
Designer - CL	1.965	7.183	.274	.784	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
[a.] Significance values have been adjusted by the Bonferroni correction for multiple tests.

The MCs and the CLs have varying perceptions about the importance of the features from the Adhocracy quadrant (like flexibility and creativity), whereas the CLs desire a higher expression of these features from this quadrant than the MCs. This might also be rooted in their specific roles in the project. The CL's desire for late changes is in the turnkey business often rooted in their uncertainty about which CL will rent the premises. This goes along which demands they have. In comparison, the MCs desire clear designs to manage the actual construction processes, in order to avoid continuous planning and design changes that affect their schedule.

4.5.3 Clan quadrant – intended partnering culture

Table 31 shows that the perceptions regarding the desired features of the desired Clan quadrant in terms of partnering differ between the SC and the MC stakeholder groups. The SCs rate this quadrant lower than the MCs, also if it is still the highest ranked score from the SCs. Thus, from their perspective, other cultural characteristics - especially the features that belong to the Hierarchy quadrant - are important for a partnering project culture.

Table 31 - Pairwise comparison of the stakeholder perceptions of the Should-Clan scores

Sample1 – Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
SC - Designer	–6.214	6.795	–.914	.360	1.000
SC - CL	9.263	7.015	1.320	.187	1.000
SC - MC	18.853	6.795	2.775	.006	.033
Designer - CL	3.049	7.186	.424	.671	1.000
Designer - MC	12.639	6.971	1.813	.070	.419
CL - MC	–9.590	7.186	–1.335	.182	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
[a.] Significance values have been adjusted by the Bonferroni correction for multiple tests.

The SCs judge the cultural features of the Clan quadrant not as crucial as the MCs do. Thus, the MCs want to focus more on cooperation within projects, whereas the SCs desire a more balanced project culture, thus viewing distinct characteristics from the other quadrants as purposeful. It could be argued that the MCs' long-term role within the projects (i.e. to manage the different interests of the stakeholders) could be the main reason for their focus on the cultural cooperation aspects, whereas the SCs often have to deal with multiple projects. Therefore, they also have also to deal with project external aspects, which in turn, leads to a more balanced desired culture in terms of the four quadrants.

4.6 Discussion

The CLs confirm the result of the global study from Cameron and Quinn (2011, 90), which describes the construction industry's culture as especially pronounced by the competitive features from the Market quadrant. In comparison, the features from the other three quadrants are less pronounced. All other stakeholder groups see the features from the Hierarchy (like clear standards and procedures) as more pronounced than those reported by the global study. The SC's perception of the common culture differs in terms of cooperative behaviours, which they perceive as fewer pronounced than the global study or the other stakeholder groups do.

The QCA results about the common project cultures have shown that CL, MC and Designers define antipathy between individual project members is a significant reason for competing and adversarial project cultures. This aspect was not named by any source about partnering. It is partly covered by 'team building activities', which is one helpful ingredient of the partnering framework by Nyström (2005, 478). Project members should continuously consider the team's

composition and realise if there is antipathy between individuals that could affect the entire project culture in a negative way.

The CLs define an ideal partnering culture as especially pronounced by cooperative features from the Clan quadrant and with few competitive characteristics from the Market quadrant. Moreover, they outline the necessary features of clearness and flexibility as balanced.

Among all the stakeholder groups, the MC's definition of a partnering culture is most pronounced by cooperative features with remarkably pronounced features from the Hierarchy quadrant. Competing behaviours and flexibility are only little distinct.

Furthermore, the SCs define a culture with highly pronounced features from the Clan and Hierarchy quadrants as necessary. What is striking is that they have the biggest desire for competitive features. It is concluded that the reason could be their service on multiple projects. From their point of view, the creative and flexible features from the Adhocracy quadrant must be least pronounced in contrast to the other quadrants. Furthermore, the designers define the ideal partnering culture as especially characterized by features from the Clan quadrant, followed by features from the Hierarchy quadrant. Furthermore, from their point of view, the features from the Adhocracy and the Market quadrants are almost medium waged.

Taking the mean scores from all participants, the ideal partnering culture would be characterized by cooperative and clear features from the Clan and Hierarchy quadrants, whereas competitive and flexible behaviour are only medium, but still remarkably, distinct.

All stakeholders, except the designers, do not see significant changes of other cultural features than the Market and Clan quadrants as necessary to improve projects in terms of partnering. Thus, the actual cultural distribution between the features of the Adhocracy and Hierarchy quadrants seems appropriate for all stakeholders except the designers. The designers wish for a cultural shift from the features of the Hierarchy quadrant towards the Adhocracy quadrant, that is, from clear standards and processes towards more creativity and spontaneous decisions. The reason for this shift might be their perception of the common culture, which they considered as extraordinarily inflexible. Their non-inclusion in decision-making processes about changes, but the confrontation with determined modifications from the CLs might also play a role. If changes are agreed between CLs and their CLs, designers must often find solutions for these new agreements without flexibility allowed for their tasks from the other stakeholders. The designer's scores of the desired culture on the Hierarchy-Adhocracy axis are comparable to the other stakeholders; hence, the desire for the change is especially rooted in their perception of the common culture, and not of the desired culture.

Only the CLs and designers differ in their perceptions of the common culture, and only about the features from the Adhocracy quadrant. The designers see these features as only little pronounced and the CLs perceive it in an opposite manner. It has been presumed that this is rooted in the different roles of these groups, especially CLs who have to deal continuously with planning changes due to their customer demands. Especially, the designers do not share this perception but consider the features of the Adhocracy quadrant as only little pronounced.

Observing an intended partnering culture, there are different perceptions between the MCs and the CLs, whereas the MCs view the features of the Adhocracy quadrant to be not as important as the CLs. This evaluation was also traced back to their specific roles, that is, the MCs' desired for clear planning to manage the various construction processes, whereas the CLs desired for flexibility due to changing customer demands. Regarding the desired features of the Clan quadrant, the perceptions differ between the MCs and the SCs. The MCs perceive more pronounced features, that is, more partner-like conditions, than the SCs. Such different desires might be rooted in the MCs' focus on few single projects and the SCs' need to manage multiple projects and smaller time ranges. Accordingly, the SCs have a bigger desire to watch the common Market situations and their own needs instead of the single project's necessities.

It is striking that the QCA confirmed from all stakeholders' perspective that 'soft' cultural features as trust and mutual understanding, which were defined by Nyström (2005, 478) as necessities, are indeed important to implement a partnering culture. Nevertheless, the QCA's main result is that in particular mutual project objectives are seen as necessary to implement partnering. This reflects one of the core reasons for the traditional and adversarial project cultures (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1). As presented in Chapter 2 in the principal-agent theory, this state leads towards intended information asymmetries through the individual choice of sharing- or not sharing information (Cerić 2016, 29) which leads towards the principal's attempt to overcome this asymmetry through control mechanisms (Schieg 2008, 48).

4.7 Conclusion

The aim of this chapter was to investigate the common project culture in the German turnkey Market and the ideal project culture under the perspectives of various key stakeholders in terms of partnering. Another aim was to investigate which cultural characteristics must be changed to move from the common project culture towards an ideal partnering project culture from the perceptions of various stakeholder groups. To measure the common culture and to define a

partnering culture from the respective stakeholder perspective, the OCAI was conducted and data was gathered from 72 participants.

As project cultures are shaped by the various individuals from the various stakeholders and functions, the research questions about the common project culture and the intended partnering culture are answered based on the entire stakeholder responses from Section 4.4. The answers to the research question about differences between the stakeholder groups are based on the findings of Section 4.5. Following, the SQRs of this chapter are answered.

SRQ2.1: How do the key stakeholders consider the common project culture in the German turnkey construction industry?

The results have shown that the common culture is especially characterised by competitive behaviours and the stakeholders' respective interests and less, but remarkable cooperative features. Compared to the global study from Cameron and Quinn (2011), the scores of the Clan characteristics indicate that the participants perceive even less cooperation in the German project culture than in the global construction industry.

The common project culture is levelled on the Hierarchy-Adhocracy axis, so it is evenly characterised by features from both quadrants. The study's participants rank the Hierarchy features higher than in the global study, which means that it is perceived as more characterized by formalisms, standards, and clear procedures compared to the global evaluations of Cameron and Quinn (2011).

The QCA results confirm literature's main reasons for this culture are especially different and contrary project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and the traditional understanding of adversarial roles with the associated general mistrust between the different project members (Eriksson et al. 2008, 534 - 537). In addition, antipathy between individual project members, was evaluated as one main reason for the common competitive project cultures.

SRQ2.2: How does the ideal project culture for the German turnkey construction industry look like from the key stakeholders' perspectives if partnering is intended?

The mean scores for the desired culture in terms of partnering show that it is especially characterized by cooperative features from the Clan quadrant, but also by remarkable features from the competitive Market quadrant. This means that especially high degree of collaboration is desired, but the study's participants see also the necessity to strive for individual project objectives and to keep an eye on influences besides the mutual project.

The scores on the Hierarchy-Adhocracy axis are balanced with a slight tendency towards the features from the Hierarchy quadrant, so clear tasks and responsibilities, but also remarkable spontaneous and creative behaviours.

Based on the QCA, the major motivations to strive for this culture are especially a high degree of efficiency, and through this better project results, long-term relationships between the project members and a high motivation for the own staff. Furthermore, the investigations have shown that mutual project objectives, open communication, clear distribution of tasks and responsibilities, mutual trust and partner-like interpersonal relationships are necessary ingredients of a partnering culture. Despite the long-term relationships, these aspects confirm the partnering framework by Nyström (2005, 478), which was presented in Chapter 1 and Figure 2.

The answers to SRQ2.1 and SRQ2.2 enable scientists and practitioners to put project cultures from individual cases in the context of the defined common project culture and the intended partnering project culture. Through this, they can assess whether the individual project cultures are similar to one of these two cultures, or if they differ in any cultural direction.

SRQ2.3: Which characteristics of project culture should be changed to improve it in the direction of the defined ideal project partnering culture?

The results from all stakeholder groups have shown that the cultural features that especially must be changed from common project culture towards partnering cultures are those on the Clan-Market axis, so from competition towards collaboration.

In comparison, less clear agreement is seen in the findings of the Hierarchy-Adhocracy quadrants. Including the entire sample, the results of the Wilcoxon Signed Ranks test (Table 10) show that the Hierarchy quadrant is the only one that does not require a change to shift the project culture towards partnering. In terms of the characteristics from the Adhocracy quadrant, there should be a little cultural shift towards greater flexibility and creativity.

These answers to SRQ2.3 give a direction which cultural features must be changed to improve project cultures in terms of partnering.

SRQ2.4: What are the differences between the stakeholder perspectives of the actual and the desired partnering project culture?

The results show that there are many similarities and differences between the stakeholders' perspectives in terms of the common and the idealized partnering project cultures. The MCs desire more cooperative behaviours than the SCs, and the CLs desire more pronounced

flexibility than the MCs. All stakeholders desire a cultural change from highly competitive behaviours towards more cooperation. Changes in terms of clear procedures or more flexibility are only desired by the designers, particularly towards more flexible behaviours.

This knowledge enables different project stakeholders, and especially project managers, to understand the similar and different needs of the different stakeholder groups which might influence their project management approach.

5 INVESTIGATIONS ABOUT PROJECT CULTURES NOT APPLYING AND APPLYING LPS

Parts of this Chapter were submitted in Lühr et al. (2021)

5.1 Introduction

In Chapter 3, it was defined how project culture can be measured under the aspects of partnering. Through this, project cultures can be measured and project cultures that do not apply the "Last Planner® System of Production Control" (LPS) (Ballard 2000, 3-1) can be compared with those that apply LPS. This is necessary to answer the main research question about LPS's influence on project culture. Therefore, the sub-research question *SRQ3* was defined as following:

How do project cultures of projects not applying and those applying LPS differ?

To answer this question, a further division as following is necessary:

- *SRQ3.1: What are the characteristics of project culture in construction projects not applying LPS?*
- *SRQ3.2: What are the characteristics of project culture in construction projects applying LPS?*

Chapters 1 and 2 have shown the interfaces between partnering and LPS and Chapter 2 has ended with the hypothesis that LPS improves project culture under the aspects of partnering. In Chapter 4, the common- and the intended partnering culture were defined. If the cultural differences between projects that do not apply LPS and those that apply LPS are investigated, the hypothesis can be tested through answering sub-research question *SRQ4*, which is:

Does LPS's application lead towards a partnering project culture?

5.2 Research design

To answer the questions, in-depth case studies are carried out. These are suitable to investigate questions and relationships that are too complex for alternate methods as surveys or experiments (Brookes et al. 2016, 216; Maylor et al. 2017, 204; Yin 2018, 18). A multiple case study approach is chosen for two reasons: first, to identify similarities and differences within the groups of projects that do apply LPS and those that do not apply LPS (Maylor et al. 2017, 208) and second, to compare the findings of these groups. LPS is not standardised, there are varieties of components that are applied in practice (Priven and Sacks 2013, 537; Ballard and Tommelein 2016, 4). The multiple case study approach will show how LPS is actually applied

in practice. As each project culture consists of a unique mixture of the ways of thinking and behaving of project members, the stakeholder's perceptions were weighted equally to investigate the mean project culture.

5.2.1 Case study design

The cases were selected as a stratified sample (Flyvberg 2006, 34) by the following criteria:

1. Turnkey building construction projects in Germany,

2. Same type of work / sector / phase,

3. All participants work at least for three months in the project,

4. No contractual focus on partnering.

Criterion 1 was set due to the industry's named a remarkable desire to change project culture towards partner-like conditions. Criterion 2 was set to make the cases and their work, interfaces, common issues, and involved stakeholders comparable. All chosen cases are in the same construction phase with interior- and technical building equipment work. Because the project culture as one system is of interest for this research, stakeholders with various functions were chosen to participate in the study. As the core members of multidisciplinary construction teams in this phase, Client's project managers (CL), Main Contractor's (MC), and (Sub-) Contractor's (SC) site managers and / or foremen were chosen to participate. Criterion 3 was defined to ensure that the participants were representative for defining the cultural aspects. Hofstede et al. (2010, 385) named especially for short assignments, like projects, an experienced time of three months for acculturation. Criterion 4 was defined to keep the projects comparable by ensuring that the project cultures were not affected by specific contractual partnering arrangements. In total 6 projects were selected, three not applying LPS and three applying LPS.

5.2.2 Applied research methods

To investigate the cases in-depth, a combination of quantitative and qualitative investigation was chosen to triangulate the findings (Maylor et al. 2017, 219 - 221).

Quantitative method – the Organizational Culture Assessment Instrument

To use the 'Competing Values Framework' (CVF) by Cameron and Quinn (2011), the belonging "Organizational Culture Assessment Instrument" (OCAI) was applied as an online survey and analysed as presented in Chapter 3.

To get a deep understanding of the CVF's findings, semi-structured interviews were held with the study's participants. Such interviews allow for investigations about human affairs, actions and personal views (Yin 2018, 114, 121). The interviews were conducted after the named online survey was conducted.

The interview questions were structured to explore the categories of interest: (1) general information about the projects' meetings, (2) project culture in terms of CVF's categories, (3) trust vs. control and (4) mutual understanding. To ensure that the current level of trust represents the usual trust level within the project without being affected negatively and abrupt by sudden developments that happened (see Figure 17), the participants were asked if this was the case. All interviews were conducted via telephone and documented through written keywords. Interviews were transcribed and later approved by the participants.

To analyse the interviews, qualitative content analysis (QCA) was applied as this is suitable to analyse data in terms of cultures and their attributes in specific contexts (Krippendorff 1989, 403). A deductive approach was chosen by pre-defining the patterns as a first step of the analysis (Mayring 2015, 97), similar to the named categories. Similar to the OCAI's results, the QCA's findings for each case were clustered in three evenly divided sections for each category. These sections were the same as for OCAI's results. The findings from Chapter 4 about the usual and the intended partnering culture are used to put the cases' cultures in those contexts to interpret if they are alike usual construction project cultures, or like partnering project cultures. For trust and mutual understanding, results were categorized into 'low', 'balanced' and 'high'.

5.2.3 Triangulation of the quantitative and qualitative data

To triangulate the data, the quantitative and the qualitative data were compared for each case as a within-case analysis. It is assumed that both research approaches have the same significance. So if the results from the two methods differed, a mean of both was determined.

Next a cross-case analysis was conducted for each of the two groups (not applying and applying LPS) to investigate common patterns or differences (Maylor et al. 2017, 216). Finally, the findings about the two groups were compared to investigate the impact of LPS on project culture.

5.3 Results cases not applying LPS

First, the meetings' structure for each case is presented, based on the QCA of the interviews. Next, the categories 'CVF', 'Mutual Understanding', and 'Trust vs. Control' for three projects of each group are compared, based on the QCA and the investigations of the surveys.

5.3.1 Project culture Case 4

5.3.1.1 Case 4's meeting structure

Case 4 conducts irregular production control meetings. The MC's site managers invite the site managers and foremen of the various SCs if he perceives such meetings as necessary, and members of all actual trades participate at these meetings. There is no consistent structure for the meetings, and they get organized in order of the current project priorities. The perception of the review of issues is different along the parties. Whereas the MC's site manager reports that issues get discussed each day directly on site, the SCs report that this is conducted during the production control meetings or via written correspondence.

All participants agree that the usual planning of processes and interfaces between the trades is conducted through the staff of the MC and that the updated schedules get distributed via email. The MC's site manager reports in this context, that he prepares different schedules for the CL and the SCs, which differ based on different strategical motivations.

5.3.1.2 Case 4's within-case analysis

Table 32 shows the OCAI's results, which are visualised in the CVF in Figure 38.

Table 32 - OCAI results Case 4

	Case 4	Common Project Culture	Intended Partnering Culture
Clan	23.3	18.7	31.2
Market	26.5	34.9	20.7
$Mean_{C-M}$	-1.6	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	42.1	29.0	27.6
Adhocracy	8.1	17.3	20.6
$Mean_{H-A}$	-17.0	-5.9	-3.5
Evaluation	Hierarchy	Balanced	Balanced

Figure 38 - CVF Case 4
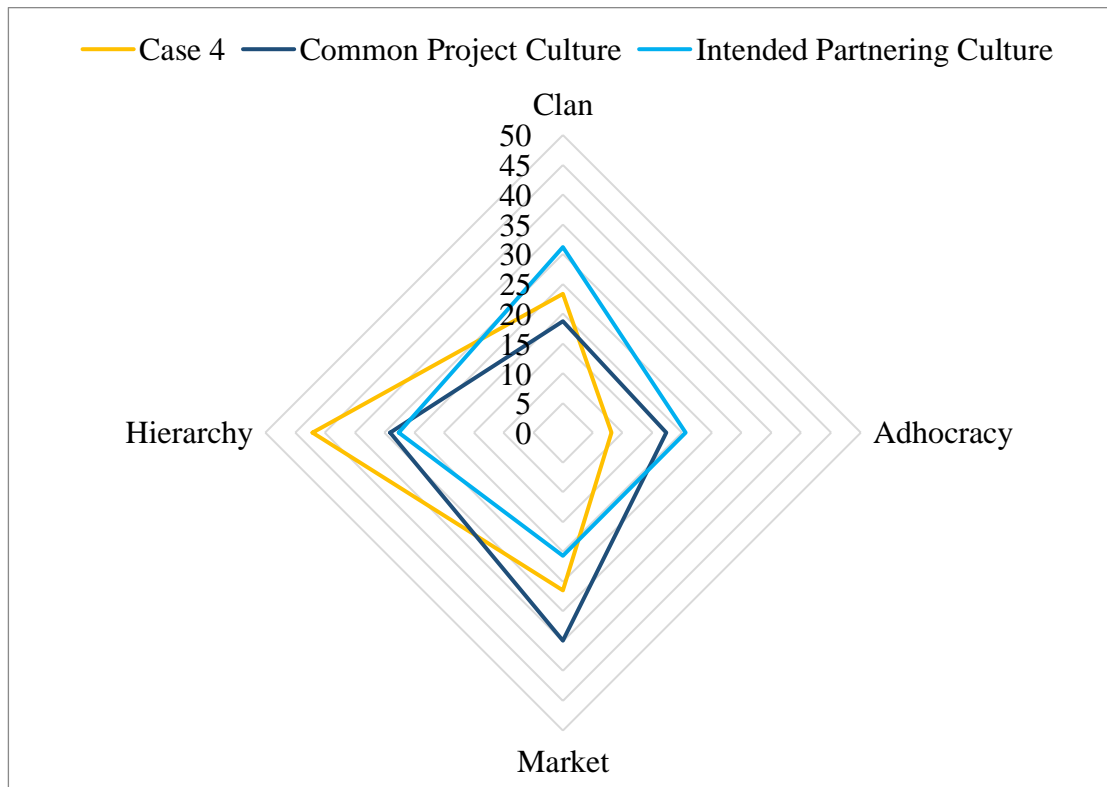
The results show that Case 4's project culture is highly characterised by the features from the Hierarchy quadrant, so clear responsibilities and processes, and only few spontaneous and creative behaviours. The triangulation with the QCA confirms this (see Table 35). Figure 38 shows that this cultural pronunciation is higher than at usual project cultures or the intended partnering culture.

The OCAI results in Table 32 and Figure 38 show that the project culture is on the Clan-Market axis between the usual project culture and the intended partnering culture. The triangulation in Table 35 shows that the project culture is slightly characterised by partnering features from the Clan quadrant, which gets also expressed through the high level of trust among the participants despite a high perceived level of control (see Table 36). Nevertheless, the culture includes also remarkable competitive features, which are expressed through the different distributions of mutual understanding between the stakeholders as presented in Table 37.

The QCA shows that the MC has a high level of knowledge about the tasks and issues of the others, whereas the other stakeholders have only a rough overview about the other trades. This imbalance is also expressed through the MC's attitude to share or not to share his knowledge, as current schedules, due to his strategic motivations.

In conclusion, the project culture can be described as slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries.

5.3.2 Project culture Case 5

5.3.2.1 Case 5's meeting structure

Weekly meetings are applied, where the site managers and foremen from the MC and the SCs meet to discuss the current construction processes. The meeting is equally structured every time, starting with a review of the processes from the past week through the staff from the MC. Hereafter, the MC attendants present the updated detailed schedule for the upcoming 2 – 4 weeks and discuss it with the SCs. For scheduling the most important milestones, a joint discussion with the SC takes place during the meeting. The MCs takes the input from the SCs into account for his planning and presents the updated strategy during the next meeting. The perception of the review of issues is different along the parties. Whereas the MC's site manager reports that issues get discussed, each day directly on site, the SCs report that this is conducted during the production control meetings or via written correspondence.

All participants agree that the usual planning of processes and interfaces between the trades is conducted through the staff of the MC and that the updated schedules get distributed via email. Also, the CL receives an updated schedule each week or the latest all two weeks. The MC's site manager reports in this context, that he prepares different schedules for the CL and the SCs, which differ through different strategical motivations.

5.3.2.2 Case 5's within-case analysis

Table 33 shows the OCAI's results, which are visualised in the CVF in Figure 39.

Table 33 - OCAI results Case 5

	Case 5	Common Project Culture	Intended Partnering Culture
Clan	25.5	18.7	31.2
Market	26.7	34.9	20.7
$Mean_{C-M}$	-0.6	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	33.0	29.0	27.6
Adhocracy	14.8	17.3	20.6
$Mean_{H-A}$	-9.1	-5.9	-3.5
Evaluation	Hierarchy	Balanced	Balanced

Figure 39 - CVF Case 5
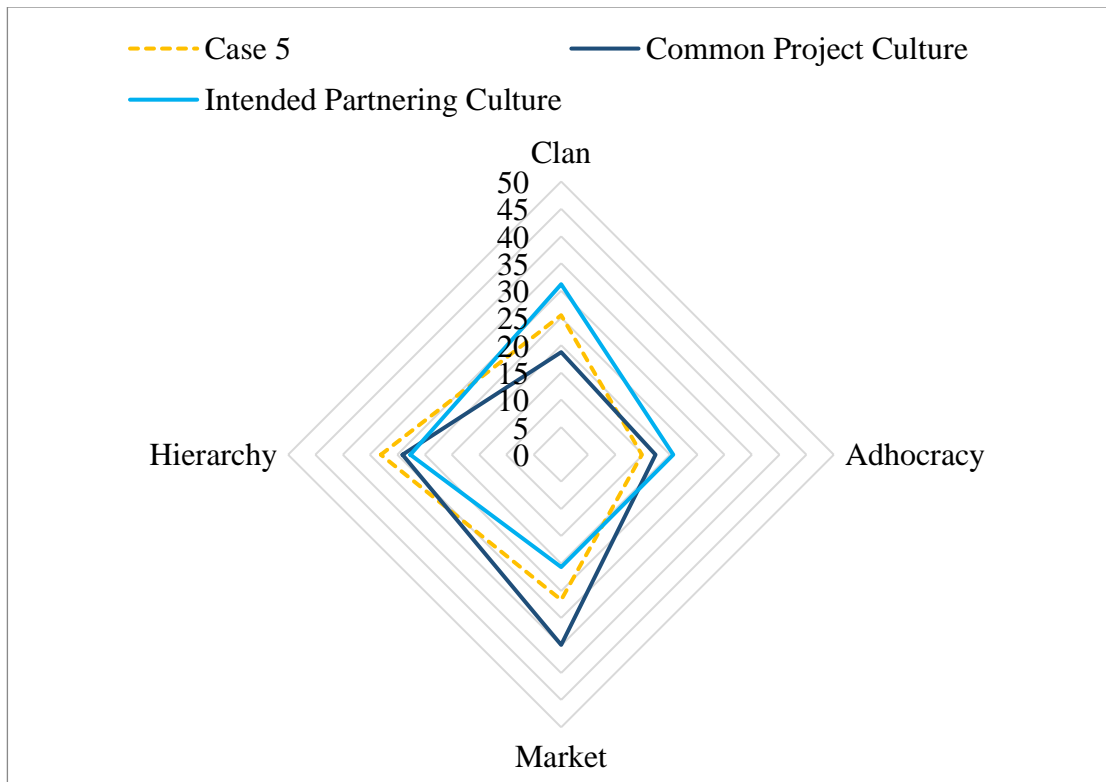
The results from the OCAI and the triangulation with the QCA (see Table 35) show that Case 5's project culture is slightly dominated by the features from the Hierarchy quadrant, so clear processes and responsibilities. Nevertheless, also some spontaneous and creative characteristics are noticeable, represented by the scores of the Adhocracy quadrant. In comparison to the

common project culture and the indented partnering project culture, Case 5's project culture is on this axis slightly more dominated by the features from the Hierarchy quadrant.

Similar to Case 4, Case 5's project culture is slightly dominated with cooperative behaviours with remarkable competitive features (see Table 35), which are expressed through uneven understanding of the other's tasks and issues, whereas the MC has a lot of knowledge and the others only have a rough overview about the others' (see Table 37). Therefore, Case 5's project culture on the Clan-Market axis is in comparison to the usual-, and the indented partnering project in the middle, but slightly inclined towards the partnering project culture.

Also similar to Case 4, the MC decides who gets which knowledge about the actual processes strategically through different schedules that he shares or rather not shares with the different parties.

The level of control is, as well as the level of trust, perceived as high in the project whereas one participant reports that he has to differentiate who is trustworthy, and who is not (see Table 36).

In conclusion, Case 5's project culture can be described as slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries.

5.3.3   Project culture Case 6

5.3.3.1   Case 6's meeting structure

The interview results from Case 6 show that the participants perceive the continuity of the meetings differently. Whereas the MC's site manager and senior site manager report that production control meetings take place only irregularly, and only if absolute necessary, the SCs report from weekly meetings with the MC's staff. If meetings take place, the constellation of participants changes due to the current issues. One could interpret that such meetings indeed are not scheduled regularly, but still take place in a weekly frequency. The CL is not involved in such meetings.

There is no consistent structure for the meetings, and they get organized in order of the current project priorities. The production control is conducted through daily site observations by the MC's staff. Hereby, all actual issues and necessary planning changes get discussed daily on various discussions between different persons from the MC and different staff from the various SCs on site. Whereas the MC's staff perceives these planning processes as solely done by himself, the SCs perceive it as joint planning.

The MC has commissioned one company for updating the schedule monthly. The MC's site managers give this company information about the actual state of work. This updated schedule gets not shared with the other stakeholders as the MC's site manager declares that it is not true anymore as soon as it is prepared.

5.3.3.2 Case 6's within-case analysis

Table 34 shows the OCAI's results, which are visualised in the CVF in Figure 40.

Table 34 - OCAI results Case 6

	Case 6	Common Project Culture	Intended Partnering Culture
Clan	25.7	18.7	31.2
Market	27.2	34.9	20.7
$Mean_{C-M}$	-0.8	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	35.0	29.0	27.6
Adhocracy	12.2	17.3	20.6
$Mean_{H-A}$	-11.4	-5.9	-3.5
Evaluation	Hierarchy	Balanced	Balanced

Figure 40 - CVF Case 6
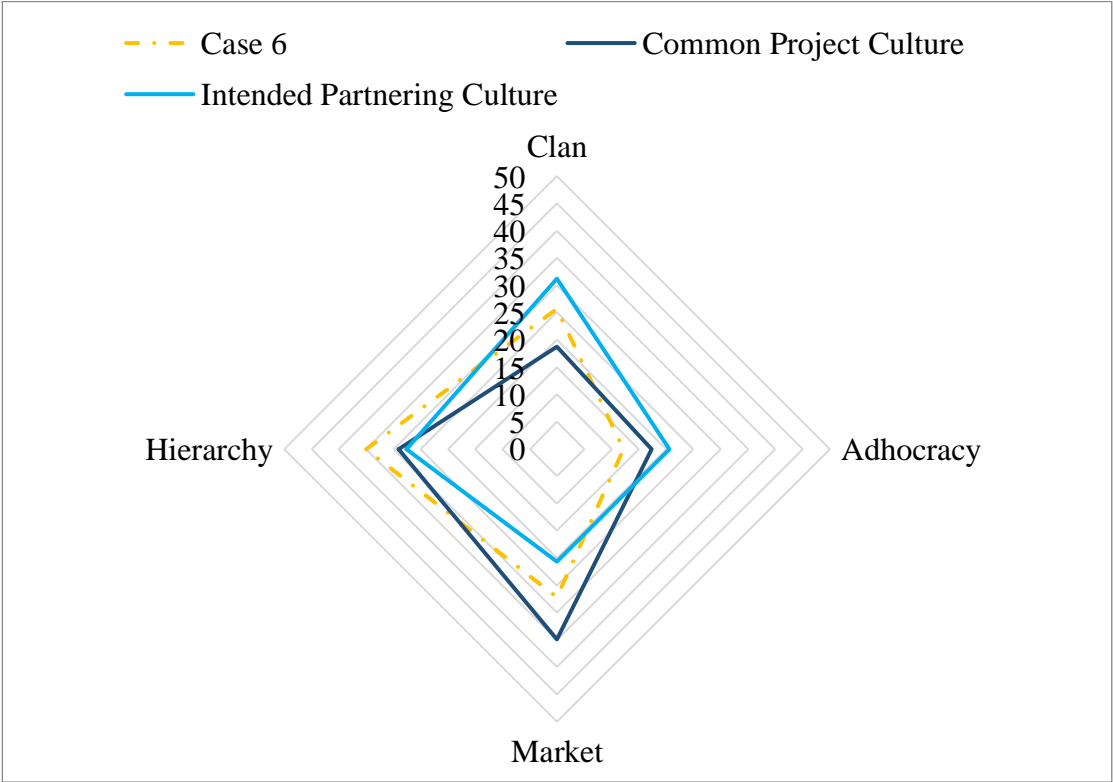
The OCAI's results show on the Hierarchy – Adhocracy axis a pronunciation from the features of the Hierarchy quadrant. As the QCA show especially that the features from the Adhocracy quadrant represent the project culture, it is concluded that the project culture is balanced between the features from the Hierarchy-, and the Adhocracy quadrant (see Table 35). So, features from both quadrants are remarkable to a certain level and through this comparable to the usual German project culture and the intended partnering culture.

On the other axis, the project culture is slightly dominated by the cooperative features from the Clan-quadrant and remarkable features from the competitive Market-quadrant. So, the project culture represents on the Clan-Market axis is in comparison to the usual-, and the indented partnering project slightly the features of a partnering project culture.

Table 36 shows that both: the level of trust and the level of control are perceived as high.

The level of mutual understanding differs along the stakeholders, whereas the MC has a high level of understanding the actual situation of the others, and the other parties have a good overview about the own tasks and issues and a rough overview about the others. As in Case 4 and Case 5, this uneven level of information gets amplified through the MC's withholding of information.

In conclusion, Case 6's project culture can be described as slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries.

5.3.4 Cross-case analysis: cases not applying LPS

5.3.4.1 Meeting Structures

Summarizing the meetings of the three cases not applying LPS, the regularity and structures of the production control meetings differ at all projects. The meeting's participants are site managers and foremen of the MC and the SCs. The meeting participants differs at some projects, whereas the MC decides who is necessary, dependent on his perception of the actual issues of the project. In none of the cases, employees from the CL participate. The meetings take usually place on a weekly basis, whereas also daily site visits are used by the MC's staff to control the construction progresses and to investigate and solve actual issues.

The projects don't use a systematic meeting structure, but discuss the topics based on MC's perception of relevance.

5.3.4.2   Competing Values Framework

Figure 41 visualises the OCAI's results and Table 35 shows the OCAI's and the QCA's results and the conclusions which are drawn by combining both in terms of the CVF. It is striking that the shapes of all three project cultures in Figure 41 are very similar on the Clan-Market axis. They are slightly dominated by the cooperative Clan-features, but that noticeable features from the competitive Market quadrant are perceptible.

Compared to the common project culture and the intended partnering culture, the results of all three cases are between on the Clan-Market axis. So, their project cultures are characterised by more cooperative and less competitive features than the common project culture, but also by less cooperation and more competition than the intended partnering culture.

In contrast, the results on the Hierarchy-Adhocracy axis differ between the cases, even if there is a tendency for the features from the Hierarchy quadrant remarkable, so for clear processes and responsibilities. It is concluded that there are no equal cultural characteristics remarkable. However, all three project cultures are more characterised by the features from the Hierarchy quadrant and less features from the Adhocracy quadrant than the common project culture and the intended partnering culture to a certain degree.

Figure 41 - CVFs projects not applying LPS
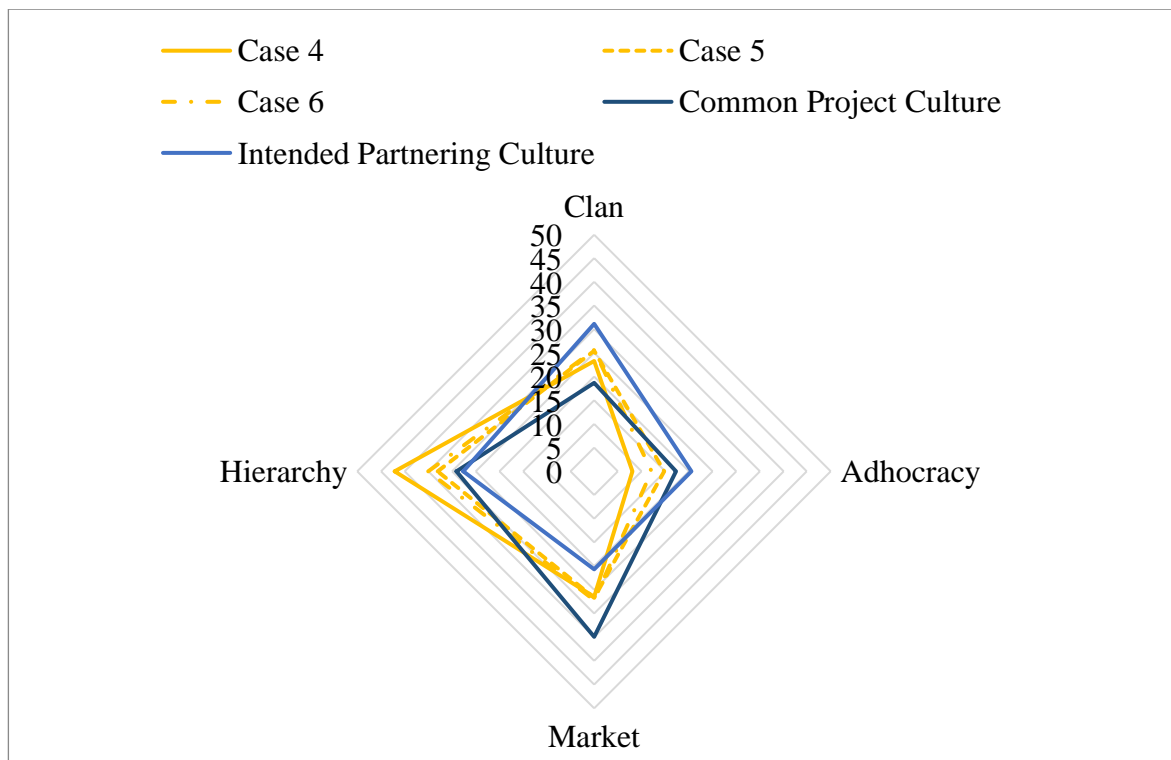
Table 35 - Competing Values Framework: Comparison of data gathered through interview's QCA and OCAI – projects that do not apply LPS

Case	Axis	OCAI evaluation	Project culture, QCA	Summary	Conclusion
4	Clan-Market	Balanced	3 * Clan 1 * Market	Clan	Slightly Clan
	Hierarchy-Adhocracy	Hierarchy	3 * Hierarchy 1 * Adhocracy	Hierarchy	Hierarchy
5	Clan-Market	Balanced	4 * Clan 1 * Balanced	Clan	Slightly Clan
	Hierarchy-Adhocracy	Hierarchy	4 * Balanced 1 * Hierarchy	Balanced	Slightly Hierarchy
6	Clan-Market	Balanced	3 * Clan 2 * Balanced	Clan	Slightly Clan
	Hierarchy-Adhocracy	Hierarchy	1 * Hierarchy 1 * Balanced 3 * Adhocracy	Adhocracy	Balanced
Summarizing Cases not applying LPS	Clan-Market	All projects very similar: slightly pronounced by Clan			
	Hierarchy-Adhocracy	Different at the projects, but tendency to Hierarchy			

5.3.4.3 Trust vs. Control

The levels of trust and control are perceived as high in all cases which do not apply LPS (see Table 36). The high level of trust reinforces the investigations from the CVF that the project culture is by tendency partner-like and the high level of control does not seem to influence this in a negative way.

Table 36 - Qualitative content analysis of cases not applying LPS: Level of Trust and Level of Control

Case	Level of Trust		Level of Control	
	Distribution	Summary	Distribution	Summary
4	4 * High	High	4 * High	High
5	4 * High 1 * distinction between different project participants	High	5 * High	High
6	3 * High 1 * continuously changing (ranked as balanced) 1 * Low	High	5 * High	High
Summarizing Cases not applying LPS	-	High	-	High

5.3.4.4 Mutual Understanding

Table 37 shows that the level of mutual understanding is similar at all 3 cases which do not apply LPS: the MCs have a good overview of the actual construction processes and issues of the various participants. The other parties have only a rough overview of the processes and issues from the other project parties, but a good overview of their tasks. The different levels of mutual understanding get controlled by the MC's through sharing different information about the current processed through different schedules. This behaviour must be evaluated as competitive and not partner-like.

Table 37 - Qualitative content analysis of cases not applying LPS: Level of Mutual Understanding

Case	Distribution	Summary
4	1 * MC: High for all trades 1 * CL / 2 * SC: Detailed knowledge about own trade and tasks, a rough overview of the other trades and issues	MC has a high level of mutual understanding and the other stakeholders a detailed knowledge about own trade and tasks, a rough overview of the other trades and issues
5	2 * MC: High for all trades 2 * CL / 2 * SC: Detailed knowledge about own trade and tasks, rough overview of the other trades and issues	MC has a high level of mutual understanding and the other stakeholders a detailed knowledge about own trade and tasks, a rough overview of the other trades and issues
6	2 * MC: High for all trades 1 * CL / 2 * SC: Detailed knowledge about own trade and tasks, rough overview of the other trades and issues	MC has a high level of mutual understanding and the other stakeholders a detailed knowledge about own trade and tasks, a rough overview of the other trades and issues
Summarizing Cases not applying LPS	MC has a high level of mutual understanding and the other stakeholders a detailed knowledge about own trade and tasks, a rough overview of the other trades and issues	

5.3.5   Conclusion about project cultures not applying LPS

SRQ3.1 about the characteristics of project culture in construction projects not applying LPS can be answered as following:

Project cultures that do not apply LPS differ in terms of their meeting structures. The project cultures differ in terms of clear processes and responsibilities respectively creative and spontaneous features.

Project cultures that do not apply LPS are slightly dominated by cooperative characteristics, but also by remarkable competitive features. The levels of trust and control are high.

In terms of mutual understanding, the project cultures are characterised by information asymmetries as the MC gains a high level of knowledge about the tasks and issues of all other stakeholders through monitoring them in the meetings, whereas the other parties have detailed knowledge about their own tasks and issues, but only a rough overview about the other stakeholders. This is especially for the relationship between the MC and the SCs true, that are

the stakeholder groups that participate at the production control meetings. Figure 42 visualises this relationship and the communication between the MC and the SCs in the context of the Principal-Agent theory: both parties share information during the production control meetings and the MC monitors the SC and their actual performances.

Figure 42 - Visualisation of Main Contractor - (Sub-) Contractors' relationship in the Principal-Agent Theory – projects without applying LPS
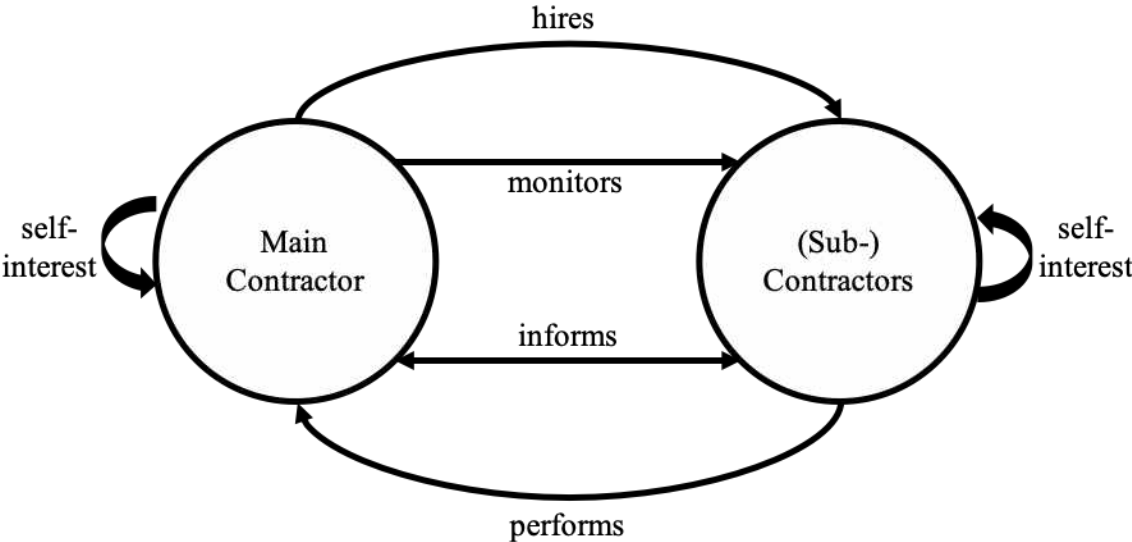
Related to Cerić (2012b, 772; 2016, 106)

In summary, the project cultures that do not apply LPS are slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries.

5.4 Results cases applying LPS

The results about the cases that apply LPS are presented in the same order as for the cases not applying LPS. First, the meetings' structures for each case is presented, based on the QCA of the interviews. Next, the categories 'CVF', 'Mutual Understanding', and 'Trust vs. Control' for three projects of each group are compared, based on the QCA and the investigations of the surveys.

5.4.1 Project culture Case 7

5.4.1.1 Case 7's meeting structure

The production control meetings take place on a weekly basis. The various site-managers and foremen from the MC and the different SCs participate. None of the CL's staff participates. The project applies the visualization of the work packages through sticky notes with different

colours, one for each trade, as a tool from LPS. One site manager acts as the facilitator of the meetings.

The meetings are structured as follows. First, the last week is reviewed. The facilitator asks the representative of the respective work package if it could be fulfilled as planned in the past week. If yes, the sticky note gets removed from the schedule. If not, the reasons for not-fulfilment get discussed. Next, the facilitator updates the milestones for the next 10-12 weeks. The MC's staff defines events that he perceives as mostly crucial as milestones. As an orientation, the MC has an overall schedule for the entire project which is updated monthly. The MC does not share this schedule with the other stakeholders as he perceives that this is not necessary as they get all relevant scheduling information during the LPS meetings. The CL says that he did not get any updated schedule since the beginning of the project and estimates this as drawback and presumes that this is strategically motivated by the MC.

In the next step, the next 4-6 weeks get jointly planned in detail whereas the not-fulfilled tasks are included in this planning process. The focus is on finding solutions to reach all milestones. If this is not possible, the single milestones get moved backwards and all participants try to find ways to catch up other processes to fulfil the target of the project's completion date.

The MC's site manager takes pictures of the not-fulfilled tasks and the updated schedule and stores them, without sharing. Some SC's foremen take pictures from the updated scheduling wall and use them for their work-preparation and -control.

5.4.1.2 Case 7's within-case analysis

Table 38 shows the OCAI's results, which are visualised in the CVF in Figure 43.

Table 38 - OCAI results Case 7

	Case 7	Common Project Culture	Intended Partnering Culture
Clan	17.6	18.7	31.2
Market	32.2	34.9	20.7
$Mean_{C-M}$	-7.3	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	36.3	29.0	27.6
Adhocracy	13.9	17.3	20.6
$Mean_{H-A}$	-11.2	-5.9	-3.5
Evaluation	Hierarchy	Balanced	Balanced

Figure 43 - CVF Case 7
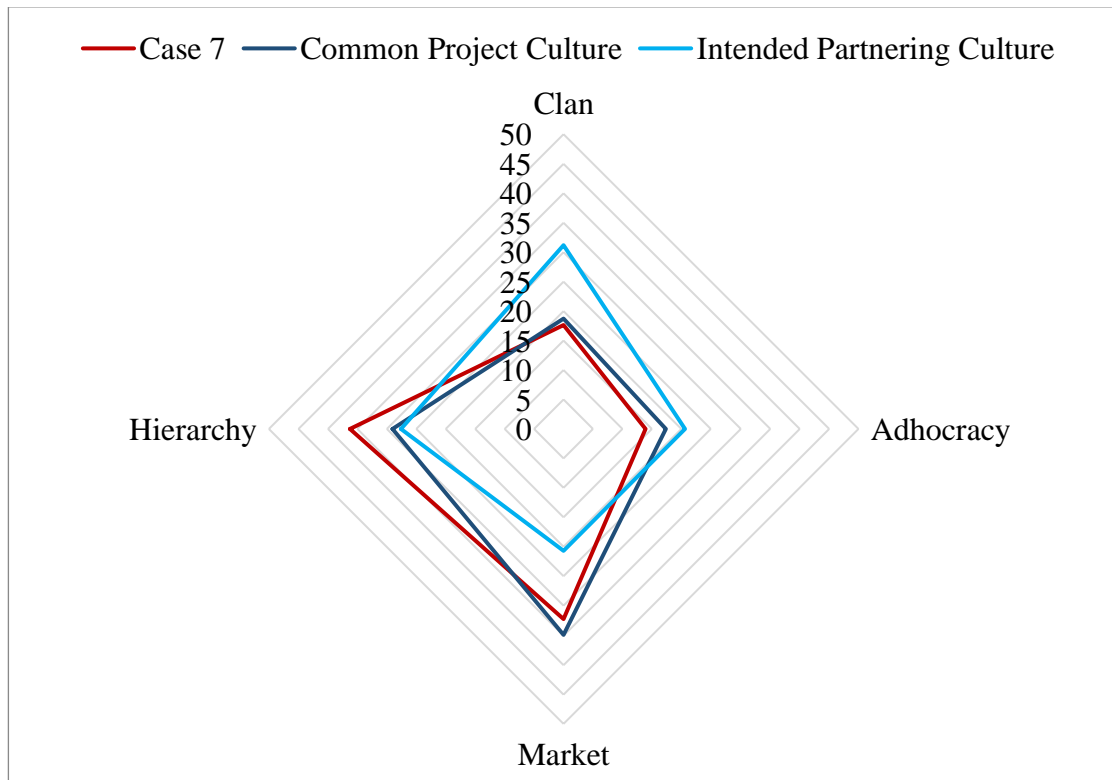
The OCAI's results show on the Hierarchy – Adhocracy axis a pronunciation from the features of the Hierarchy quadrant. This expression is also in comparison to the usual project culture and the intended partnering project culture high. However, the triangulation with the QCA indicates that Case 7's project culture is only slightly dominated by the features from the Hierarchy quadrant with remarkable features from the Adhocracy quadrant (see Table 41).

Table 38 and Figure 43 show that Case 7's project culture is balanced on the Clan-Market axis, but mainly characterised by competitive features and remarkably cooperative features. The triangulation in Table 41 shows that the features on the Clan-Market axis are levelled. This estimation gets reinforced by the participant's clear statements that they distinct about the trustworthiness of the different project members as this differs between the individuals (see Table 42). The level of control is perceived as high between all stakeholders (see Table 42) and all participants report that they have a high level of understanding about the tasks and issues of all other parties (see Table 43), despite the information asymmetry through the MC's withhold about the updated overall project schedules.

In conclusion, Case 7's project culture can be described as equally pronounced by partnering- and competitive features whereas the project members distinct between the behaviours of individual project members in this context.

5.4.2 Project culture Case 8

5.4.2.1 Case 8's meeting structure

The production control meetings take place on a weekly basis. Various site-managers and foremen from the MC and the different SCs participate, but none of the CL's staff. The project applies the visualization of the work packages through sticky notes with different colours, one for each trade, as a tool from LPS. In Case 8 the PPC score is calculated. Only the MC that acts as LPS' facilitator roughly knows the average score (80%).

The meetings are structured as follows: First, the last week is reviewed. The facilitator asks the representative of the respective work package if it could be fulfilled as planned in the past week. If yes, the sticky note gets removed from the schedule. If not, the facilitator asks for the reasons for the not-fulfilment, but doesn't question them much in detail. The MC's staff reports that they did so earlier by using an evaluation chart about the reasons for not-fulfilments of commitments, but that this led to a tense atmosphere as participants felt offended. Thus, the MC's staff decided that issues get not discussed in detail to keep a peaceful atmosphere, as long as the issues do not critically affect the overall schedule.

After the review of the last week, the facilitator updates the milestones for the next 12 weeks. The MC's staff defines the milestones. The MC has an overall schedule for the entire project which is updated all two-three months, but not shared with other stakeholders.

In the next step, the next 6 weeks get jointly planned in detail whereas the not-fulfilled tasks are included in this planning process. The focus is on finding solutions to reach all milestones. If this is not possible, the single milestones get moved backwards and all participants try to find ways to catch up other processes to fulfil the target of the project's completion date.

5.4.2.2 Case 8's within-case analysis

Table 39 shows the OCAI's results, which are visualised in the CVF in Figure 44.

Table 39 - OCAI results Case 8

	Case 8	Common Project Culture	Intended Partnering Culture
Clan	35.5	18.7	31.2
Market	22.3	34.9	20.7
$Mean_{C-M}$	6.6	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	27.6	29.0	27.6
Adhocracy	14.5	17.3	20.6
$Mean_{H-A}$	-6.6	-5.9	-3.5
Evaluation	Balanced	Balanced	Balanced

.

Figure 44 - CVF Case 8
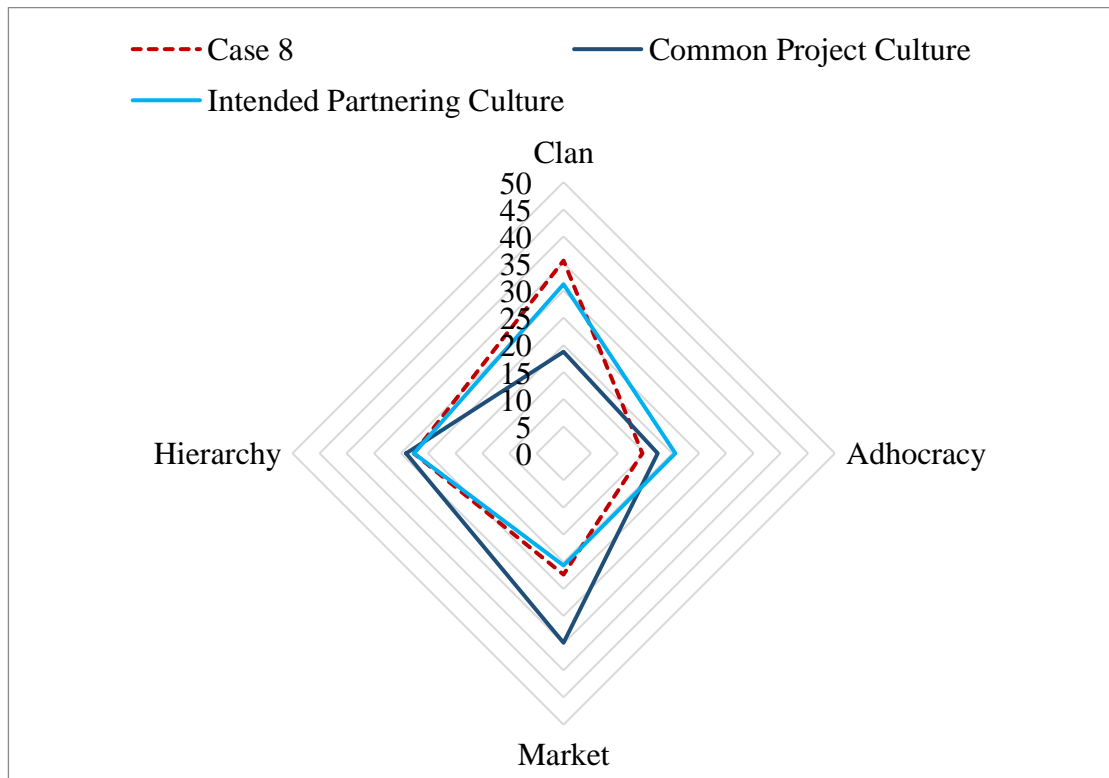
The OCAI's result show that Case 8's project culture has very high scores from the Clan quadrant. As the OCAI's results from the Market quadrant are also pronounced, the mean score on this axis must be ranked as balanced. The QCA's results (see Table 41) indicate that the

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culture is especially characterised by the features from the Clan quadrant. Thus, the triangulation ends in the conclusion that the project culture is slightly pronounced by the features from the Clan quadrant. It is striking that the project culture's shape in the CVF (see Figure 44.) is almost similar to the intended partnering culture and even a little more pronounced by the cooperative features from the Clan quadrant.

Furthermore, the project culture is characterised by a high level of trust within the project team, despite the perceived high level of control between the parties (see Table 42).

As in Case 7, all participants rank the level of mutual understanding as high between all trades (see Table 43) despite the information asymmetry which arises through the withholding of the overall schedule through the MC.

It is concluded that Case 8's project culture can be described as a partnering culture.

5.4.3 Project culture Case 9

5.4.3.1 Case 9's meeting structure

Case 9 applies weekly production control meetings where the site-manages and foremen from the MC and the different SCs participate, without CL involvement. The project applies the visualization of the work packages through sticky notes with different colours, one for each trade, as a tool from LPS.

One MC's site manager acts as the facilitator of the meetings. The meetings are structured as follows: First, the last week is reviewed. The MC's staff reports that they prepare for this review in detail and internally discuss the last week's performance before the LPS meetings. The necessary information is gathered through daily site observations from the MC's site managers and foremen.

At the internal preparation meeting, the project MC's project members discuss already how the schedule must be updated to reach the crucial project milestones. This process actually differs to the core idea of LPS – the inclusion of the Last-Planners in the scheduling process. The MC's senior site manager reports that this is a strategic decision as the involvement of the Last-Planners in past projects has led to long discussions during the meetings which were not perceived as expedient by the MC's staff. Therefore, the MC's company implements LPS without joint planning with the other stakeholders at all of its projects. The milestones are defined through an overall schedule which is updated on a monthly-basis by the MC, but not shared with the other stakeholders. During the LPS meetings, the MC's facilitator asks the SCs about the fulfilments of the planned tasks of the last week. The fulfilled tasks, represented by

the coloured sticky-notes, get removed from the schedule. The unfulfilled tasks stay on the wall. The reasons for not-fulfilled tasks are not discussed in detail as the MC perceives to know the reasons, and the solutions to improve the processes. After this procedure, the MC's staff presents the updated schedule for the next 4-6 weeks towards the SCs by rearranging all sticky notes. The updated schedule is then discussed with the SCs.

5.4.3.2 Case 9's within-case analysis

Table 40 shows the OCAI's results, which are visualised in the CVF in Figure 45.

Table 40 - OCAI results Case 9

	Case 9	Common Project Culture	Intended Partnering Culture
Clan	28.0	18.7	31.2
Market	20.8	34.9	20.7
$Mean_{C-M}$	3.6	-8.1	5.3
Evaluation	Balanced	Balanced	Balanced
Hierarchy	32.5	29.0	27.6
Adhocracy	18.6	17.3	20.6
$Mean_{H-A}$	-6.9	-5.9	-3.5
Evaluation	Balanced	Balanced	Balanced

Figure 45 - CVF Case 9
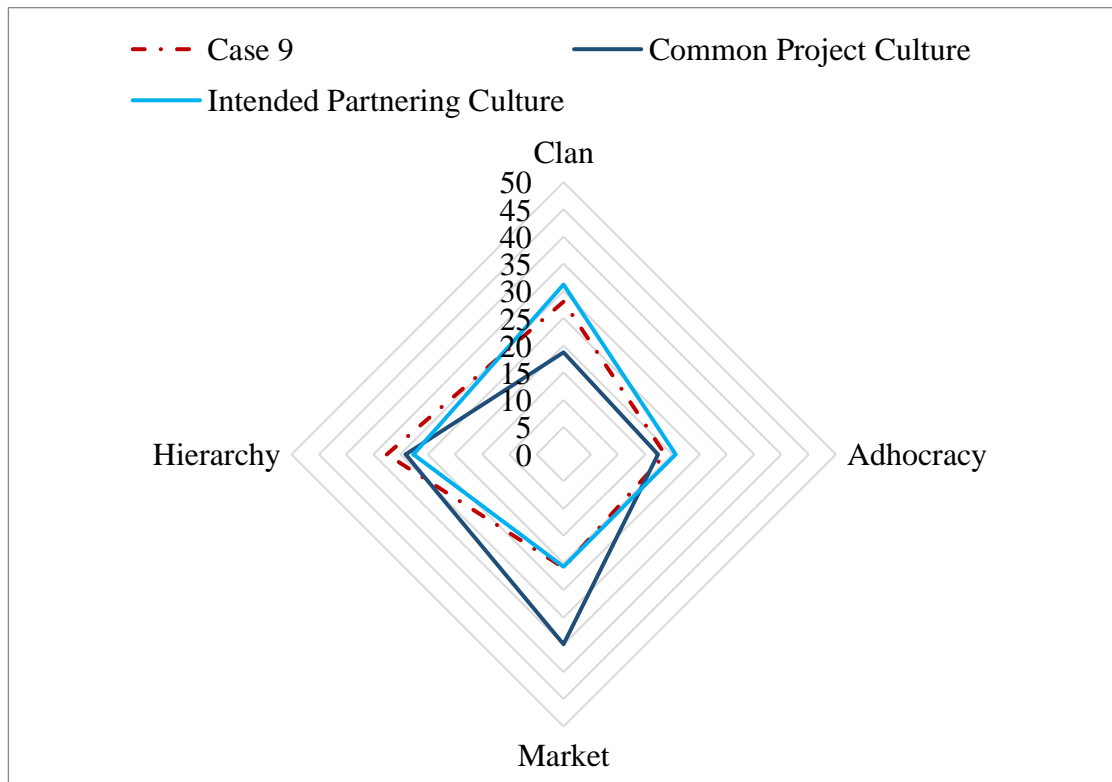
The OCAI's result show that Case 9's project culture has high scores from the Clan quadrant. As the OCAI's results from the Market quadrant are also pronounced, the mean score on this axis must be ranked as balanced. The QCA's results (see Table 41) indicate that the culture is especially characterised by the features from the Clan quadrant. Thus, the triangulation ends in the conclusion that the project culture is slightly pronounced by the features from the Clan quadrant. Table 41 shows that the project culture is slightly pronounced by the features from the Hierarchy quadrant, which also means that features from the Adhocracy quadrant are still remarkable. It is striking that the project culture's shape in the CVF (see Figure 45) is almost similar to the intended partnering culture, but only with few more scores of the Hierarchy quadrant.

As in Case 7, the participants distinguish clearly between the trustworthiness about the single project members and the perceived level of control between the project team is perceived as high (see Table 42).

Differently to the other two cases that apply LPS, the level of mutual understanding differs between the stakeholders (Table 43), whereas the MC has a high level of knowledge about the tasks and issues from the others and the other stakeholders have only a rough overview about

the processes of the other parties. This difference seems to be come through the application of LPS without involving the other stakeholders in the planning processes.

In conclusion, Case 9's project culture can be described as slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries and the intentional application of LPS without involving the SCs in a joint planning process.

5.4.4   Cross-case analysis: cases applying LPS

5.4.4.1   Meeting Structures

The regularity of the production control meetings is equal at all LPS cases. The weekly LPS meeting's participants are site managers and foremen of the MC and the SCs. None of the CLs participates. Visualization of the work packages through sticky notes is the only used tool from LPS used in the three cases. At only one case, the PPC score is determined, but not discussed during the LPS meeting. All LPS meetings are characterized by a clear and equal structure: A site manager acts as the facilitator. A review about last week's tasks is done.

The projects differ regarding the discussion on reasons for the not-fulfilments. While Case 7 discusses the reasons in detail with all participants to avoid repetition and to improve the processes, Case 8 avoids such a discussion with the motivation not offending anybody in front of the others, thereby risking the partner-like atmosphere. Case 9 does not discuss reasons for not-fulfil tasks as the MC perceives to know the reasons for the issues.

After the review, the next weeks get planned at all projects in different ways. Case 7 and Case 8 update the milestones for the next 10-12 weeks. Hereafter, they plan the tasks towards the milestones of the upcoming 4-6 weeks jointly with the SCs in detail.

At Case 9, the MC plans the processes for the upcoming 4-6 weeks before the LPS meetings in detail and presents this schedule towards the participating SCs. This process actually differs to the core idea of LPS – the inclusion of the Last-Planners in the scheduling process. The MC's senior site manager reports that this is a strategic decision as the involvement of the Last-Planners in past projects has led to long discussions during the meetings which were not perceived as expedient by the MC's staff. Therefore, the MC's company implements LPS without joint planning with the other stakeholders at all of its projects.

At all three projects, the MC updates an overall schedule, uses this as an orientation for the LPS meetings, but does not share these versions with the other stakeholders.

5.4.4.2   Competing Values Framework

Figure 46 visualises the OCAI's results about the individual project cultures. Table 41 shows the triangulation of these results and the QCA. It becomes clear that the project cultures show especially varying characteristics from features of the Clan- and Market axis. This statement gets supported by the OCAI's scattered scores and the multiple statements that the project members differentiate who is trustworthy, and who is not. Compared to the common project culture and the intended partnering culture on the Clan-Market axis, it is remarkable that Case 7's cultural characteristics are very similar to the common project culture. In contrast, Case 8's and Case 9's project cultures are very similar to the intended partnering culture.

The cultural features on the Hierarchy-Adhocracy axis differ slightly between all three cases that apply LPS. Nevertheless, they all are especially characterised by features from the Hierarchy quadrant with recognizable pronunciations of the Adhocracy quadrant. In comparison to the common project culture and to the intended project culture, the project cultures are slightly more pronounced by the features from the Hierarchy quadrant.

Figure 46 - CVFs Cases applying LPS
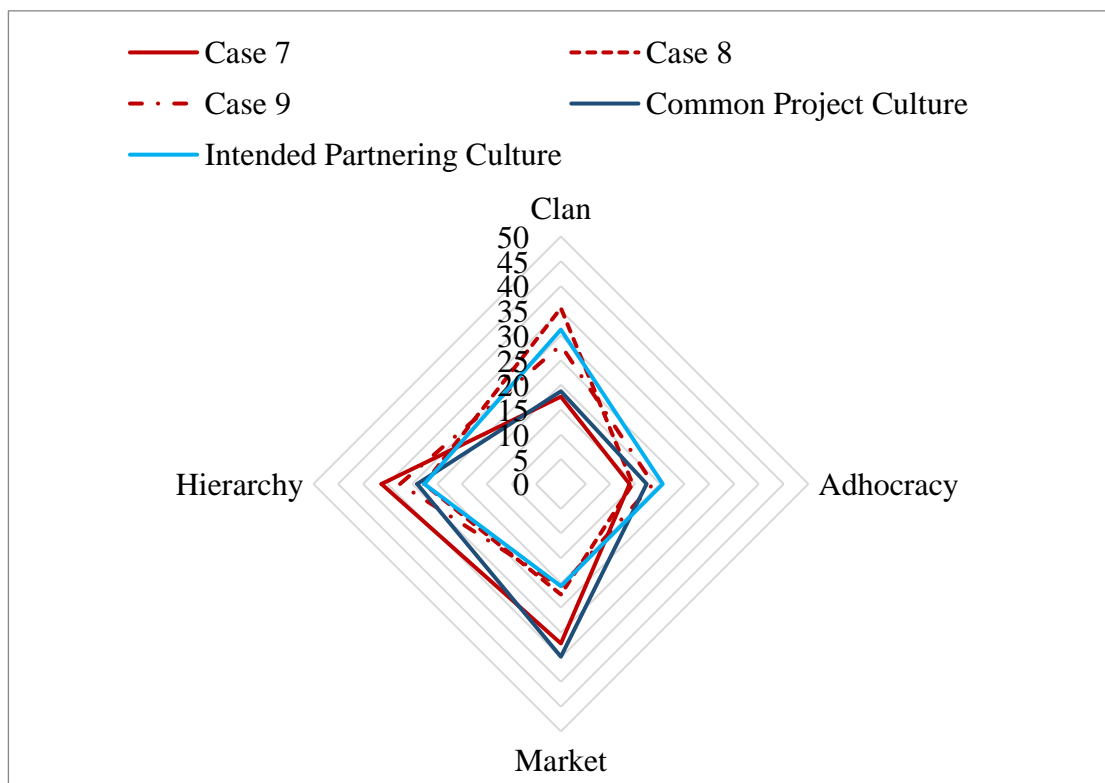
Table 41 - Competing Values Framework: Comparison of data gathered through interview's QCA and OCAI - projects that apply LPS

Case	Axis	OCAI evaluation	Project culture QCA	Summary	Conclusion
7	Clan-Market	Balanced	2 * Clan 3 * Balanced 1 * Market	Balanced	Balanced
	Hierarchy-Adhocracy	Hierarchy	1 * Hierarchy 3 * Balanced 2 * Adhocracy	Balanced	Slightly Hierarchy
8	Clan-Market	Balanced	5 * Clan	Clan	Slightly Clan
	Hierarchy-Adhocracy	Balanced	2 * Hierarchy 2 * Balanced 1 * Adhocracy	Balanced	Balanced
9	Clan-Market	Balanced	3 * Clan 1 * Balanced 1 * Market	Clan	Slightly Clan
	Hierarchy-Adhocracy	Balanced	3 * Hierarchy 1 * Balanced 1 * Adhocracy	Hierarchy	Slightly Hierarchy
Summarizing Cases applying LPS	Clan-Market	Project 7 differs with Balanced, Projects 8 and 9 slightly Clan			
	Hierarchy-Adhocracy	Differences between the projects: 2 times slightly Hierarchy, 1 time balanced			

5.4.4.3 Trust vs. Control

Table 42 shows the different trust levels of the projects that apply LPS. Especially the project members from Case 4 and Case 6 report that are influenced by their experiences about the fulfilment of tasks of the others, which becomes visible during the LPS meetings and that these experiences influence their perception of the trustworthiness of the individual persons. The level of control is also perceived as high, especially through the application of LPS (see Table 42). Nevertheless, the interviews have shown that the SCs do not perceive this as a negative

control mechanism, but as self-control about the upcoming tasks, which is helpful for their work-preparation.

Table 42 - Qualitative content analysis of cases applying LPS: Level of Trust and Level of Control

Case	Level of Trust		Level of Control	
	Distribution	Summary	Distribution	Summary
7	2 * High 4 * distinction between different project participants	Balanced / Distinction	4 * High 1 * few control (CL, not participating at LPS)	High
8	4 * High 1 * distinction between different project participants	High	5 * High	High
9	1* High 4 * differentiate between single individuals	Balanced / Distinction	5 * High	High
Summarizing Cases applying LPS	-	2 * Balanced/ Distinction 1 * High	-	High

5.4.4.4   Mutual Understanding

The level of mutual understanding about the different tasks and issues from all project participants is high at the two cases where the Last-Planners are involved in the planning process (Table 43). At Case 9, where the updated planning is done by the MC, they only claim to have a high level of understanding of the current work packages and issues from all stakeholders. The SC's report that they have detailed knowledge about the own trade, but only a rough overview about the other trades.

Table 43 - Qualitative content analysis of cases applying LPS: Level of Mutual Understanding

Case	Level of Mutual Understanding
	Distribution
7	6 * High about all trades and issues
8	5 * High about all trades and issues
9	2 * MC: High for all trades 1 * CL / 2 * SC: Detailed knowledge about own trade and tasks, rough overview about the other trades and issues
Summarizing Cases applying LPS	2 * High between all trades 1 * (Case 6): High from MC over tasks from SC and from CL over tasks from MC and SC

5.4.5 Conclusion about project cultures not applying LPS

SRQ3.2 about the characteristics of project culture in construction projects applying LPS can be answered as following:

The meeting structures of projects that apply LPS are characterised by very similar and clear structures.

The project cultures differ in terms of clear processes and responsibilities respectively creative and spontaneous features, whereas two of the three project cultures are slightly pronounced by the features from the Hierarchy quadrant, and one project culture is balance on the Hierarchy-Adhocracy axis.

In terms of mutual understanding, the projects where the joint planning processes are conducted (Case 7 and Case 8), the project cultures are characterised by a high level of knowledge about the tasks and issues from all stakeholders. This relationship with the mutual monitoring is visualised in Figure 47 in the context of the principal-agent theory.

At the project (Case 9), where LPS is applied without involving the SC, the level of mutual understanding differs. The MC has a good overview of the actual construction processes and issues of the various participants. The other parties have only a rough overview of the processes and issues from the other project parties, but a good overview of their tasks. So, the relationship can be expressed as shown in Figure 42, which shows the MC – SCs relationships with a one-way monitoring from the MC towards the SCs.

visualises this relationship and the communication between the MC and the SCs in the context of the Principal-Agent theory: both parties share information during the production control meetings and the MC monitors the SC and their actual performances.

Figure 47 - Visualisation of Main Contractor - (Sub-) Contractors' relationship in the Principal-Agent Theory – LPS projects with joint planning processes
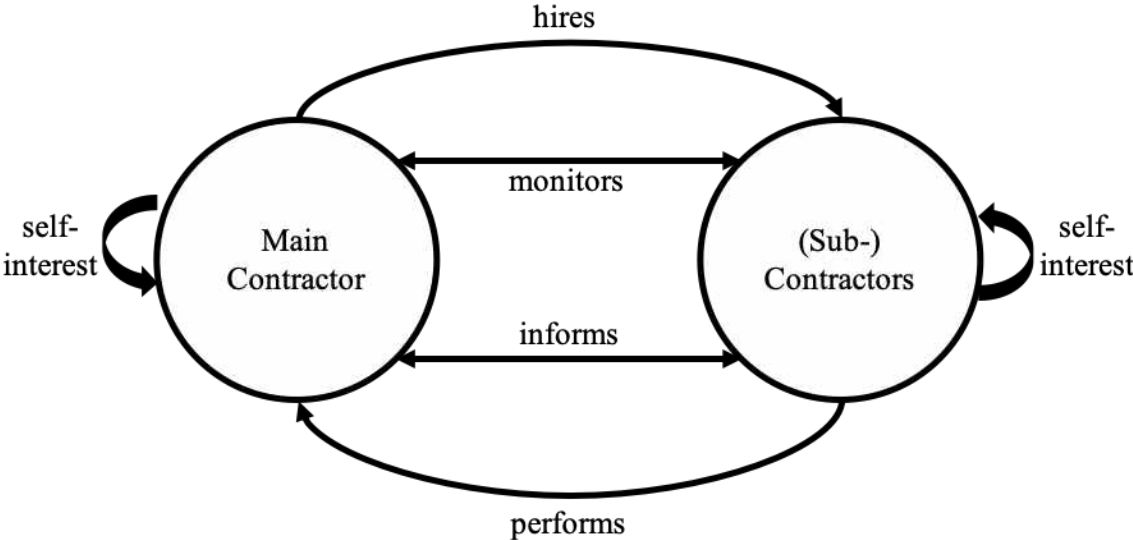
Related to Cerić (2012b, 772; 2016, 106)

The members of projects applying LPS differentiate about the trustworthiness of the other project members. This is also recognisable as the cases that apply LPS differ on CVF's Clan-Market axis.

It is concluded that project cultures of projects that apply LPS differ in terms of partnering. The high level of mutual understanding enables the project members to know who acts partner-like, and who does not, but this knowledge does not necessarily lead towards more partner-like behaviours.

5.5 Comparing project culture not applying and those applying LPS

5.5.1 Meeting Structures

The production control meetings are less structured at projects that do not apply LPS than at those which apply LPS. The projects applying LPS apply a more structured and weekly review of the past processes as an indigent of the LPS meetings, even if they get supported by daily conversations on site. At all six projects, the MC update frequently schedules for the entire project whereas he creates for strategical reasons different versions which he shares with the different stakeholders as the CL and the SCs.

5.5.2 Competing Values Framework

Figure 48 shows the CVF with the shapes of the different project cultures, based on the OCAI. The project cultures in both groups differ with their pronunciation on the Hierarchy-Adhocracy axis. This represents different levels of clear processes and responsibilities vs. creative and spontaneous behaviours and that these are very individual, despite not applying or applying LPS. As shown in in Table 35 and Table 41, these findings were confirmed through the QCA's results.

On the Clan-Market axis, a pattern can be recognised that distinguishes the two groups of meeting systems.

All projects that do not apply LPS are very similar, which can be also clearly seen in Figure 41 and Figure 48. The triangulation with the QCA's results has shown that these project cultures and slightly characterised be the cooperative features form the Clan quadrant, which indicates remarkable behaviours from the Market quadrant (see Table 35).

Figure 46 and Figure 48 show that the OCAI results about the project cultures that apply LPS differ on this axis much more, which indicates different perceptions about cooperative or rather competitive behaviours within the projects. The triangulation with the QCA's results has confirmed that there are remarkable differences on this axis (see Table 41). The project culture from Case 7 is balanced on this axis, so it is evenly characterised by cooperative as competitive features and Case 8 and Case 9 are slightly characterised by the cooperative characteristics from the Clan quadrant and remarkable features from the Market quadrant.

Figure 48 - CVFs cases not applying and those applying LPS, based on OCAI results
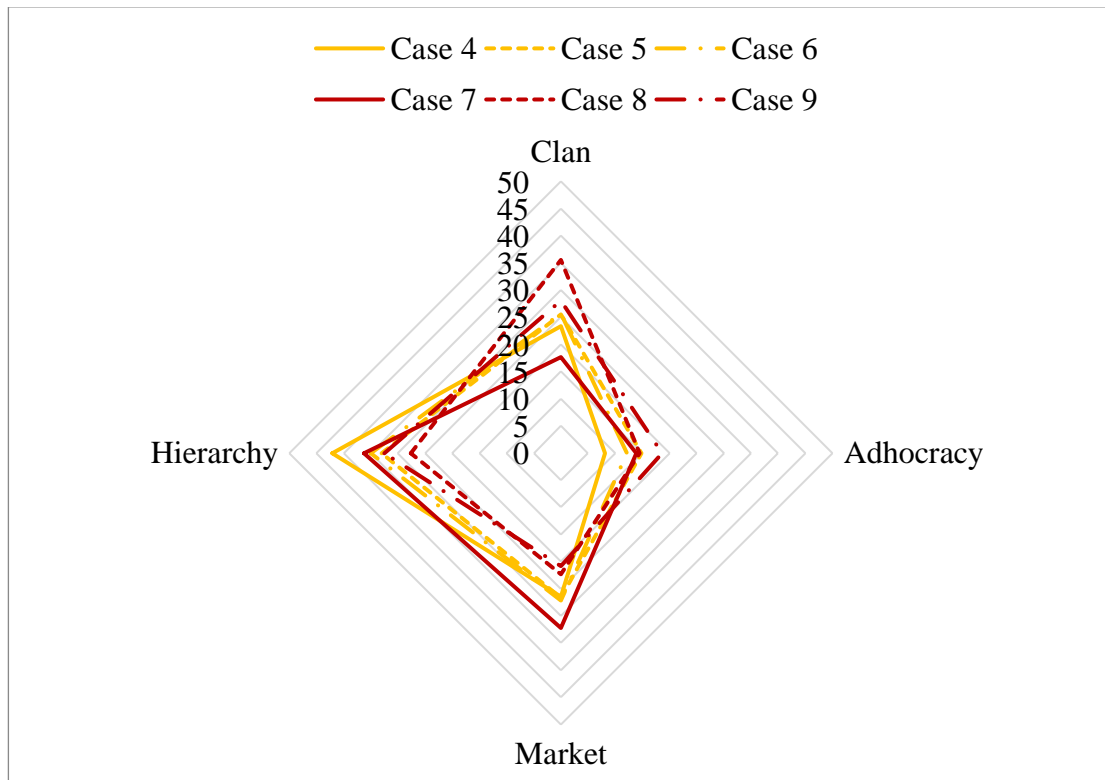
5.5.3 Trust vs. Control

At the projects, where LPS is not applied, the level of trust and the level of control are perceived as high. At two of the three cases that apply LPS, the participants distinguish very clearly whom they trust and whom not. It must be mentioned that Case 9, where the SC are not involved in the planning process, is one of these cases.

Thus, it can be concluded that LPS's structure and the visualisation of the tasks and their fulfilments respectively not fulfilment impacts the level of mutual control and trust whereas the less structured meetings lead to less knowledge about the tasks, issues and interfaces and through this towards a high level of trust. This does not necessarily mean that projects applying LPS have are characterised by a lower level of trust, but more over by a more specific estimation about trustfulness.

5.5.4 Mutual Understanding

The four cases where the SCs are not involved in the planning processes differ from the two cases where the SCs are involved in the planning process of the work packages and the interfaces of the upcoming weeks. The involvement of the active planning and discussion process affects especially the knowledge from the SCs about the current tasks and issues of the other SCs and thus the level of mutual understanding, which is one necessity for partnering

culture. At the four projects without SC's involvement, only the MCs claim that they have a good overview about the tasks and issues form all parties. The SCs and CLs perceive that they have only a rough overview about the tasks and issues from the other parties and a good overview about the own ones. At the two cases where the SCs are involved, all meetings participants report that they do not only have a good overview about the own tasks and issues, but also about those of the other parties.

5.6 Discussion

The previous Sections have shown that projects that do not apply LPS differ from those, that do apply LPS.

What is striking is that at all six cases, the level of control is perceived as high. This control differs between two groups of projects: those where the MC updates the schedules by his own and where he presents the results towards the other stakeholders (Case 4, Case 5, Case 6 and Case 9), and the projects where the review of the past tasks and issues and the update scheduling of the upcoming tasks is performed jointly (Case 7 and Case 8). In the first group, the control is unilateral, as only the MC has a high knowledge about the tasks and issues of all parties, which is expressed through the different levels of mutual understanding between the stakeholders. This relationship represents the original principal-agent theory as presented in Chapter 2 and in Figure 22 and Figure 42. In the second group, the joint review and planning leads towards a high level of mutual control and mutual understanding between all stakeholders. Thus, in terms of the principal-agent theory, there is a change as presented in Figure 47, where the monitoring is bilateral. The resulting high level of mutual understanding is an indicator for partnering, as presented in Figure 2.

Nevertheless, it is striking is that the project members at all three projects that apply LPS (jointly, and with the corresponding high level of mutual understanding as in Case 7 and Case 8, and not jointly without a high level of mutual understanding as in Case 9) name and distinct explicitly about the trustworthiness of single project participants. This ability to differentiate about the trustworthiness might be rooted in the structured review of the past tasks and the upcoming work packages, interfaces and correlations which are easy to understand through LPS's visualisations. This investigation about the different assessments about who is trustworthy, confirms the findings from Priven and Sacks (2013, 543) and Uusitalo et al. (2020, 11). As this differentiation is so noticeable, it must be questioned if LPS really leads to an improved willingness to complete tasks and promises as described by Ballard and Tommelein (2016, 8), or if it becomes just clear who keeps his promises, and who does not.

This means in terms of the relationship of trust and control that a high level of mutual control does not preclude trust, but that it enables to judge whether the other person is trustworthy, or not. Appropriately, the high level of trust at the projects that do not apply LPS represents basically trusting without really knowing the past and the upcoming tasks and who acts trustworthy, and who does not.

5.7 Conclusion

This study investigated the impact of the LPS on project culture, especially under the main aspects of collaboration as one level of partnering: trust and mutual understanding. The main research question was if LPS's application leads towards more collaboration between the participants.

In order to investigate this question, a multiple case study approach was chosen where quantitative and qualitative research methods were used to compare three projects that did not apply LPS with three projects where LPS was applied.

SRQ3.1 about the characteristics of project cultures in construction projects not applying LPS was answered as following: In terms of mutual understanding, these project cultures are characterised by MC's high level of knowledge about the tasks and issues of all other stakeholders. Those have detailed knowledge about their own tasks and issues, but only a rough overview about the other stakeholders. The level of trust is high in these projects.

In terms of the CVF, the projects not applying LPS are slightly dominated by Clan-features, but also noticeable features from the Market quadrant. All projects differ on the Hierarchy-Adhocracy axis which expresses the different levels of clear structures respectively spontaneous decisions at all projects. It was concluded that projects that do not apply LPS are slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries.

SRQ3.2 about the characteristics of project cultures in construction projects not applying LPS was answered as following: In terms of mutual understanding, those projects are characterised by a high level of knowledge about the tasks and issues from all stakeholders. The members of projects applying LPS differentiate about the trustworthiness of the other project members. This is also recognisable as the cases that apply LPS differ on CVF's Clan-Market axis. It was concluded that this is based on the high level of information which is achieved through the LPS meetings. It is concluded that project cultures of projects that apply LPS differ in terms of partnering. The high level of mutual understanding enables the project members to know who

acts partner-like, and who does not, but this knowledge does not necessarily lead towards more cooperative behaviours.

The cultural differences between projects not applying and applying LPS were investigated to answer *SRQ3*. The crucial difference between these project cultures is that LPS leads towards a higher level of mutual understanding and mutual control and through this to a clearer distinction about the trustworthiness of the other project members. It was concluded that this does not necessarily mean that LPS leads towards a higher level of partnering. Through this, the project cultures of projects that apply LPS vary a lot in terms of cooperative and competitive behaviours.

In contrast, project cultures that do not apply LPS have a low level of mutual understanding and mutual control. Through this, the cooperative and competitive features of these project cultures are very similarly perceived as balanced, which is rooted on the lack of information about the behaviours of the other parties.

These findings enable to answer research question *SRQ4*, which is if LPS's application leads towards a partnering project culture. As described, projects that do not apply LPS are slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries. The projects that apply LPS vary more in terms of partnering.

It was concluded that the high level of mutual understanding enables the project members to know who acts partner-like, and who does not, but this knowledge does not necessarily lead towards more cooperative behaviours. Therefore, the answer to *SRQ4* is that LPS does not necessarily leads towards a partnering project culture, but that the level of partner-like behaviours becomes clearer through its application.

Therefore, LPS's implementation can be recommended to improve mutual control, which can lead to the early detection of issues through the joint awareness about upcoming issues. To build a collaborative culture, which is characterised by trustfully behaviours and a common strive for mutual goals, other approaches must be found.

6 FEEDBACK FROM PRACTISE

6.1 INTRODUCTION

Chapter 5 has shown that the "Last Planner® System of Production Control" (LPS) (Ballard 2000, 3-1) is applied differently at projects and that if it is used as a joint planning process (which is its original idea), it leads towards a high level of mutual understanding between all participants, which is next to trust one necessary aspect of a partnering culture. However, the study's main finding is that LPS leads especially towards a high level of mutual control which enables all project participants to differentiate who behaves trustworthy, and who does not. Despite the high level of mutual control, this does not necessarily lead towards more trustworthy behaviours, which was shown through the participant's distinct differentiation about the trustworthiness of other individuals.

Chapter 1 and Chapter 2 have shown that the traditionally competing and adversarial project cultures are especially rooted in conflicting project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1). This was confirmed by the findings of Chapter 4. Nevertheless, Chapter 4 has also shown that the various stakeholders consider especially efficiency as the main reason to strive for partnering behaviours in construction projects (see Figure 36). LPS's application leads towards a higher level of productivity (Fernandez-Solis et al. 2013, 359), so to efficiency.

Main Contractors (MC) usually decide whether or not to introduce and facilitate LPS on construction projects. The question arises: are MC willing to implement LPS if they know Chapter 5's outcomes – that LPS leads towards a high level of mutual control between all stakeholders, which also means that other stakeholders get more understanding about the different contractual motivations and issues between them and the MC?

Therefore, SRQ5 was formulated as following:

What is the relevance of the findings about LPS's impact on project culture?

6.2 RESEARCH DESIGN

To answer this SRQ5, a group discussion in a workshop setting with a MC was arranged. Such a group discussion is a qualitative method to gain multiple data, based on the outcome of the dynamic discussion of various individual experts (Weber 2015, 100; Maylor et al. 2017, 190).

The outcomes of such group interviews are strongly subjective and attitudinal (Weber 2015, 53) and the facilitator of such a research workshop has an active role in the process of the discussion (Weber 2015, 100 ff.).

The workshop's participants (7 in total) were chosen based on their job functions with the aim to have representatives from different functions and hierarchies to gain a comprehensive view on the findings. Three managers of two different subsidiaries, the head of the company group's partnering strategy, one senior site manager, one site manager and one foreman were involved. The senior site-manager, the site manager and the foreman applied LPS by themselves and the other participants knew the system through different presentations and from feedback about the system's application on sites from their staff.

First, the results from Chapter 4 about the definition of the common project culture and the intended partnering project culture were presented. Next, the results from Chapter 5 about the cultural differences between projects not applying and those applying were presented.

After the presentation of the research results, the following questions were asked to facilitate the discussion:

1.) Do you agree with the definitions about common project and the intended partnering project culture?
2.) Were the findings about LPS's impact on project cultures foreseeable?
3.) Which ingredients of the partnering framework by Nyström (2005, 478) (see Figure 2) could improve project cultures under the aspects of partnering?

6.3   RESEARCH RESULTS

First, it was discussed why the industry is known for the described cultural features instead of more partner-like conditions. It was argued that the adversarial culture is necessary as MC's contracts are "never" adequate and that the focus on the own interests is necessary to make money. One participant reported that partnering only makes sense if the CL had not defined the final design of the construction without consulting the MC with his experience and that shared goals can only be defined and achieved through the MC's involvement in the design processes.

Regarding LPS's impact on project culture, the participants replied that it was not foreseeable that LPS does not necessarily lead towards a partnering project culture, as LPS is often described as improving collaboration and partnering behaviours and the according cultural features. Nevertheless, the participants agreed that LPS is especially a controlling tool and that

the outcome – the ability to recognise easily and in detail which trade is performing as expected – is its biggest added value.

Next, the group discussed one project where LPS was applied in detail. The manager and the senior site manager were directly involved in this project. The project was characterised by adversarial relationships between the participant's company, its joint-venture partner, and the CL. The experience of the senior site manager, the site manager and the foreman is that LPS did not help to solve issues. Rather, they agreed that LPS's main value is to make the issues transparent. This discussion concluded that LPS is after all an "early warning system" which enables the project members to intervene earlier than in projects where LPS is not applied and where issues are later recognised.

The foreman especially reported that he perceives that the (Sub-) Contractor's (SC) involvement in continuous planning processes helps to foresee issues as the trade's interfaces are estimated under their perspective. Further, he reports that he had observed that the involved parties felt more obliged for the fulfilments of their commitments. This observation represents the statement from Ballard and Tommelein (2016, 8) but does not entirely go along with the findings from the earlier sections, which have shown that LPS's implementation does not necessarily mean that such promises are kept.

The foreman reported furthermore, that the high level of fulfilling commitments is only true for those SCs that show the willingness to cooperate and that only those companies should be involved in LPS. He detects a threat that if parties are involved where the target is not to cooperate, but to strive for individual objectives, and which are in the worst case opposed to their objectives, LPS can be abused to manipulate schedules under the respect of the own interests.

This statement led the discussion in a different direction. The participants discussed that LPS can also easily be used to manipulate the other stakeholders under the aspects of their own specific interests. Examples are milestones that are defined and presented as necessary targets whereas the necessary production pace is chosen quicker than contractually agreed, or using LPS' visualisation to represent interdependencies to create and explain claims.

Furthermore, it was discussed whether the study's main outcome, that LPS does not necessarily change project cultures towards partnering, instead that it deepens the knowledge about the trustworthiness of the different project participants, has an impact on applying or not applying LPS in upcoming projects. The participants concluded that LPS should be applied in all upcoming projects as it improves the controlling mechanisms and the early detection of

impending problems. Thus, it can be concluded that changing project cultures towards partnering is not the main motivation for implementing LPS, but that LPS is seen as a method to structure and control the construction processes better than in traditional ways.

Finally, the workshop's participants were asked which other aspects from the presented partnering concept by Nyström (2005, 478) (see Figure 2) would change project culture towards partnering. The outcome of this discussion is, that especially the economic incentive contracts would have the biggest impact as they lead towards shared project objectives. This statement confirms the findings from Chapter 4 and reflect that different project objectives are one of the main roots for adversarial and competing project cultures (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1). Furthermore, it was agreed that also the choice of working partners, which is one of the partnering framework's ingredients by (Nyström 2005, 478) (see Figure 2), would have a big impact on the level of partnering.

The participants agreed that especially the trust level grows over multiple projects and experiences, where trust was reciprocally shown. This statement is in contrast to the findings from Wong and Cheung (2005, 76 ff.), who claim that time is not crucial in terms of trust and partnering, but it confirms studies such as from Loraine (1994, 8) and Beach et al. (2005, 612), which question in general if projects as environments with short-term relationships are capable to support trustful relationships.

6.4 DISCUSSION

The results from the group discussion have shown that LPS is perceived as a good controlling tool which helps to identify issues earlier that with alternative progress meeting approaches. The participants discussed that LPS could be used to manipulate the other stakeholders under the aspects of their own specific interests. This attitude represents the behaviour that was investigated in all six cases in Chapter 5, where the updated schedules were not spread at all, or manipulated for strategic interests, and then spread in different versions towards different stakeholders. One could argue that this part of the workshop's discussion represents the industry's long executed culture with the focus on its interests and the tendency to use tools and approaches to strive for individual goals and to manipulate others to their disadvantage sticking on traditional cultural patterns (Eriksson et al. 2008, 534 - 537). That the workshop's participants claimed that the common adversarial and competing project cultures are from their perspective necessary represents the construction industry's issue of contrary and conflicting project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1).

The described behaviour about the intended information asymmetries through the manipulated schedules is accordingly rooted in the individual self-interests of the different stakeholders which was explained in the principal-agent theory.

6.5 CONCLUSION

The research question SQR5 about the relevance of the findings about LPS's impact on project culture can be answered as following:

That LPS's implementation does not necessarily lead towards a partnering culture does not mean that LPS should not be applied. Moreover, LPS is perceived as a useful controlling instrument which can be used early indicate issues and to influence other stakeholders by determining individual project objectives and by discussing with the participating stakeholders how they can be reached.

7 DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this chapter, the dissertation's findings are discussed and concluded with the aim to stimulate scientific debate in the field of project management that is related to this study. Therefore, Section 7.1 discusses the study's findings, and the issues that were raised during the various steps and puts them in a broader context. In Section 7.1 also the limitations are discussed. In Section 7.2, the research questions are answered. Section 7.3 shows the dissertation's contribution to science. Finally, Section 7.4 presents recommendations for practice and shows opportunities for future research directions.

7.1 Discussion

In this section, the conducted research and its findings are discussed.

Chapter 3 has shown that 'Competing Values Framework' (CVF) by Cameron and Quinn (2011) and the belonging "Organizational Culture Assessment Instrument" (OCAI) are suitable instruments to measure and describe project cultures under the aspects of partnering. Nevertheless, Chapter 3 has also shown issues of this framework, which will be discussed in Section 7.1.1.

In Section 7.1.2, the relationship between trust and time is discussed. This is necessary as some scholars (Wong and Cheung 2005, 76 ff.) claim that trust can arise immediately and that the lengths of relationships have therefore no impact on partnering. Others (Loraine 1994, 8; Beach et al. 2005, 612) claim the opposite and also findings from Chapters 4, 5 and 6 suggest that there is a relationship between trust and the lengths of relationships.

In Section 7.1.3, the dilemma between trust and control is discussed, which was shown in Chapter 1. The findings from Chapter 5 can be used to enrich the discussion about this dilemma.

Section 7.1.4 is used to discuss the national cultural impact on project cultures as other scholars (like Sandrk Nukic and Huemann 2016; or Uusitalo et al. 2020, 16) discuss a relationship between the national cultural context and project cultures.

Chapter 1 has shown that LPS covers only some ingredients of the partnering framework by from Nyström (2005, 478). How this limitation influenced this dissertation is discussed in Section 7.1.5..

In Chapter 4, the intended partnering culture was defined. Section 7.1.6 is used to discuss if this definition is suitable for all phases of construction projects.

Section 7.1.7 shows the limitations of this dissertation.

7.1.1 The Organizational Culture Assessment Instrument's inner test reliability issue

This study used the 'Competing Values Framework' (CVF) by Cameron and Quinn (2011) and the belonging "Organizational Culture Assessment Instrument" (OCAI) for Chapters 3, 4 and 5 despite the findings about its lack of inner test reliability in Chapters 3, which was also reported earlier in literature as well (Helfrich et al. 2007, 7; Strack 2012, 36). Fortunately, the meaningfulness of the CVF's findings could be confirmed through qualitative investigations. However, as the OCAI was applied in the entire study in 9 Cases in total and for defining the common project culture and the intended partnering culture, OCAI's inner reliability could be verified with a bigger sample size (n = 195). Table 44 shows that compared to the Chapter 3 scores, considerably higher Cronbach Alpha coefficients were calculated with this bigger sample size.

Table 44 - Cronbach's Alpha coefficients all data

Quadrant	Cronbach's Alpha
Clan	0,77
Adhocracy	0.57
Market	0.77
Hierarchy	0.59

Especially the coefficients on the Clan-Market axis, which were of interest for investigating the impact of LPS on project culture in terms of partnering, are higher than the critical coefficient of 0,7 (Field 2018, 823), which strengthens the survey's reliability. Nevertheless the scores on the Hierarchy-Adhocracy axis below the critical coefficient of 0,7 (Field 2018, 823).

The CVF was used with its simplicity, applicability, and transparency with a focus on easily describing organizational culture (Strack 2012, 39) as an orientation at all 9 cases. The qualitative methods that were added gained deeper information about the project cultures, especially regarding 'trust' and 'mutual understanding'. This approach followed the triangulation of the chosen interpretivism research philosophy which was described in Chapter 1.3.1. As the qualitative findings could confirm the OCAI's outcomes in all cases it was concluded that OCAI's and CVF's use was reliable.

7.1.2 Trust and time

Wong and Cheung (2005, 76 ff.) have shown that the length of relationships is in general not crucial for the level of trust regarding a partner-like relationship. Vanneste et al. (2014, 1989) have shown that the direct influence of the relationship's duration on the level of trust has not been explored yet. However, models about (project) culture as from Hofstede et al. (2010, 385) (see Figure 10) showed that there is a relation between cultures, and therefore the trust level, and lengths of time as different stages of acculturation periods can range between three months at short affiliation times, and several years, if longer assignments are expected. This is also true for the model from Cerić (2016, 15) (see Figure 17), which describes trust as dynamic and as such continuously changing over time.

The findings of Chapters 4, 5 and 6 have confirmed that there is a relation between trust and time in construction projects. In Chapter 4, the MCs and the SCs stated that the length of relationships is crucial for implementing a partnering culture. The statements from the 'feedback from practice' workshop in Chapter 6 represented the same. The participants explained that trust must grow over long-term and multiple projects and that this process is crucial for creating a partner-like relationship. This goes along with data that Loraine (1994, 8) gained from practitioners, which stated that relationships need to last for longer time as for single projects to secure benefits on both sides and that culture therefore cannot be effected in single projects but must grow over a longer time-period. Beach et al. (2005, 612) question in general, if projects as environments with short-term relationships are capable to support a concept which is based on trust and collaboration. This goes along with the approach of 'strategic partnering' programs that differ to a 'partnering project' as the former are designed for multiple projects and aim to lead to the desired partnering cultures (Matthews et al. 1996, 120, referring to Bennett and Jayes, 1995) over a longer time frame.

Cases 4 - 6 have shown that project participants perceive a general high level of trust in construction project cultures in those projects where the "Last Planner® System of Production Control" (LPS) (Ballard 2000, 3-1) was not applied. It was concluded in Chapter 5 that the low level of controlling and knowledge about the current tasks and issues of the others lead towards this perception. Therefore, it should be discussed if trust should be distinguished into short-term trust, based on the actual experiences, which are usually based on limited knowledge about the others' trustworthiness, short-term trust, based on a high level of mutual understanding between the parties, which could be achieved through LPS's application, and long-term trust with multiple experiences about the trustworthiness of others.

7.1.3 The trust and control dilemma

As described in Chapter 1, there are different perspectives on the relationship between trust and control. The 'subsidiary perspective' describes that trust and control are in opposite to each other (Jørgensen and Åsgård 2019, 399) as controlling is a clear signal of distrust (Mayer et al. 1995, 712; Kadefors 2004, 177). The 'complementary perspective' describes mutual supportive effects between them (Jørgensen and Åsgård 2019, 399) as shown cooperation and trust improve its reciprocity (Kadefors 2004, 177).

The findings in Chapters 5 have shown that all stakeholders despite the Main Contractors have limited understanding about the current tasks and issues from the other parties, which can be equated with little control. Those projects are also characterised by a high level of trust between all parties. One could argue that this fits to the 'subsidiary perspective' (Jørgensen and Åsgård 2019, 399), so that limited control is equivalent to a high level of trust.

The findings in Chapter 5 about the projects that apply LPS, however, are different. The project cultures in those projects are especially characterised by a high level of mutual understanding about the current tasks and issues of all stakeholders, which is equivalent to a high level of control. The level of trust differs in these projects due to experiences about the trustworthiness of individuals, which gets evident through the high level of mutual understanding. This does not mean that the high level of control rules a high level of trust out. Moreover, it enables the project participants to recognise trustworthy respectively untrustworthy behaviours.

Therefore, the 'subsidiary perspective' (Jørgensen and Åsgård 2019, 399) cannot be confirmed as this would mean that the combination of a high level of trust and a high level of control would be impossible. It seems like the 'complementary perspective' is more suitable for the relationship between trust and control, under the condition that people in the project act trustworthy.

7.1.4 Project culture versus national cultural context

While other studies (like Sandrk Nukic and Huemann 2016; or Uusitalo et al. 2020, 16) put single project cultures or industry's cultures in national contexts and investigate their unique particularities in the national cultural context, this dissertation focused on cultures of individual projects within a single country, but without referring to the country's cultural particularities. The reason for focusing on this aspect is that project cultures, similar to organizational cultures, are influenced by multiple cultural dimensions that are beyond national cultural characteristics (Karahanna et al. 2005) because of the many individual project members with multiple (national) cultural backgrounds.

Next to the presented data from the Cases 1 - 3 from Chapter 3, the question was asked on the national cultural backgrounds of the participants. It was revealed that 54% of the participants have a German cultural background, while 46% of the participants have mixed, or non-German national cultural backgrounds. All individuals within an (project) organization influence each other and form an individual common culture through shared experiences (Schein 2017, 6), but all individuals are of course influenced by their individual (national) cultural backgrounds and history (Sackmann 2009, 4). Given the mixture of participant backgrounds in our study, putting projects only in the national cultural contexts of their localization seems to be too simplistic.

Nevertheless national, or local differences cannot be dismissed out of hand as they influence the individual project members with their unique background, and therefore also the project culture. Therefore, there might be differences of LPS's impact on project cultures in other cultural environments with different mixes of national cultural project members.

7.1.5 Additional impacts on project cultures

This study covers the impact of LPS, as a progress meeting, on project culture. As such, LPS covers some aspects of the used framework from Nyström (2005, 478) (see Figure 2) but not all. For instance, economic inventive contracts and the choice of working partners are named in this framework to have possible influences on culture in terms of partnering. The participants' satisfaction their contractual situation and the choice of the other project members was not investigated in this study, but the findings of Chapter 4 and Chapter 6 have shown that the various stakeholders see especially mutual project objectives as necessary to implement partnering. Contracting models that focus on such mutual project objectives and partnering are for instance 'Alliancing' and 'Integrated Project Delivery' (IPD) models (Hosseini et al. 2018, 2).

Besides the framework from Nyström (2005, 478), literature shows other critical impacts on project cultures and the level of partnering. This study investigated only the project cultures of the project members that participate at the progress meetings and did not directly include their supervisors. A broader context is shown in Figure 49, which sketches the relationships of three parties and two hierarchies for each party with their connections in relation to the principal-agent theory.

LPS's participants must be seen as a sub-culture of the entire project with a unique culture that can differ to other sub-cultures of the project. In Figure 49, they are pictured as the inner triangle and it becomes clear that the sub-culture that is shaped by these project members is also influenced by additional project members, as their supervisors, with their own self-interests and

direct or indirect, connections to other project members. In this relation, one crucial element might be that LPS takes place at the hierarchical lowest possible level but that the senior management support is especially crucial for implementing collaborative relationships successfully (Bresnen and Marshall 2000a, 822). Rother (2010, 37) points out that behaviours on the shop floor level are the reflection of the management, so there might be direct or indirect influences of the higher hierarchies on the participating hierarchies that hinder the collaboration. The mutual interactions of people that participate at the LPS meetings with their higher hierarchies were not investigated in this study.

Figure 49 - Principal-agent theory framework for construction projects with three parties
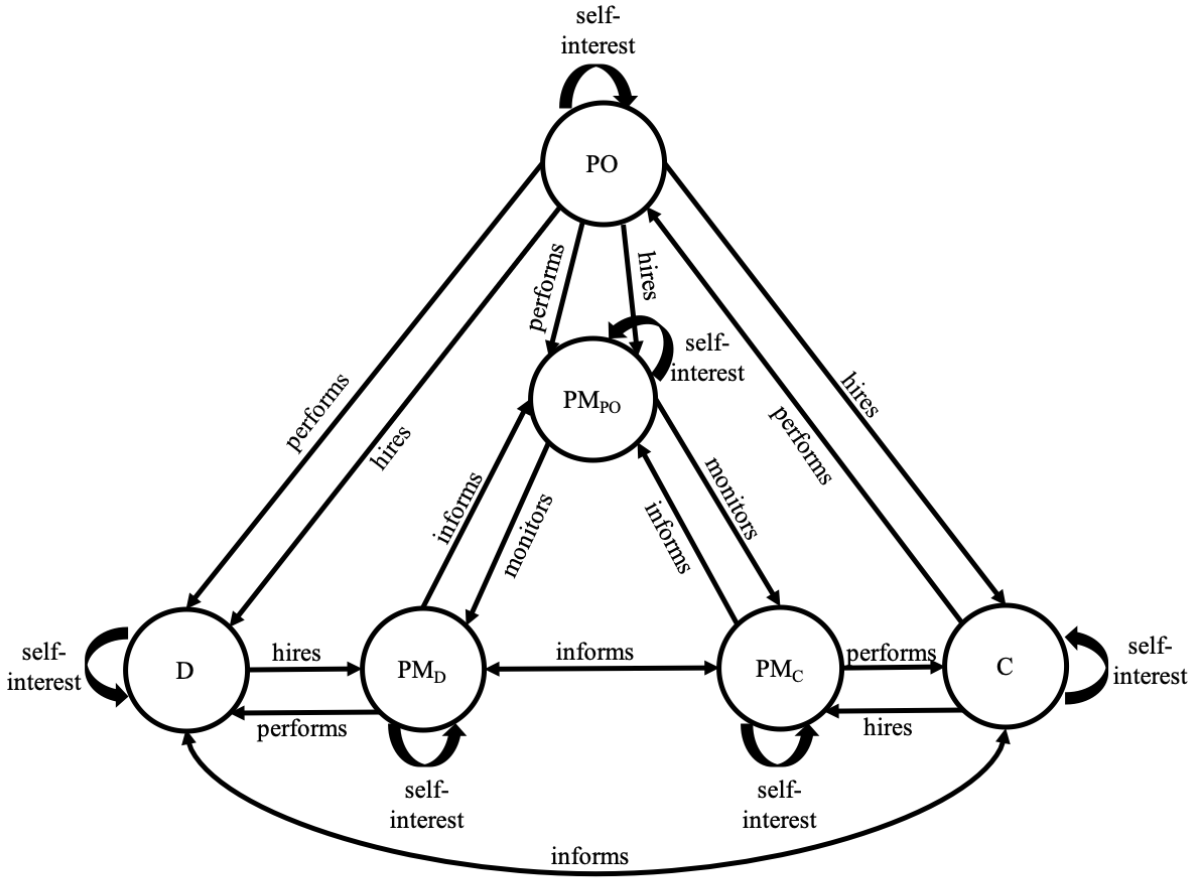
PO: Project Owner, C: Contractor, D: Designer, PM$_{PO}$: Project Owner's Project Manager, PM$_D$: Designer's Project Manager, PM$_C$: Contractor's Project Manager

Sources: Cerić (2012b, 772; 2016, 106)

7.1.6 The intended partnering project culture and different project phases

In Chapter 4, the intended partnering project culture was defined, based on the mean scores from different stakeholder groups. It should be discussed whether 'one' ideal partnering culture

exists, such as that presented in Figure 34, or if there would be ideal partnering cultures for different project phases and different stakeholder constellations. One could argue that early project phases with limited knowledge about the details better fit creative and spontaneous characteristics from the Adhocracy quadrant than the opposite clear structured features from the Hierarchy quadrant. The opposite could be true during the construction phases, wherein design changes can lead to the known issues at construction projects (Olawale and Sun 2010, 515).

7.1.7 Limitations of the research

This dissertation is limited to the German construction industry. As discussed, local cultural particularities influence all individual project members with their personal cultural background. Thus, projects in other locations might show other results. Another cultural limitation is that this dissertation covers only the turnkey construction industry as one unique sub-culture of the construction industry. In other sub-cultures as infrastructure projects, the results might differ as different tendering processes are applied in such public projects and different numbers of parties are involved.

Furthermore, cultures are dependent on temporal situations with variables such as the economic situation (Eschenbruch 2008, 4). Therefore, this study is also limited to the temporal context. All data were gathered in 2019 and 2020.

Case 1 of Chapter 3 has confirmed that (project) cultures are continuously, and sometimes even immediately changing. Therefore, investigations about project cultures are always only a snapshot about the common cultural conditions. The development of project cultures during LPS's implementation, or team building processes was not investigated.

The findings of Chapter 4 have shown that the various stakeholders see especially mutual project objectives as necessary to implement partnering, and this aspect was not considered in this study to keep the projects comparable by ensuring that the project cultures were not affected by specific contractual partnering arrangements.

In Chapter 5, it was assumed that project culture can be investigated by considering all perspectives with an equal weight in the calculations. It was not investigated in depth if there are different perceptions about LPS's impact on project culture.

7.2 Conclusions

This doctoral dissertation aimed to close the research gap about the impact of the 'Last-Planner® System of Production Control' (LPS) on project culture in terms of partnering.

This topic is of interest as partnering is a management approach (Racky 2008, 2) and was identified as an intended culture (Phua and Rowlinson 2004, 913; Bygballe et al. 2010, 245), which is currently remarkably desired in the German construction industry (Boldt 2020, 11; Haghsheno 2020, 13). Business approaches are used to implement such managing approaches (Racky 2008, 2). In Chapter 1 and Chapter 2, LPS as a progress meeting system was introduced and interfaces between partnering and LPS were shown, resulting in the hypothesis that LPS would impact project cultures under the aspects of partnering. In this study, the main research question was formulated:

How does the Last-Planner-System influence Project Culture?

To answer this question, several sub-questions were designed, which are answered subsequently to be able to answer to the main research question. As (project) cultures are by definition unique (Hofstede 1984, 82) and dynamic, so continuously changing (Sackmann 2009, 4), an interpretivism research philosophy was identified as suitable to answer the research question. In this interpretivism, social reality is seen as the product of everyday activities and interactions from a group of people (Blaikie and Priest 2019, 107). Therefore, mixed research methods consisting of quantitative and qualitative methods where chosen to answer the sub-research questions and through this the main research question.

7.2.1 SRQ1: How to measure project culture?

To investigate the impact of a variable, as a progress meeting, on project culture, it is necessary to make it measurable. A literature gap was identified that has shown that there are many different tools to describe and measure culture, but that there are only few information about measuring project culture as an unique sub-culture, especially under the aspects of partnering.

The first empirical phase of this dissertation, described in Chapter 3, was used to close this gap. The 'Competing Values Framework' by Cameron and Quinn (2011) (CVF) was identified as promising as it is often named as one of the most common frameworks (Yu and Wu 2009, 37; Cameron and Quinn 2011, 27; Ferreira 2014, 87) to measure organisation's culture. The 'Organizational Culture Assessment Instrument' is the survey that belongs to the CVF.

A multiple case study, consisting of three cases and with overall 22 participants was carried out to investigate if the OCAI and its CVF was the right approach to measure project culture under the aspects of LPS and partnering. The results have shown that the CVF lacks in terms of its inner reliability, expressed through Cronbach Alpha coefficients below the critical score of 0,7. Nevertheless, the CVF outcomes were confirmed through qualitative investigations. Because of this and the framework's advantages such as its simplicity, applicability, and transparency

with a focus on easily describing organizational culture, and especially to measure a common state and to identify an intended culture (Strack 2012, 39), it was concluded that the CVF is a suitable framework to measure project culture, especially to define the common and the intended partnering project culture, but that additional qualitative research methods must be added to gain more in-depth information about individual and project cultures.

7.2.2 SRQ2: What are the characteristics of the common- and the intended partnering project culture in the German turnkey construction industry?

The dissertation's second empirical phase in Chapter 4 was used to define the common and the intended project culture in the German construction industry. These examinations were necessary to investigate if LPS's application impacts project cultures in the hypothesised direction in the further steps of the research.

Using the determined quantitative framework to describe and to measure project culture, a workshop setting was chosen was chosen. Participants of these workshops were selected from different stakeholder groups and job functions to gather information from the different actors that shape project cultures. Overall, 3 organisations from each of the core stakeholder groups (CLs, MCs, SCs and Designers) participated, and 72 participants contributed to these 12 workshops.

The results showed that there are many similarities and few differences between the stakeholders' perspectives in terms of the common project culture and the intended partnering project culture.

The common culture is especially characterised by competitive behaviours and the stakeholders' respective interests and less, but remarkable by cooperative features. Furthermore, the common cultural characteristics are balanced on the Hierarchy-Adhocracy axis. So, it is to the same degree characterised by clear processes and responsibilities as by spontaneous and creative decisions and behaviours. The QCA, confirms literature's main reasons for this culture are especially different and contrary project objectives (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) and the traditional understanding of adversarial roles with the associated general mistrust between the different project members (Eriksson et al. 2008, 534 - 537). In addition, antipathy between individual project members, was evaluated as one main reason for the common competitive project cultures.

The intended partnering culture is especially characterized by cooperative features from the Clan quadrant, but also by remarkable features from the competitive Market quadrant. This means that especially high degree of collaboration is desired, but the study's participants see

also the necessity to strive for individual project objectives to a certain degree and to keep an eye on influences besides the joint project. The scores on the Hierarchy-Adhocracy axis are balanced with a slight tendency towards the features from the Hierarchy quadrant, so clear tasks and responsibilities, but also remarkable spontaneous and creative behaviours.

Based on the QCA, the major motivations to strive for this culture are especially a high degree of efficiency, and through this better project results, long-term relationships between the project members and a high motivation for the own staff.

Furthermore, the investigations have shown that mutual project objectives, open communication, clear distribution of tasks and responsibilities, mutual trust and partner-like interpersonal relationships are necessary ingredients of a partnering culture. Despite the long-term relationships, these aspects confirm the partnering framework by Nyström (2005, 478), which was presented in Chapter 1 and Figure 2.

7.2.3 SRQ3: How do project cultures of projects not applying and those applying LPS differ?

The third empirical phase is described in Chapter 5 and investigated LPS's impact on project culture. A multiple case study approach (Maylor et al. 2017, 208) was chosen to identify similarities and differences of projects that do apply LPS and those that do not apply LPS and to compare the findings of these groups. Three projects for each of these two groups were investigated by applying the OCAI and performing semi-structured interviews, which were evaluated through QCA. The focus of the investigations were the project's progress meeting approaches, investigations about the project cultures in the CVF, and in-depth information about trust and mutual understanding as the necessity ingredients of a partnering culture. Overall, 30 participants were involved in the investigations, divided over six projects.

The results showed that project cultures of projects that did not apply LPS are characterised by MC's high level of knowledge about the tasks and issues of all other stakeholders. The other stakeholders have detailed knowledge about their own tasks and issues, but only a rough overview about the other stakeholders. The levels of trust and control are perceived as high in these projects.

In terms of the CVF, the projects not applying LPS were slightly dominated by cooperative features of the Clan quadrant, but also by noticeable competitive features from the Market quadrant. All projects differed on the Hierarchy-Adhocracy axis which expresses the different levels of clear structures respectively spontaneous decisions at all projects. It was concluded that projects that did not apply LPS were slightly dominated by partnering features with

remarkable competitive characteristics, especially expressed through intended information asymmetries.

Project cultures of projects that did apply LPS differ. Their meetings were more structured and visual tools as sticky notes were used for a structured and weekly review of the past processes and for updating the schedule for the tasks and interfaces for the next few weeks. In terms of mutual understanding, those projects were characterised by a high level of knowledge about the tasks and issues from all stakeholders. The members of projects applying LPS differentiated about the trustworthiness of the other project members. This was also seen in the CVF scores on the Clan-Market axis, which expresses the level of cooperation vs. competition. It was concluded that this is based on the high level of information which is achieved through the LPS meetings. The high level of mutual understanding enables the project members to know who acts partner-like, and who does not, but this knowledge does not necessarily lead towards more cooperative behaviours.

The crucial difference between project cultures of projects that did not apply LPS and those that did apply LPS is that project cultures that did not apply LPS were very similar in terms of cooperative and competitive characteristics, whereas project cultures of projects that apply LPS varied a lot in these aspects. The explanation for this was found in the higher level of mutual understanding at projects that did apply LPS, as LPS's application leads towards a higher level of mutual understanding and mutual control and through this to a clearer distinction about the trustworthiness of the other project members.

7.2.4   SRQ4: Does LPS's application lead towards a partnering project culture?

The findings about the common project culture and the intended partnering culture from Chapter 4 were used to interpret the findings about the project culture's differences from projects that do not apply LSP and those that apply LPS in terms of partnering.

Project cultures of projects that do not apply LPS were slightly dominated by partnering features with remarkable competitive characteristics, especially expressed through intended information asymmetries. The projects that apply LPS varied more in terms of partnering.

It was concluded that the high level of mutual understanding enables the project members to know who acts partner-like, and who does not, but this knowledge does not necessarily lead towards more cooperative behaviours. Therefore, the answer to *SRQ4* is that LPS does not necessarily leads towards a partnering project culture, but that the level of partner-like behaviours becomes clearer through its application.

7.2.5 SRQ5: What is the relevance of the findings about LPS's impact on project culture?

Main Contractors (MC) usually decide whether or not to introduce and facilitate LPS on construction projects. The question arises: are MC willing to implement LPS if they know Chapter 5's outcomes – that LPS leads towards a high level of mutual control between all stakeholders, but not necessarily towards a partnering project culture with its benefits? The research question SQR5 about the relevance of the findings about LPS's impact on project culture can be answered as following:

That LPS's implementation does not necessarily lead towards a partnering culture does not mean that LPS should not be applied. Moreover, LPS is perceived as a useful controlling instrument which can be used early indicate issues and to influence other stakeholders by determining individual project objectives and by discussing with the participating stakeholders how they can be reached.

7.2.6 Main research question: How does the Last-Planner® System influence Project Culture?

The literature review in Chapter 2 ended with the hypothesis that LPS would improve project culture under the aspects of partnering as some interfaces were determined that indicated this possible relation. The belonging main research question is "How does the Last-Planner® System influence Project Culture?".

This question can be answered through the results of this study, as it is concluded that projects that do apply LPS use visual tools as sticky notes for a structured and weekly review of the past processes and for updating the schedule for the tasks and interfaces for the next few weeks. This application influences project cultures towards a high level of mutual understanding and mutual control between all participating stakeholders. This however does not necessarily lead to project cultures which are characterised by partnering characteristics, but it enables LPS's participants to distinguish about the behaviours and trustworthiness of all individual project members. Therefore, the hypothesis defined in section 2.4 must be rejected.

7.3 Scientific contribution

This dissertation has investigated the impact of LPS on project culture and implies several scientific contributions.

In Phase I (Chapter 3) was concluded that the 'Competing Values Framework' (CVF) by Cameron and Quinn (2011, 39) and the belonging 'Organizational Culture Assessment

Instrument' (OCAI) are simple and suitable tools to measure and describe current and intended project cultures. Nevertheless, they lack in terms of inner test reliability. It was concluded that qualitative research methods for the specific interests (as in this dissertation partnering's necessities 'trust' and 'mutual understanding') should be added to the OCAI to investigate these cultural aspects in depths and to confirm the CVF's findings. This was implemented in Chapter 3, Chapter 4 and Chapter 5 and the CFV's usability for measuring and describing project's level of partnering was confirmed is all cases.

In Phase II (Chapter 4), the common project culture in the German construction industry and the intended partnering project culture were defined. These definitions enable scientists and practitioners to put project cultures from individual cases in the context of the defined common project culture and the intended partnering project culture. Through this, they can assess whether the individual project cultures are like one of these two cultures, or if they differ in any cultural direction.

In Phase III (Chapter 5), the gap about cultural differences between project cultures of projects that do not apply and those that do apply LPS was closed. This knowledge, in combination with feedback from practise in Phase IV (Chapter 6), lead towards recommendations weather LPS should be applied despite the knowledge that it does not necessarily lead towards a partnering project culture.

The dissertation's findings contribute to the scientific debate about the trust vs. control dilemma as it shows that LPS, as a structured and transparent production control meeting approach, leads towards a project culture which is characterised by a reciprocal understanding about the trustworthiness of individual project members. This finding is a significant scientific contribution as other scholars usually focus on the relationship between Clients and Main Contractors (Bygballe et al. 2010, 246), whereas the investigated change through LPS takes place on the Main Contractor – (Sub-) Contractor relationship as especially these parties participate at the production control meetings.

7.4   Recommendations

This section presents the recommendations of this dissertation. First the recommendations for the use of the findings in practice are given, followed by recommendations for further research.

7.4.1   Recommendations for the use of the findings in practice

This study shows that the application of LPS not necessarily contributes to a partnering culture. Still, the application of LPS is perceived as a useful controlling instrument which can be used

to early indicate issues and to influence other stakeholders by determining individual project objectives and by discussing with the participating stakeholders how they can be reached.

Regarding main contractor behaviour, Chapter 5 has shown that none of the MCs from the case studies was willing to share their actual information with the other stakeholders. This behaviour has obviously reasons. An example could be the described different project objectives between the stakeholders and the MC's (in)ability to manage the different stakeholders. It could be that more transparency, which would arise if all information was shared, would narrow MC's ability to manage the project after its interests.

As shown in Chapter 5, LPS leads to more transparency and mutual understanding between all participating stakeholders and MCs must decide whether they are entirely willing to allow transparency, or not. In Case 9 of Chapter 5, the MC's project team decided to update the crucial project milestones without involving the 'Last Planners' to manage them according to the MC's interests. The same strategy was mentioned by another MC in Chapter 6. The disadvantage of this strategy is that the 'Last Planners' are not entirely involved in the scheduling processes and that their knowledge is not used, which is against the system's core idea. In this context, it is also striking that none of the CLs participated in the Case studies, except Case 1, and even in this case, the CL stopped participating due to adversarial behaviours between the project's stakeholders. For successful implementation of LPS, such client involvement would be highly recommended.

7.4.2 Research recommendations

This research was conducted in the German turnkey construction industry. As discussed earlier, the cultural environment of project cultures has an impact on them. Thus, further research projects could investigate this connection and put LPS's application in the cultural context of different locations, such as nations.

Furthermore, the turnkey construction industry is only one sub-culture of the construction industry. Other types of projects and their cultures, such as infrastructures projects, could be investigated to determine if LPS's application has a different impact on their project cultures.

Additionally, this study's focus was LPS's application and as discussed, LPS covers only some of the ingredients of the partnering framework from Nyström (2005, 478) (see Figure 2). Chapter 4 has shown that the study's participants especially evaluate mutual project objectives as a way to implement a partnering culture. The impact of contracts, that define such objectives, were not considered in this dissertation. Thus, further studies could investigate how different

contract types, such as 'Alliancing' and 'Integrated Project Delivery' (IPD) models (Hosseini et al. 2018, 2) influence project culture.

Findings of Chapter 6 and from Ballard and Tommelein (2016, 8) indicate that LPS's participants feel through the system's transparency socially obliged for the fulfilments of their commitments. In contrast, this study has shown that not all LPS participants give reliable statements and that LPS leads towards mutual control which enables the meeting's participants to indicate who acts reliably, and who does not. So, there is no general reliability of LPS's participant's statements. This dissertation has also confirmed that different project objectives are often the root for competing behaviours, which are expressed through unreliability. There might be issues within organizations where the 'Last planners' feel through LPS's transparency obliged to their statements in front of the other meeting's participants. Their non-participating supervisors, which could possibly focus more on the contractual situation, don't perceive this social obligation and do not have to justify themselves in front of the others. Therefore, further research could investigate the mutual influences of co-workers and supervisors that participate respectively don't participate at the LPS meetings.

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ANNEXES

ANNEX A – THE ORGANIZATIONAL CULTURE ASSESSMENT INSTRUMENT BY CAMERON AND QUINN (2011), ADJUSTED FOR PROJECT ORGANIZATIONS

1.	Dominant Characteristics	Now	Preferred
A	The project organization is a very personal place. It is like an extended family. People seem to share a lot of themselves		
B	The project organization is a dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.		
C	The project organization is very result oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.		
D	The project organization is a very controlled and structured place. Formal procedures generally govern what people do.		
	Total	100	100

2.	Organizational Leadership	Now	Preferred
A	The leadership in the project organization is generally considered to exemplify mentoring, facilitating, or nurturing.		
B	The leadership in the project organization is generally considered to exemplify entrepreneurship, innovation, or risk taking.		
C	The leadership in the project organization is generally considered to exemplify a no-nonsense, aggressive, result-oriented focus.		
D	The leadership in the project organization is generally considered to exemplify coordinating, organizing, or smooth-running efficiency.		
	Total	100	100

3.	Management of Employees	Now	Preferred
A	The management style in the project organization is characterized by teamwork, consensus, and participation.		
B	The management style in the project organization is characterized by individual risk taking, innovation, freedom, and uniqueness.		
C	The management style in the project organization is characterized by hard-driving competitiveness, high demand, and achievement		
D	The management style in the project organization is characterized by security of employment, conformity, predictability, and stability in relationships.		
	Total	100	100

4.	Organization Glue	Now	Preferred
A	The glue that holds the project organization together is loyalty and mutual trust. Commitment to this organization runs high.		
B	The glue that holds the project organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.		
C	The glue that holds the project organization together is the emphasis on achievement and goal accomplishment.		
D	The glue that holds the project organization together is formal rules and policies. Maintaining a smoothly running organization is important.		
	Total	100	100

5.	Strategic Emphases	Now	Preferred
A	The project organization emphasis human development. High trust, openness, and participation persist.		
B	The project organization emphasizes acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.		
C	The project organization emphasizes competitive actions and achievement. Hitting stretch targets and winning in the Marketplace are dominant.		
D	The project organization emphasizes permanence and stability. Efficiency, control, and smooth operations are important.		
	Total	100	100

6.	Criteria of Success	Now	Preferred
A	The project organization defines success on the basis of the development of human resources, teamwork, employee commitment, and concern for people.		
B	The project organization defines success on the basis of having unique or the newest products. It is a product leader and innovator.		
C	The project organization defines success on the basis of winning in the Marketplace and outpacing the competition. Competitive Market leadership is the key.		
D	The project organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling, and low-cost production are critical.		
	Total	100	100

ANNEX B - INTERVIEW QUESTIONS PHASE 3 (CHAPTER5)

<u>Project- and participant's information (gained before the interview)</u>

Project:

Meeting System (Traditional / LPS):

Participant:

Date of interview:

1. <u>Questions about the project and the participant's function:</u>
    a. Since when are you working in the project
    b. What is your function in the project?
2. <u>Questions about the meetings and schedules:</u>
    a. At what kind of meetings do you participate?
    b. How often do the meetings take place?
    c. Who is participating at the meetings?
    d. Who is acting as the meetings' facilitator?
    e. What is the regular structure of the process meetings?
        i. Is a structured review performed during the meetings?
        ii. Is the schedule updated during the meetings?
            1. Who gives information about actual processes and issues?
            2. Are visual tools used to update visualise the schedule?
        iii. Do you use statistical determinations about the reliability of statements and processes?
        iv. How are the meetings documented?
    f. Are current schedules provided?
    g. Who is updating the schedules?
3. <u>Trust and Control</u>
    a. How would you describe the level of trust within the project team?
    b. Did something happen in the recent past, that affected the level of trust within the project team remarkably?
    c. How would you describe the level of control within the project team?
4. <u>Mutual Understanding</u>

    a. Do you have a good understanding about the current tasks, issues and motivations of the other project members?

    b. Do you perceive that the other parties have a good understanding about the current tasks, issues and motivations of the other project members?

5. <u>Competing Values Framework</u>

    a. How would you describe the project culture? Cooperative and family-like, or competitive, where every single person strives for his own project objectives?

    b. How would you describe the project culture? Characterised by clear tasks and responsibilities, or characterised by creative and spontaneous decisions and behaviours?

ANNEX C - POVZETEK (SLOVENIAN SUMMARY)

Strokovnjaki pogosto poročajo o slabih rezultatih projektov na področju gradbeništva v smislu prekoračitve stroškov, prekoračitve časa, slabih pogojev varnosti in težav s kakovostjo (Smiley et al. 2014, 804; Sohi et al. 2016, 252). En razlog za to situacijo je ta, da število potrebnih deležnikov, ki morajo sodelovati v gradbenih projektih, narašča z zapletenostjo projekta (Chen et al. 2019, 1) in se je v zadnjih desetletjih še povečalo (Ranf 2010, 657). Ti deležniki pogosto ne delijo projektnih ciljev. Predvsem so pogosto interesi projektnih strank v neposrednem sporu z interesi drugih (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1) in povečana osredotočenost na njihove zadevne interese ovira sodelovanje med strankami (Akintan and Morledge 2013, 1).

Visoka stopnja konkurenčnosti je posebej pomembna v času ekonomske recesije (Eschenbruch 2008, 4) v času katere se pogodbeniki soočajo z visoko stopnjo konkurenčnosti zaradi nizkega številka dejanskih gradbenih projektov in investitorji imajo številne priložnosti za konkurenčne izvajalce. Ustrezni konkurenčni postopki javnih naročil pogosto pripeljejo do nedobičkonosnih pogodb za pogodbenike s prirezanimi maržami. To spodbuja strateško osredotočenost pogodbenikov na zahtevke za izvedbo donosnih projektov, kot pa da bi raje ustvarjali pogoje projektov, primerne za partnersko sodelovanje (Barlow et al. 1997, 4; Hatush and Skitmore 1998, 2, 4; Eschenbruch 2008, 4; Chen et al. 2019, 2). Ti pogoji vodijo do pomanjkanja izmenjav informacij in odnosov na podlagi tržnih načel, za katere gre pogosto v takšni zelo konkurenčnih panogah (Johnston and Lawrence 1988, 98). Celo s sodelovanjem različnih deležnikov je potrebno projekt izvesti (Cheng et al. 2001, 62; Cheung et al. 2003, 339; Baiden et al. 2018; Chen et al. 2019, 1), vedenje pogosto določajo poskusi zaščite ustreznih interesov deležnikov, da se izognejo pravnim sporom in minimizirajo svoje tveganje, namesto, da bi se pomikali proti skupnemu cilju.

Kulturo panoge in kulturo projekta karakterizira defenzivno in sovražno vedenje (Beach et al. 2005, 612) in zaostreni odnosi (Eschenbruch 2008, 3 - 4). "Kultura" je "kolektivno programiranje mišljenja, ki razlikuje člane ene skupine ali družbe od druge" (Hofstede 1984, 82) in kot takšna predstavlja (projektno) organizacijo kot nekaj kar "je" in ne kot nekaj kar "ima" (Meyerson and Martin 1987, 623; Meek 1988, 470; van Marrewijk 2018, 146).

Slabe učinke projektov poskušajo preprečiti različni študentje in praktikanti. Nekateri splošni primeri nemške gradbene panoge so (1) celostno upravljanje kakovosti, (2) vitko upravljanje in (3) partnerstvo (Racky 2008, 3). To so abstraktni pristopi upravljanja in ne predstavljajo "ne poslovnega in tudi ne pogodbenega pristopa" (Racky 2008, 2). Kot takšni, so opisani kot

filozofije višje stopnje (Bresnen and Marshall 2000b, 230; Liker 2004, 67 ff.; Zuo and Zillante 2005, 354; Polesie 2010, 376 ff.; Rother 2010, 37 ff.) ali kot kulture (Phua and Rowlinson 2004, 913; Bygballe et al. 2010, 245; Zollondz 2013, 261; Bortolotti et al. 2015, 1 ff.; Santorella 2017, 1 ff.). Različni pristopi upravljanja ne vladajo drug drugemu, vendar se lahko izvedejo vzporedno ali pa jih je mogoče kombinirati (Racky 2008, 2). Takšni pristopi upravljanja so ustvarjeni ali pogojeni s konkretnimi načini in orodji, kot so poslovni pristopi, ki omogočajo upravljavske pristope (Racky 2008, 2). Primeri poslovni pristopov so povezani s pogodbenimi modeli ali delovnimi pristopi.

Slika 1 Prikazuje 'Partnering flower' (cvet partnerstva) s Nyström (2005, 478) katero se določa (1) zaupanje in (2) medsebojno razumevanje kot potreb za uspešno izvedbo partnerstva. (3) Predhodno določeni načini za reševanje sporov, (4) ekonomske inovativne pogodbe, (5) posrednik, (6) odprtost, (7) neprekinjeni in strukturirani sestanki, (8) izbira partnerjev za sodelovanje in (9) aktivnosti, za ustvarjanje odnosov so določeni kot podporni dodatki na poti do zagotavljanja zaupanja in medsebojnega razumevanja.

'Last Planner® System of Production Control' (LPS) (Ballard 2000, 3-1) / "Zadnji načrtovalec® Sistem nadzora proizvodnje", kot pristop vitki gradnji, prikazuje povezave s temi sestavinami partnerstva. Gre za neprekinjen proces načrtovanja s ciljem izboljšanja predvidljivosti toka dela in zanesljivostih zapletenih proizvodnih sistemov (Aslesen and Bertelsen 2008, 334; Mossman 2015, 2). Osredotočenost je usmerjena na upravljanje "odnosov, pogovorov in zavez, ki skupaj omogočajo programiranje in načrtovanje proizvodnih odločitev, da se te sprejemajo s sodelovanjem na najnižji možni ravni" (Mossman 2015, 2). Kjer je tradicionalen način načrtovanja gradbenega procesa, se izvaja z individualnimi profesionalnimi načrtovalci in projektnimi menedžerji (Mossman 2015, 5), LPS vključuje vse udeležence v aktivnem, rednem, integracijskem in sodelujočem procesu načrtovanja (VDI 2019, 77). "Zadnji načrtovalec" je najbolje zadnja oseba v oskrbovalni verigi (običajno delovodja ali vodja gradbišča ustreznih nalog trženja ali načrtovanja, specializiran načrtovalec ali vodja skupine za disciplino (Ballard and Howell 2003b, 4; Fernandez-Solis et al. 2013, 354; VDI 2019, 77).

Projekt je razdeljen na različne hierarhije načrtovanja z različnimi stopnjami podrobnosti, kjer se natančnost določa za vsako stopnjo, ko se približuje čas za začetek naloge (Frandson and Tommelein 2015, 175 - 176). Enojni delovni paketi so pogosto prikazani s samolepilnimi lističi z različnimi barvami, kjer ena barva predstavlja ustrezno eno dejavnost. Zadnji načrtovalci pa sami navedejo svoje delovne pakete na samolepilne lističe na časovnem razporedu in

koordinirajo in razpravljajo o njih z zadnjimi načrtovalci, katere vodi moderator (VDI 2019, 78).

Pretekli delovni paketi se pregledajo za nazaj med tedenskimi sestanki in ustrezno je potrebno posodobiti časovni razpored. Če nalog ni mogoče izpolniti je treba o razlogih za te izpade razpravljati skupaj in pripraviti spremembe za izboljšanje prihodnjih procesov (VDI 2019, 79) in preprečiti ponavljanje napak.

Nekaterih povezav med partnerstvom in LPS in nekaterih sestavin partnerstva, ni mogoče pokriti z LPS, oglejte si Slika 1.

Določene povezave z modelom partnerstva z Nyström (2005, 478) so naslednje:

- LPS izvaja moderator (VDI 2019, 78). Moderator je lahko del projektne skupine ali zunanja oseba. Njegova vloga je še posebej vodenje z urnikom LPS in usklajevanje moči in vplivov vseh strank (Nyström 2005, 477).
- LPS vsebuje tudi nenehne in strukturirane sestanke (Mossman 2015, 20) , ki se izvajajo enkrat na teden (Ballard and Howell 2003b, 7).
- Preglednost skozi vizualizacijo delovnih paketov s samolepilnimi listki vodi do odprtosti med vsemi udeleženci.

Naslednje sestavine partnerskega okvirja ne sodijo v LPS:

- Ni povezave med LPS in predhodno določenimi metodami reševanja sporov, če te niso povezane s sestanki LPS. Kakorkoli, LPS je način skupnega razpravljanja preteklih in prihodnjih zadev in ko se razprava preprosto izvaja z več ali manj nevtralno stranjo, se lahko temu oporeka, kot obliki strukturiranega načina reševanja sporov.
- LPS torej tudi nima vpliva na izbor delovnih partnerjev in ni povezave z ekonomskimi cilji pogodb med različnimi strankami.
- Prav tako ni določil o tem, kdo se dejansko udeleži sestankov LPS, celo, če je nameravano, da se udeležijo vse stranke, ki trenutno ali v bližnji prihodnosti izpolnjujejo naloge.

Za nekatere elemente in posebej potrebne sestavine, povezave med partnerskimi okvirji in LPS niso razvidne:

- Ni jasno ali uporaba LPS pripelje do več zaupanja v okviru projektne skupine.
- Če LPS pripelje do visoke stopnje zaupanja v okviru projektne skupine, se lahko LPS smatra kot aktivnost odnosa, ki izboljšuje projektno kulturo in pogoje partnerstva.

-   Ni informacij o tem, ali uvedba LPS, in posebej pridobljene preglednosti, pripelje do
    več skupnega razumevanja med udeleženci

Slika 1 - Povezave med partnerstvi in LPS
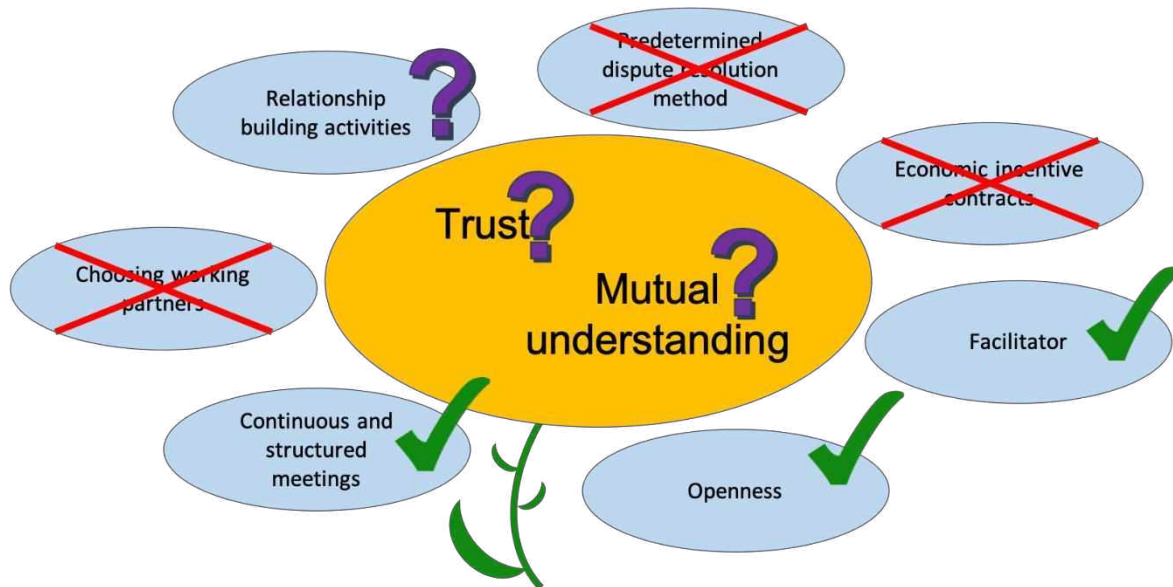
Na podlagi Nyström (2005, 478)

Zaključimo lahko s tem, da obstajajo nekatere očitne povezave med partnerstvom kot
menedžerskim pristopom in LPS kot poslovnim pristopom, vendar nimamo informacij o vplivu
LPS na potrebne kulturne elemente partnerstva: zaupanje in medsebojno razumevanje.

Na podlagi povezav med partnerstvom in LPS, je zasnovana naslednja hipoteza:

LPS izboljša projektno kulturo z vidika partnerstva.

Ta bi dokazali to hipotezo, smo zastavili naslednje glavno vprašanje raziskave:

Kako vpliva sistem zadnjega načrtovalca na projektno kulturo?

Da bi lahko odgovorili na to vprašanje je potrebno vzpostaviti način merjenja projektne kulture,
da določimo trenutno projektno kulturo in načrtovano projektno kulturo in preverimo vpliv
uvajanja LPS na projektno kulturo na podlagi primerjave trenutne kulturne karakteristike in
želenih funkcij določene partnerske kulture.

Zato je disertacija razdeljena na tri empirične dele.

1. empirični del: Merjenje projektne kulture

V prvem empiričnem delu smo preučili podvprašanje raziskave (SRQ1) "Kako izmeriti projektno kulturo".

Ker je projektna kultura tako dinamična in zapletena (Sackmann 2009, 4) smo izbrali pristop študije primera s triangulacijo med kvantitativnimi in kvalitativnimi podatki za preverjanje uporabnosti kompetenčnega okvirja prednosti (CVF) za projektne kulture, namesto organizacijske kulture, za katere je bil prvotno zasnovan. V študiji navajamo tri primere z 20 udeleženci.

CVF sestavljata dve osi z ustrezno konkurenčnimi kulturnimi vrednotami na vsaki osi (glejte Preglednica 2). V skladu s tem je sistem razdeljen na štiri kvadrante, ki so:

- klan (sodelovanje) – smisel za skupino ali družino, osredotočenost na razvoj ljudi in timski duh,

- adhokracija (ustvarjanje) – karakterizira ga začasna, specifična in dinamična osredotočenost,

- hierarhija (nadzor) – visoka stopnja delovnih standardov, pravil in postopkov za ohranitev

  nadzora internih operacij,

- trg (tekmovalnost) – zunanja osredotočenost na dobavitelje in stranke za pridobitev konkurenčne prednosti.

Posebej os klan in trg razdeljuje kulturne značilnosti na dva pola interesov za namene te disertacije, saj kvadrant trga opisuje konkurenčne kulturne značilnosti, ki predstavlja tradicionalne projektne kulture in kvadrant klana opisuje sodelovalne kulturne značilnost, ki predstavljajo značilnosti partnerstva. Zato je boljši za merjenje vpliva LPS na projektno kulturo.

Za zbiranje potrebnih podatkov je bila izvedena raziskava "Instrument ocene organizacijske kulture" (OCAI). Rezultati so prikazani v Preglednica 1 in Preglednica 2.

Preglednica 1 - OCAI rezultati 1., 2., 3. primera in svetovne gradbene industrije

	Primer 1	Primer 2	Primer 3	Svetovna gradbena industrija (Cameron and Quinn 2011, 90)
Klan (Clan)	28.1	12.4	27.2	22.0
Trg (Market)	28.3	32.4	26.9	37.0
$Mean_{C-M}$	0.1	10.0	-0.1	7.5
Ocena	Uravnotežen	Adhokracija	Uravnotežen	Uravnotežen
Hierarhija (Hierarchy)	27.9	40.5	30.6	23.0
Adhokracija (Adhocracy)	15.7	14.7	15.3	18.0
$Mean_{H-A}$	-6.1	-12.9	-7.6	-2.5
Ocena	Uravnotežen	Hierarhija	Uravnotežen	Uravnotežen

Preglednica 2 - Projektne kulture primera 1, primera 2, primera 3 in svetovne gradbene industrije
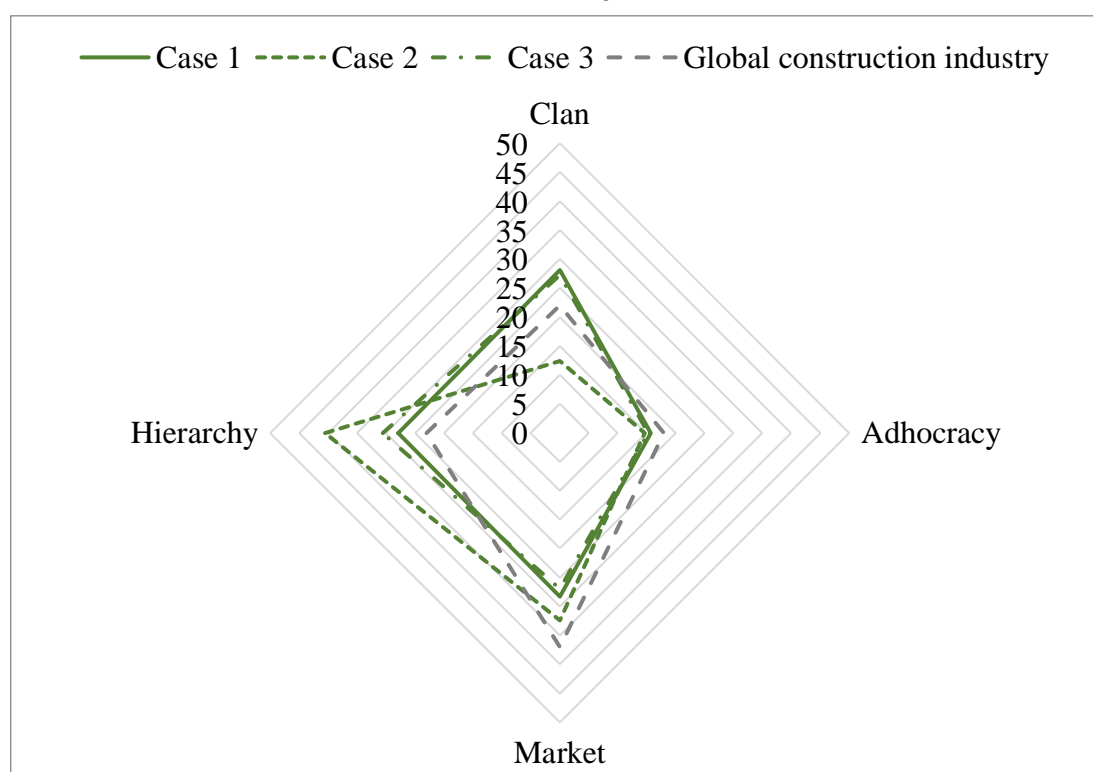
Za ocenjevanje teh ugotovitev so bila opravljena opazovanja in odprti intervjuji kot kvalitativne raziskovalne metode, v obdobju nekaj tednov za zagotovitev bolj globokega razumevanja sodobne situacije in okoliščin raziskave (Yin 2018, 15). V času študij primera, je avtor te disertacije odgovoren za uvajanje LPS za glavnega pogodbenika. To je vključevalo omogočanje ustreznih sestankov, ki so omogočili procese zbiranja podatkov.

Triangulacija med analizo prispevkov podjetij, rezultati OCAI in udeleženimi opazovanji je omogočila pridobitev vpogleda o sistematskih medsebojnih odvisnosti. (Weber 2015, 97).

Podobne oblike relativno uspešnih projektov LPS (primer 1 in primer 3) in določena oblika manj uspešnih projektov LPS (primer 2) predlaga odnos med izmerjeno projektno kulturo in uspehom projekta z določanjem uspeha LPS in sodelovanjem in procesno zanesljivostjo. Ta domneva potrebuje nadaljnje preiskovanje z določanjem idealne projektne kulture z vidikov partnerstva za preiskovanje uporabe LPS vodenja v primerjavi z nameravano kulturo.

Zaključiti je bilo mogoče, da so konkurenčno vrednostno omrežje" in pripadajoči „instrumenti organizacijske kulture" preprosta in primerna orodja za merjenje in opisovanje trenutne in nameravane projektne kulture. Kakorkoli, dodatne metode bi bilo treba dodati za merjenje različnih vidikov interesov (kot 'zaupanje' in 'medsebojno razumevanje'), in sicer bolj podrobno.

2 empirični del: Določanje trenutne in nameravane partnerske projektne kulture

S tem znanjem je bilo omogočeno določanje trenutne in nameravane partnerske projektne kulture in druge empirične faze te disertacije.

Pripadajoče podvprašanje raziskave (SRQ2) se glasi: Kakšne so karakteristike splošne projektne kulture in nameravane partnerske projektne kulture v nemški panogi gradbeništva na ključ?

Če je odgovorjeno na to vprašanje in sta določeni obe kulturi, lahko akademiki in projektni vodje merijo in primerjajo svoje dejanske projektne kulture in jih postavijo v kontekst običajne industrijske projektne kulture in idealne partnerske projektne kulture. Nadalje, merijo lahko, če so prizadevanja za spremembo projektne kulture glede partnerstva učinkovita ali ne.

Raziskava je bila organizirana v okviru delavnice, v času katere smo zagotovili, da so bile predstavljene vse skupine deležnikov, vključno z različnimi funkcijami v okviru teh skupin.

Ključni deležnik gradbenih projektov so: (1) Stranke (CL); (2) Glavni izvajalci (MC); (3) Svetovalci (Doloi 2013, 627), kot so arhitekti in gradbeni inženirji; in (4) (pod-) izvajalci (SC) (Hinze and Tracey 1994, 274). Tri podjetja za vsako skupino deležnikov, vsa delujoča na področju nemške panoge gradbeništva na ključ, so bila povabljena k udeležbi v tej študiji. Udeleženci so bili izbrani za vključevanje mešanih funkcij, kot so fizični delavci, inženirji, trgovci in generalni direktorji ustrezne discipline. Ta raznolikost je ključnega pomena, saj

projektno kulturo oblikujejo vsi projektni člani, ki pripadajo različnim strankam in funkcijam in imajo različne interese. Skupaj je bilo izvedenih 12 delavnic z 72 udeleženci.

Opisani OCAI je bil izveden. Dodatno je bilo s kvalitativno skupinsko razpravo preverjeno, kakšni so razlogi za trenutno in tradicionalno projektno kulturo, kakšne so značilnosti potrebne partnerske kulture in kakšna je motivacija za prizadevanje za partnersko projektno kulturo.

Preglednica 2 in Preglednica 3 prikaz OCI pomeni rezultate vseh skupin deležnikov.

Preglednica 2 - Predstavlja rezultate vseh deležnikov o trenutni, nameravani partnerski projektni kulturi in kulturi svetovne gradbene industrije

	Trenutno stanje	Načrtovano stanje	Svetovna gradbena industrija (Cameron and Quinn 2011, 90)
Klan (Clan)	18.7	31.2	22.0
Trg (Market)	34.9	20.7	37.0
$Mean_{C-M}$	-8.1	5.3	-7.5
Ocena	Uravnotežen	Uravnotežen	Uravnotežen
Hierarhija (Hierarchy)	29.0	27.6	23.0
Adhokracija (Adhocracy)	17.3	20.6	18.0
$Mean_{H-A}$	-5.9	-3.5	-2.5
Ocena	Uravnotežen	Uravnotežen	Uravnotežen

Preglednica 3 - CVF o rezultatih vseh deležnikov o trenutni, nameravani partnerski projektni kulturi
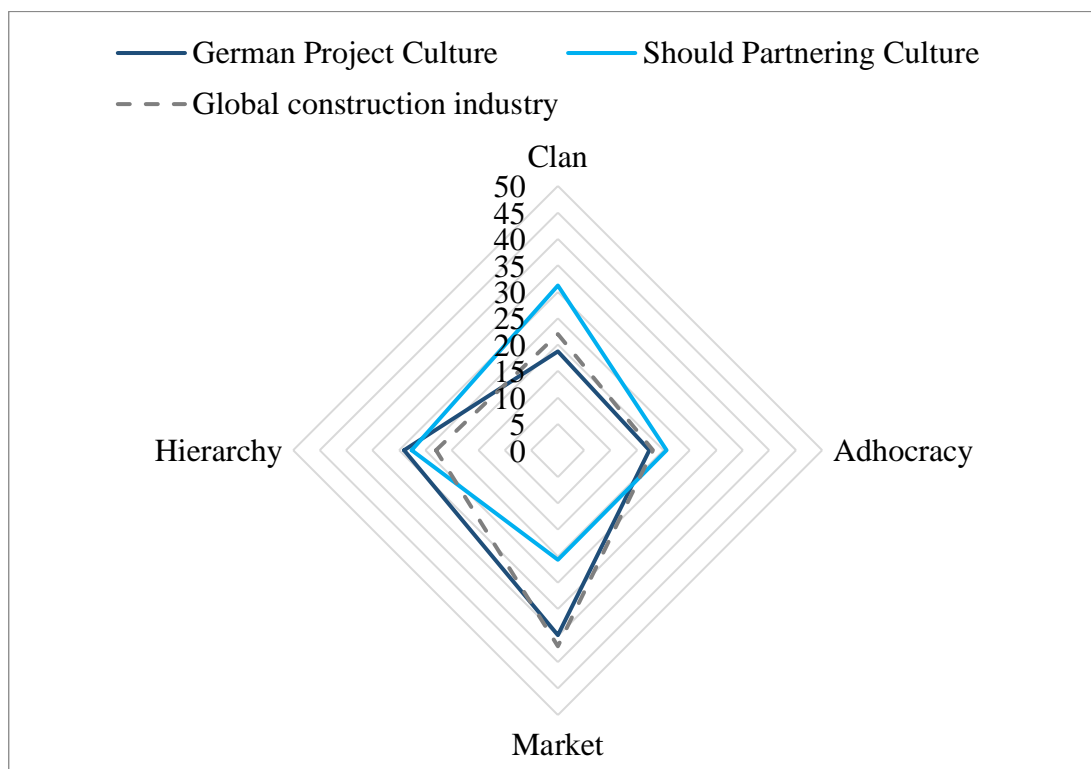
Rezultati so pokazali, da trenutno kulturo posebej karakterizira konkurenčno vedenje in manj trenutni interesi deležnikov, vendar pa vsebuje pomembne značilnosti sodelovanja. Primerjava z globalno študijo Cameron and Quinn (2011, 90), rezultati karakteristike klan predstavljajo, da udeleženci prejmejo manj sodelovanja v nemški projektni kulturi v primerjavi z globalno gradbeno industrijo.

Trenutna projektna kultura je stopnjevana na osi hierarhija-adhokracija, torej je enakomerno karakterizirana s funkcijami obeh kvadrantov. Udeleženci študije rangirajo funkcije hierarhije višje od svetovne študije, kar pomeni, da jih bolj dojemajo kot karakterizirane z vidika formalnosti, standardov in jasnih postopkov v primerjavi z globalnimi ocenami Cameron and Quinn (2011, 90).

Razlogi za to kulturo so posebej različni in nasprotujejo ciljem projekta, prihaja do antipatije med posameznimi člani projekta, tradicionalno razumevanje nasprotnih vlog s povezanim splošnim nezaupanjem med različnimi člani projekta.

Povprečni rezultat želene kulture v smislu partnerstva prikazujejo, da jih posebej karakterizirajo funkcije sodelovanja v kvadrantu klan, vendar tudi pomembne funkcije konkurenčnega tržnega kvadranta. To pomeni, da je iskana posebej ta stopnja sodelovanja, vendar vidijo udeleženci

študije tudi potrebo po prizadevanju za individualne projektne cilje in za osredotočanje na vplive, poleg skupnega projekta.

Rezultati osi hierarhija in adhokracija so uravnoteženi z rahlo nagnjenostjo proti značilnostim kvadranta hierarhije, torej gre za jasne naloge in odgovornosti, vendar tudi za pomembna spontana in kreativna vedenja.

Motivacija za prizadevanje za to kulturo je posebej visoka stopnja učinkovitosti in s tem tudi boljši rezultati projektov, dolgoročni odnosi med člani projektov in visoka motivacija lastnega osebja.

Nadalje, so raziskave pokazale, da skupni cilji projekta, odprta komunikacija, jasna razdelitev nalog in odgovornosti, medsebojno zaupanje in partnerstvu podobni medsebojni odnosi predstavljajo potrebne sestavine partnerske kulture.

Rezultati vseh individualnih skupin deležnikov so pokazali, da je potrebno kulturne funkcije posebej spremeniti s trenutne proti partnerski kulturi, torej to so tiste na osi klan-trg, torej v smeri od konkurenčnosti proti sodelovanju. V primerjavi, je v ugotovitvah kvadrantov hiearhija in adhokracija videti manj jasnih sporazumov. V smislu karakteristik kvadranta adhokracije, bi moralo biti manj kulturnih premikov v smeri večje prilagodljivosti in kreativnosti.

3 empirični del: Raziskave kulturnih razlik med projekti, ki ne uporabljajo LPS in tistimi, ki uporabljajo LPS

S temi definicijami, je bilo mogoče izmeriti projektne kulture projektov, ki ne uporabljajo LPS in projektne kulture projektov, ki uporabljajo LPS za preiskovanje njihovih razlik, in, če uporaba LPS vpliva na projektno kulturo v smislu določenih nameravanih partnerskih projektnih kultur.

V ta namen so bila zastavljena naslednja raziskovalna vprašanja: SRQ3: Kako se razlikujejo projektne kulture projektov, ki ne uporabljajo LPS od tistih, ki uporabljajo LPS? SRQ4: Ali uporaba LPS pripelje do partnerske projektne kulture?

Da bi odgovorili na ta vprašanja so bile izvedene podrobne študije primerov. Te so primerne za preiskovanje vprašanj in odnosov, ki so preveč zapleteni za alternativne načine raziskav ali preskusov (Brookes et al. 2016, 216; Maylor et al. 2017, 204; Yin 2018, 18). Pristop v obliki večkratne študije primera je izbran iz dveh razlogov: najprej, za identifikacijo podobnosti in razlik v okviru skupin projektov, ki uporabljajo LPS in tistih, ki ne uporabljajo LPS (Maylor et al. 2017, 208) in drugih, za primerjavo ugotovitev teh skupin. Ker LPS ni standardiziran, obstajajo različne sestavine, ki se uporabljajo v praksi (Priven and Sacks 2013, 537; Ballard

and Tommelein 2016, 4) in pristop v obliki večkratne študije primera bo pokazal, kako se dejansko LPS uporablja v praksi. Ker vsako projektno kulturo sestavlja edinstvena mešanica načinov razmišljanja in vedenja članov projekta, je bilo zaznavanje deležnikov enakomerno ocenjeno, z namenom preiskovanja glavne projektne kulture.

Kombinacija kvantitativne in kvalitativne preiskave je bila izbrana za triangulacijo ugotovitev (Maylor et al. 2017, 219 - 221). Kot kvantitativna metoda je bil opisan OCAI uporabljen kot spletna raziskava. Za pridobitev globokega razumevanja ugotovitev CVF so bili izvedeni polstrukturirani intervjuji s študijo udeležencev po izvedbi OCAI. Takšni intervjuji omogočajo preiskavo človeških odnosov, vedenj in osebnih stališč (Yin 2018, 114, 121).

Vprašanja intervjuja so bila oblikovana z namenom preiskovanja kategorij interesov: (1) splošne informacije o projektnih sestankih, (2) projektna kultura v smislu kategorij CVF, (3) zaupanje v primerjavi z nadzorom in (4) medsebojno razumevanje. Vsi intervjuji so bili izvedeno po telefonu in dokumentirani s ključnimi besedami. Intervjuji so bili prepisani in kasneje potrjeni s strani udeležencev.

Za analizo intervjujev je bila uporabljena analiza kvantitativne vsebine (QCA), saj je ta primerna za analiziranje podatkov v smislu kultur in njihovih lastnosti v specifičnih okvirih (Krippendorff 1989, 403). Pristop z odbitki je bil izbran s predhodno določenimi vzorci, kot oblika prvega koraka analize, (Mayring 2015, 97) podobno z imenovanimi kategorijami. Podobno z rezultati OCI, so ugotovitve QCA za vsak primer zbrane v tri enakomerno razdeljene dele za vsako kategorijo. Ti deli so enaki kot za rezultate OCAI.

Za triangulacijo podatkov so kvantitativni in kvalitativni podatki primerjani za vsak primer, kot v okviru analize primera. Domnevano je, da imata oba raziskovalna pristopa enak pomen. Če se rezultati teh dveh načinov razlikujejo, se določi povprečje obeh.

Kot naslednje je bila izvedena analiza med primeri za vsako od obeh skupin (brez uporabe in z uporabo LPS) za raziskovanje splošnih vzorcev ali razlik (Maylor et al. 2017, 216). Končno so bile primerjane ugotovitve dveh skupin za preiskavo vpliva LPS na projektno kulturo.

Za ocenjevanje raziskav je bila izvedena postavitev v okviru delavnice kot skupinska diskusija z MC (vodilnim izvajalcem). Posebna funkcija takšnih skupinskih razprav je ta, da do rezultata ne pridemo na podlagi enega mnenja in izkušnje, temveč na podlagi dinamične razprave različnih posameznih strokovnjakov (Weber 2015, 100).

Rezultati kažejo, da prihaja do kulturnih razlik med projekti, ki ne uporabljajo LPS in tistimi, ki uporabljajo LPS.

Nadzorni sestanki dela so manj strukturirani pri projektih, ki ne uporabljajo LPS v primerjavi s tistimi, ki uporabljajo LPS. Projekti, ki uporabljajo LPS, uporabljajo bolj strukturirane in tedenske preglede preteklih procesov, kot sestavine sestankov LPS, tudi, če jih podpirajo dnevni razgovori na lokaciji sami. Pri enem od treh projektov je bil uporabljena metoda LPS, (pod-) izvajalci niso vključeni v procesu načrtovanja. Poleg tega, glavni pogodbenik uporablja orodja za vizualizacijo LPS za komunikacijo o prihodnjih nalogah in povezavah.

Pri vseh šestih projektih, posodobitev MC redno določa urnik za celoten projekt, pri čemer ustvarja za strateške razloge različne različice, katere deli z različnimi deležniki, kot so stranke in (pod-) izvajalci.

Slika 4 prikazuje CVF z oblikami različnih projektnih kultur, na podlagi rezultatov OCAI (glejte Preglednica 3). Projektne kulture v obeh skupinah se razlikujejo s svojim označevanjem osi hierarhije-adhokracije. To predstavlja različne stopnje jasnih procesov in odgovornosti v primerjavi s kreativnim in spontanim vedenjem te so zelo individualne, kljub temu, da ne uporabljajo ali uporabljajo LPS. Te ugotovitve so potrdili rezultati QCA.

Na osi klan-trg, je mogoče prepoznati vzorec, ki razlikuje dve skupini sistemov sestankov.

Vsi projekti, ki ne uporabljajo LPS so zelo podobni, kar je jasno razvidno iz Slika 4. Triangulacija z rezultati QCA je pokazala, da so te projektne kulture rahlo karakterizirane s funkcijami sodelovanja v obliki kvadranta klan, kar prikazuje izredno vedenje kvadranta trga.

Slika 4 prikazuje, da se rezultati OCAI o projektni kulturi, ki uporablja LPS veliko bolj razlikujejo na tej osi, kar nakazuje na različna zaznavanja o sodelovalnem ali bolje konkurenčnem vedenju v okviru projektov. Triangualcija z rezultati QCA je potrdila, da prihaja do pomembnih razlik na tej osi. Projektna kultura primera 7 je uravnotežena na tej osi, torej jo enakomerno določajo sodelovalne in konkurenčne funkcije in v primeru 8 in primeru 9 prihaja do rahle karakterizacije s sodelovalnimi značilnostmi kvadranta klan in izrednih funkcij kvadranta trga.

Preglednica 3 - OCAI rezultati primeri 4 - 6 (brez uporabe LPS) in primeri 7 - 8 (z uporabo LPS)

	Primer 4	Primer 5	Primer 6	Primer 7	Primer 8	Primer 9
Klan (Clan)	23,3	25,5	25,7	17,6	35,5	28,0
Trg (Market)	26,5	26,7	27,2	32,2	22,3	20,8
$Mean_{C-M}$	-1,6	-0,6	-0,8	-7,3	6,6	3,6
Ocena	Uravnotežen	Uravnotežen	Uravnotežen	Uravnotežen	Uravnotežen	Uravnotežen
Hierarhija (Hierarchy)	42,1	33,0	35,0	36,3	27,6	32,5
Adhokracija (Adhocracy)	8,1	14,8	12,2	13,9	14,5	18,6
$Mean_{H-A}$	-17,0	-9,1	-11,4	-11,2	-6,6	-6,9
Ocena	Hierarhija	Hierarhija	Hierarhija	Hierarhija	Uravnotežen	Uravnotežen

Slika 4 - Projektna kultura primerov 4 do 6 (brez uporabe LPS) in primerov 7 do 8 (z uporabo LPS)
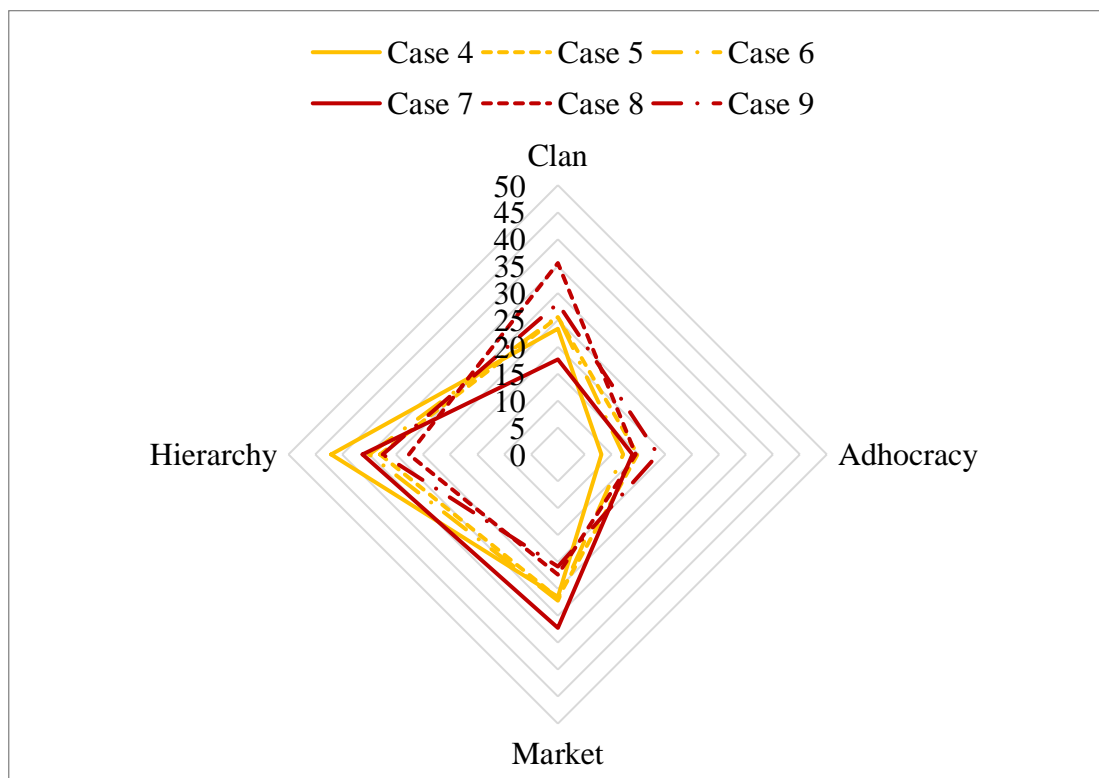
Pri projektih, kjer se LPS ne uporablja, se stopnja zaupanja in stopnja nadzora domnevata visoko. Pri dveh od treh primerov, ki uporabljajo LPS, udeleženci zelo jasno razlikujejo, komu zaupati in komu ne.

Zato je mogoče zaključiti, da struktura LPS in vizualizacija nalog in njihova izpolnitev, posebej neizpolnitev, vplivajo na stopnjo medsebojnega nadzora in zaupanja, kjer manj strukturirani

sestanki vodijo do manj znanja o nalogah, zadevah in povezavah in skozi to do višje stopnja zaupanja. To ne pomeni nujno, da imajo projektne kulture projektov, ki uporabljajo LPS, nujno značilnosti manjše stopnje zaupanja, vendar gre bolj za bolj specifično oceno o zaupljivosti.

Štirje primeri, kjer (pod-) izvajalci niso vključeni v procese načrtovanja se razlikujejo od dveh primerov, kjer so (pod-) izvajalci vključeni v proces načrtovanja delovnih paketov in povezav s prihodnjimi nalogami. Vključenost aktivnega načrtovanja in razprava o procesu vpliva posebej na znanje (pod-) izvajalcev o trenutnih nalogah in zadevah drugih (pod-) izvajalcev in s tem do stopnje medsebojnega razumevanja, ki predstavlja nujnost partnerske kulture. Pri štirih projektih brez vključitve (pod-) izvajalcev, samo glavni izvajalci trdijo, da imajo dober pregled nad nalogami in zadevami vseh vključenih. (pod-) izvajalci in stranke dojemajo, da imajo samo grob pregled nad nalogami in zadevami drugih strani in dober pregled nad lastnimi. Pri dveh primerih, kjer so vključeni (pod-) izvajalci, vsi udeleženci sestankov poročajo, da nimajo samo dobrega pregleda nad svojimi nalogami in zadevami, vendar tudi nad temi drugih udeležencev.

Zaključeno je, da predstavlja bistveno razliko med temi projektnimi kulturami pri projektih, ki ne uporabljajo in tistimi, ki uporabljajo LPS, to, da LPS pripelje do večje stopnje medsebojnega razumevanja in medsebojnega nadzora in s tem do jasnejšega razlikovanja o zaupanju drugih članov projekta. Nasprotno, projektne kulture, ki ne uporabljajo LPS, imajo nizko stopnjo medsebojnega razumevanja in medsebojnega nadzora. S tem, da so sodelovalne in konkurenčne funkcije teh projektnih kultur zelo podobno dojete kot uravnotežene, kar ima korenine v pomanjkanju informacij o vedenju drugih strank.

Zaključeno je bilo, da to ne pomeni nujno, da LPS pripelje do višje stopnje partnerstva. Visoka stopnja medsebojnega razumevanja omogoča članom projekta LPS, da spoznajo, kdo deluje v smislu partnerstva in kdo ne, vendar to znanje ne pripelje nujno do bolj sodelovalnega vedenja.

4 empirični del: Povratne informacije praktičnega dela

Poglavje 5 je pokazalo, da se sistem "Last Planner® System of Production Control" (LPS) (Ballard 2000, 3-1) uporablja različno pri projektih in, če se uporablja kot združen proces načrtovanja (kar je v svoji prvotni zasnovi), potem pripelje do višje stopnje medsebojnega razumevanja med udeleženci, kar je poleg zaupanja nujen vidik partnerske kulture. Kakorkoli, glavne ugotovitve študije so, da LPS pripelje posebej do visoke stopnje medsebojnega nadzora, kar omogoča vsem udeležencem projekta, da razlikujejo med tem, kdo se vede vredno zaupanja in kdo ne. Kljub visoki stopnji medsebojnega nadzora, to ne pripelje nujno do bolj zaupljivega vedenja, kar je bilo prikazano z izrazitim razločevanjem o zaupljivosti drugih posameznikov.

Poglavje 1 in poglavje 2 sta pokazala, da tradicionalna konkurenčnost in nasprotne projektne kulture imajo posebej globoke korenine v nasprotujočih ciljih projekta (Newcombe 2003, 841; Olander 2006, 277; Turner and Zolin 2012, 1). To so potrdile ugotovitve poglavja 4. Kakorkoli, poglavje 4 je prav tako pokazalo, da različni deležniki smatrajo posebej učinkovitost, kot glavni razlog za rast partnerskega vedenja v gradbenih projektih (glejte Figure 36). Uporaba LPS pripelje do višje stopnje produktivnosti (Fernandez-Solis et al. 2013, 359), torej učinkovitosti.

Glavni izvajalci (MC) običajno odločajo o tem ali bodo predstavili in spodbudili LPS v gradbenih projektih. Pojavi s vprašanje: ali so MC (glavni izvajalci) pravzaprav pripravljeni uvesti LPS, če poznajo rezultate poglavja 5– da LPS pripelje do višje stopnje medsebojnega nadzora med vsemi deležniki, kar prav tako pomeni, da morajo biti drugi deležniki bolj razumevajoči o različnih pogodbenih motivacijah in zadevah med njimi in MC (glavnimi izvajalci)?

Zato je bil zasnovan SRQ5, kot sledi: Kakšna je pomembnost ugotovitev o vplivu LPS na projektno kulturo?

Da bi odgovorili na SRQ5, je bila zasnovana skupinska razprava v postavitvi v obliki delavnice z MC (glavnimi izvajalci). Udeleženci delavnice so bili izbrani na podlagi svojih delovnih nalog s ciljem, da se zagotovijo predstavniki različnih nalog in hierarhij za pridobitev celovitega pogleda na ugotovitve. Trije menedžerji dveh različnih hčerinskih družb, vodja partnerske strategije družbe, en višji vodja gradbišča, en vodja gradbišča in eden delovodja. Višji vodja gradbišča, vodja gradbišča in delovodja so vpeljali LPS sami in drugi udeleženci poznajo sistem z različnih predstavitev in povratnih informacij o uvedbi sistema na gradbišču od svojega osebja.

Raziskave so pokazale, da tudi če uvedba LPS ne pripelje nujno do partnerske kulture, to še ne pomeni, da se LPS ne bi uporabila. Več kot to, LPS velja kot pomemben instrument nadzora, ki se lahko uporablja za zgoden prikaz zadev in za vplivanje na druge deležnike z določanjem posameznih projektnih ciljev in razpravljanjem z udeleženimi deležniki o tem, kako je mogoče te cilje doseči.

Splošen zaključek

Projekti, ki uporabljajo LPS uporabljajo vizualna orodja, kot so samolepilni lističi in tedenski pregled preteklih procesov in za posodobitev urnika za naloge in povezave za naslednjih nekaj tednov. Uporaba vpliva projektne kulture za zagotovitev visoke stopnje medsebojnega razumevanja in medsebojnega nadzora med vsemi udeleženimi deležniki. To ne pripelje nujno

do projektne kulture, za katero so značilne karakteristike partnerstva, vendar pa LPS udeležencem omogoča razlikovanje vedenja in zaupljivosti za vse posamezne člane projekta.

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Title of the thesis in the English language	The impact of the Last-Planner-System® on Project Culture
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