THESIS FOR THE DEGREE OF DOCTOR OF TECHNOLOGY

Designing the Design Organisation
Client-Consultant Coordination in a Large Infrastructure Project

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Abstract:

Large infrastructure projects are unique and last for a long time, but they are still temporary organisations. The technology involved is often complex, and the uncertainty is high. Managing such projects and coordinating all the actors involved is a complicated task for both suppliers and clients. During the critical early design phase of large projects, many conceptual solutions are developed that will influence the planned infrastructure's construction as well as its operation and maintenance. This phase requires contributions from and coordination of a wide array of technical competences, often from different organisations. Furthermore, management challenges arise as public infrastructure clients increasingly outsource tasks that were previously conducted in house.

The purpose of this thesis is to increase the understanding of how organisational structures and routines for coordinating project participants are designed at the start of the early design phase and developed further over time. The findings are related to previous research on the organisation of complex projects, general research on routines in organisations, and research on the role of cognition and heuristics in processes of organisational design.

When projects are unique and long, they are less influenced by the permanent client organisation's standard management models and may select and develop their own routines and organisational structures. To understand better how coordination practices emerge during the early design phase as a result of client decisions and client-consultant interaction, a longitudinal case study of a large railway tunnel project was conducted. Findings suggest that in situations where project management possess a high degree of discretion, cognitive heuristics (or rules of thumb) may potentially influence organising decisions. In addition, one type of simple organisational heuristic used to enable coordination in this complex context was short mantras.

Since many coordination mechanisms in unique, complex, and uncertain contexts are new, and because few project members have experience from similar projects, changes to the initial organisational structures and routines are to be expected. In the case study project, such changes in the early design phase were limited, incremental, and mainly reactive. A conclusion is that satisficing heuristics play an important role in a transitory and temporary environment, especially in relation to decisions on organising.

It should be acknowledged that it is often efficient to rely on previous experience, simple rules of thumb, and established solutions to organise projects. Still, it is suggested that permanent client organisations should also foster meta-routines in order to prompt the project management team to plan regular assessments to revise and adapt organisational structure and routines.

Keywords: *coordination, infrastructure, megaprojects, public projects, organisational routines, project routines, organisational heuristics, practice approach*

Acknowledgements

List of appended papers

This thesis is based on the work in the following five papers, referred to by Roman numerals in the text:

Paper I

Eriksson, T. (2015) Developing Routines in Large Inter-organisational Projects: A Case Study of an Infrastructure Megaproject, *Construction Economics and Building*, 15(3), 4-18.

Developed from a term paper in a PhD course. Anna Kadefors and Jan Bröchner provided feedback during refinement.

Paper II

Eriksson, T. and Kadefors, A. (2016) Heuristics and mantras: decisions in designing large project organisations

Under review for publication in a scientific journal.

Previous version: Conference paper presented at the peer reviewed International Research on Networks and Projects Conference (IRNOP), London, June 2015.

The purpose, research design and theoretical framework were developed jointly by Therese Eriksson and Anna Kadefors. Therese Eriksson collected all the data, Anna Kadefors participated in some interviews. The analysis and writing was a joint effort.

Paper III

Eriksson, T. and Kadefors, A. (2015) Designing and implementing incentives for engineering consultants: encouraging cooperation and innovation in a large infrastructure project. *Engineering Project Organization Journal,* 5(4), 146-159.

The initial purpose and analysis was developed by Therese Eriksson who also collected all the data. Refinement of purpose, analysis and writing was a joint effort.

Paper IV

Eriksson, T. and Söderlund, J. (2016) Evolving and involving – a process perspective on developing the client function in a large infrastructure project

To be submitted to a scientific conference or journal.

The initial purpose was developed by Therese Eriksson who also collected all the data. Refinement of purpose, analysis and writing was a joint effort by Therese Eriksson and Jonas Söderlund, Anna Kadefors participated in the late stages of development.

Paper V

Eriksson, T. (2013) Learning in the Early Design Phase of an Infrastructure Development Project, *Proceedings of the 7th Nordic Conference on Construction Economics and Organisation, Trondheim, 12-14 June 2013*.

Received 'Best young researcher award' based on the conference paper. *Appended version is updated to match thesis terminology and correct minor language errors.*

Contents

1 Introduction

Large projects, sometimes referred to as megaprojects, have become increasingly common in many industries during the last decades and are expected to continue to grow in number in the upcoming years (Lessard and Miller, 2000; The Economist, 2008; Dimitriou, 2014). A megaproject is often loosely defined as having a budget that exceeds approximately US$1 billion (about €900 million; Flyvbjerg et al., 2003; van Marrewijk et al., 2008; Flyvbjerg, 2014). Examples of different types of large infrastructure projects that often qualify as megaprojects are airport terminals, bridges, tunnels, roads, and railway projects.

The activities in and performance of large projects have always roused the interest of numerous stakeholders. Due to the huge capital investments, the large number of organisations and individuals involved, the extensive timeframes, their complexity, their influence on society, and the extensive media attention megaprojects receive, there is a growing research interest in investigating the organisational challenges associated with this context (see Hertogh et al., 2008; Geraldi, 2009; Merrow, 2011; Dimitriou, 2014; Tan, 2015).

Because of the technical complexity and the number of actors involved in large infrastructure projects, coordination needs for both design and implementation are substantial. Many key decisions are made during the early phases of planning and design and these decisions will have considerable impact on later phases. Good project management is also generally considered to be particularly important in the early phases of projects, since the level of uncertainty is high while the cost of changes is low (Paulson, 1976; Alfalla-Luque et al., 2015; Samset and Volden, 2016).

In the early design phase, an important challenge is coordinating technical expertise with the dispersed knowledge that needs to be brought together to achieve project goals. Several international studies have found that neglect in design coordination can cause delays, cost overruns, poor quality, and disputes among actors (Hertogh et al., 2008; Hanioglu and Arditi, 2013; Zerjav, 2015). Two Swedish studies also reported that the highest increases in estimated costs take place during the early stages (Lundman, 2011; Lind and Brunes, 2015). It is a difficult task for project management to decide which

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organising efforts to prioritise when many aspects need to be simultaneously attended to, especially when weighed against initiatives from permanent organisations, future actors, and upcoming tasks (Gkeredakis, 2014). A further complicating issue is that few project members typically have extensive prior experience from similar projects.

How projects should be organised to enable the coordination of interdependent tasks under conditions of uncertainty has been investigated by many researchers (Jones and Lichtenstein, 2008). For instance, it has been shown that coordinating and organising are strongly supported by routines (Becker, 2004). In an inter-organisational project, a large number of routines influence actors from multiple organisations (Jones and Lichtenstein, 2008). Routines are essential for coordinating project members' efforts, combining their expertise to produce useful output, and making decisions.

Most research on project organising focuses on the effects and performance of various strategies (Söderlund, 2011a). However, it is also important to understand how these strategies, organisations, and routines emerge. For each large infrastructure project, a unique organisation is developed, and routines and processes will never entirely replicate those of previous projects. This thesis studies a large project organisation as it was designed and how it developed during its early design phase. Thereby it contributes to a growing body of research that studies the processes and practices of large projects (see, e.g., Cicmil et al., 2006; Blomquist et al., 2010; Sanderson, 2012). The process of infrastructure development, especially during the early phases, is described in the following section.

1.1 The infrastructure development process

Large transportation infrastructure projects are usually managed by public government clients and must conform to the policies and legal frameworks of public authorities. A project may run for decades from inception until completed construction. General goals are formulated at an early stage, and details are settled along the way, sometimes many years later. Thus, these projects easily last longer than the term of office of the government that initiated them. To control the overall progress, projects are divided into a number of phases, and government approval is typically required to move forward to the next phase.

Due to uncertainties in the early phases, there is a tendency to have higher levels of client involvement and progress review than in the later phases (Winch, 2010). Traditionally, many government clients have performed large parts of their planning and design activities in-house. However, the extent to which suppliers are involved in early design varies between clients, and also between projects undertaken by the same client. During the last decades there has been a general trend to contract suppliers to provide various kinds of public services (Pollitt and Bouckaert, 2011). This trend also applies to public infrastructure development, where increased involvement of private actors in the planning processes of urban, large infrastructure projects creates challenges for contractual as well as relational capabilities for clients (Hartmann et al., 2010; van der Veen and Korthals Altes, 2012). The division of responsibility is shifting slowly from the client to the supply side, especially for the early stages and design tasks (Lessard and Miller, 2000; Brady and Davies, 2014; Winch and Leiringer, 2015).

Due to the extensive duration of megaprojects, empirical research on megaprojects seldom encompasses more than a part of the process. Instead, for practical reasons scholars tend to focus on the phase that is of specific interest to their study. Those with more holistic aims may give an overview of the entire process, from initiation to completion, although there is little consensus regarding process phase terminology. This may partially be explained by legal and administrative differences in process stages among countries and industries. Table 1 illustrates different terminologies used to describe the infrastructure development process. From this overview, it may be concluded that although the terminology and phase distinctions differ, the activities conducted and their order tend to be similar: problem identification, investigation of possible solutions, selection of a preferred option, early design, detailed design, and construction.

Table 1. Examples of differing terminologies used in prior research. Phases that include activities considered to belong to early design, as defined in this thesis, are in italics.

Publication	Phase descriptions
Szyliowicz and Goetz (1995)	1 Problem conceptualization and definition, 2 Project selection, negotiation, and decision, *3 Project formulation and design,* 4 Public approval and ratification, 5 Project implementation.
Van Marrewijk (2007)	1 Exploration, 2 Initiation, *3 Decision making,* *4 Preparation (for realisation),* 5 Realisation.
van Gestel et al. (2008)	1 Preparation/ initiation, *2 Design,* 3 Realisation, 4 Execution/ exploitation/ implementation.
Hertogh and Westerveld (2010)	1 Pre-feasibility, 2 Project definition, 3 Option selection, *4 Single option refinement,* 5 Design development, 6 Construction.
Alfalla-Luque et al. (2015)	1 Pre-feasibility/front-end, *2 Development/ design,* 3 Implementation/ construction, 4 Closing or operation.

As in other countries, the Swedish Transport Administration's (STA) process for developing infrastructure is staged into phases. The stage model was revised in 2013 to comprise four phases instead of the earlier six phases. The former process was quite similar to the process described by Hertogh and Westerveld (2010; Table 1). The revision took place after the initiation of the project studied here, and the most extensive changes related to the phases that had preceded early design. This update therefore did not influence the studied project to any great extent. A summary of the current process for developing infrastructure is presented in Table 2. In this thesis, phases with activities

similar to those of pre-study and early design in the table below are considered to belong to 'early phases'.

Table 2. A simplified overview of the STA infrastructure development process, including activities and actors belonging to each phase (Swedish Transport Administration, 2013). (Author translation)

Phase	Activities	Actors
Pre-study	• Problem formulation. • Suggestion for possible conceptual solutions using the following prioritisation: 1) use other existing infrastructure or change the need for infrastructure, 2) alternative use of current infrastructure, 3) improve current infrastructure, and 4) build new infrastructure. • Evaluation of conceptual solutions. • If option 4 is chosen, then conduct field investigations of areas for favourable possible routes. • Recommendation of a conceptual route.	Client and consultants
Early design	• Further field investigations. • Specify a corridor in the area suggested in the previous phase. • Develop early, conceptual designs and Environmental Impact Assessment. • Hand in documents for government approval to commence building. • Decide size and procurement form of contractor contracts. • Identify possible preparatory works.	Client and consultants
Detailed design	• Develop detailed designs for Design-Bid-Build contracts. • Develop tendering documents for construction contracts. • Conduct preparatory works if possible (e.g., line shifts, demo projects of novel solutions).	Client, consultants, and possibly contractors
Construction	• Build the infrastructure. • Update detailed designs according to actual construction.	Client, contractors, and consultants

1.2 Purpose and structure of thesis

This PhD thesis investigates the process to organise the early design phase of a large inter-organisational infrastructure project. The purpose is to increase the understanding of how organisational structures and routines for coordinating project participants are designed and develop over time. The thesis then responds to calls for in-depth research on project management principles and techniques in different settings (Engwall, 2012) and to study micro-level components of routines (Felin et al., 2012).

The structure of the rest of this thesis is as follows. First, a theoretical section covers the literature on project organising and organisational routines. This section also offers an overview of organising considerations in infrastructure projects, particularly as they relate to research on megaproject organising and performance. At the end of this first section the research questions are presented. The next section describes and discusses methods-related choices. Then, the single case study is presented. Subsequently, the five papers are summarised with extended abstracts in the fifth section. Following the paper summaries, the discussion relates the findings in the case study to the literature review. Finally, conclusions are presented, including implications for research and practice.

2 Research on large projects and organisational routines

Projects are characterised by their temporary nature, and exist only to achieve a specified set of tasks before being discontinued (Jones and Lichtenstein, 2008; Söderlund, 2011b). There are different types of projects, where large projects are in general more unique and smaller projects are easier to replicate and standardise (Davies and Fredriksen, 2010). Due to their high levels of aspiration, complexity, and stakeholder involvement, megaprojects have been described as their own breed of projects, as compared to 'normal' projects (Flyvbjerg, 2014).

As previously mentioned, a common basic criterion that a large project must meet to qualify as a megaproject is a capital investment of at least US$1 billion. Other, more interesting and relevant, aspects that are frequently included in definitions are: being considered one of a kind, organisational and/or technical complexity, substantial impact on society, of political and/or public interest, long-term timeline, and progressing during conditions of uncertainty and risk (van Marrewijk et al., 2008; Flyvbjerg, 2014; Alfalla-Luque et al., 2015; van Marrewijk, 2015). In this thesis the terms 'large project', 'major project', and 'megaproject' are used interchangeably.

According to a literature review of the megaproject research (limited to Web of Science between 1998 and 2011), the number of publications and citations associated with megaproject research has grown significantly since the late 1990s (Peng et al., 2012). A similar, later, study supports these findings (Hu et al., 2015). Publications on risk management in megaprojects have also increased considerably since 2009 (Alfalla-Luque et al., 2015). Much of this research evaluates the performance of megaprojects and focuses on success factors and causes of failures (Söderlund, 2011a). Success is often and easily evaluated in terms of time and/or money. Other aspects used to measure performance are quality, goal fulfilment, number of disputes, as well as public and political support for the project (Giezen, 2012). A literature review of the empirical research (Sanderson, 2012) identifies three main research themes related to failure to fulfil goals in megaprojects: planning fallacies, project cultures, and inadequate governance methods. This review concluded that failures occur because of incoherent, inappropriate, or underdeveloped governance arrangements, unable to handle all risk

and uncertainties that exist in these projects (Sanderson, 2012). Additionally, van Marrewijk et al. (2008) also focused on governance methods and suggested that projects are managed to the best of all involved professionals' abilities but fail because of complex operations, uncertainties, influences, and ambiguities.

From this brief summary of the research on megaproject performance, it is clear that many causes of failures, as well as success factors, are related to the management of uncertainties and risks in the project context. For infrastructure settings, project management has been defined as '*the complete set of decisions regarding the setup, organization and management of a project, taken during the various phases of the project, aimed at coordinating the efforts of the various actors involved in order to successfully realize the project*' (Koppenjan et al., 2011). In the following sub-section, previous research specifically focusing on organising of projects is summarised.

2.1   Organising and managing large projects

Decision making in megaprojects consists of many parallel and sequential decisions, and does not merely consist of a few mega-decisions (Giezen et al., 2015). All large projects have to manage numerous complexities, uncertainties, and risks in various respects, which are mainly categorised as either technical or organisational (Giezen, 2013). Two opposing types of strategies that project management can use to cope with uncertainty and risk are generally discussed in the research. One strategy utilises the traditional project management approach, which focuses on planning and control as crucial for handling uncertainty (Koppenjan et al., 2011). The other strategy, which has gained increasing attention in the research the past few years, emphasises flexible approaches for handling uncertainty (Olsson, 2006; Koppenjan et al., 2011). Below, research on each of these strategies is further outlined.

2.1.1 Planning and control

In a control approach, it is considered essential to make realistic predictions and to realise these predictions as closely as possible. The project management literature presents various tools that can be used for this end (Winch, 2010; Koppenjan et al., 2011; Engwall, 2012). One proposed strategy to manage uncertainty is to maintain tight control of the time and costs of the project by keeping the project simple, planned, and

controlled (e.g., by freezing requirements and designs early, as well as using established and well-known technical solutions; Dvir and Lechler, 2004; Giezen, 2012). Based on a questionnaire study of 448 German projects in various industries, Dvir and Lechler (2004) suggest that changes should be kept to a minimum, especially when it comes to changing project goals. The reason is that the effects of good project planning on project success are reduced, possibly entirely, by goal changes combined with plan changes.

Adjustments to coordination that are intended to solve problems may in turn create other issues; for example, even if identified coordination problems are solved, problems in cooperation may arise (Söderlund, 2011b). One way for a project to reduce the detrimental consequences of changes is to assure a sufficient number of human resources for proper project execution (Dvir and Lechler, 2004; Merrow, 2011). This, however, leads to one of several trade-offs in large projects and their organisations: project managers have to decide whether to involve many experts, or to keep work groups smaller and more manageable (see further section 2.3).

Recommendations to ensure project support, apply strict routines, freeze decisions early, and ensure sufficient human resources, as well as to avoid new technology, are all supposed to increase the scope for planning and control. Reducing complexity in a project during planning and decision making may be fruitful if the project is uncontested by stakeholders or politics, but may otherwise introduce new sources of uncertainty, especially in the presence of technological uncertainty (Giezen, 2013). Such methods also have drawbacks, in the sense of limiting further development within the projects' proximity (Giezen, 2012), which is in general not desirable in urban areas. If a project experiences high levels of uncertainty, plans prepared upfront may not suffice and a flexible strategy is needed.

2.1.2 Flexibility

Flexibility may be described as postponing or minimising the irreversibility of decisions, and Olsson and Magnusen (2007) use the definition '*the capability to adjust the project to prospective consequences of uncertain circumstances within the context of the project*'. Such flexibility may be even more important in the early phases of large projects, as costs associated with changes are not as substantial then as during the later

stages of the development process (Paulson, 1976; Alfalla-Luque et al., 2015; Samset and Volden, 2016).

Flexibility may be achieved in different ways and by different means. One strategy is to, at the outset, identify the critical parts of projects where flexibility is needed (Olsson, 2006). Further, by using the information that is available at an early stage and by using parallel design processes, innovative solutions may be achieved, although with the inevitable consequence of design rework (Chua and Hossain, 2011). Another practice is to keep (scope) reduction lists. Thereby, unexpected cost increases may be countered by scope changes that do not affect the overall functionality of the final project outcome (Olsson and Magnusen, 2007; Cui and Olsson, 2009).

A literature study of flexibility in various industries showed that in practice, project management generally does not plan for flexibility in the decision-making process but ends up exercising it anyway (Olsson, 2006). Further, high levels of planned flexibility also resulted in high levels of actual flexibility. Research has recommended that megaprojects should adopt a '*responsive, adaptively designed decision-making and planning process that does justice to the uncertainty and complexity of the project and its context*' (Giezen, 2013). Findings from a case study of three large Swedish infrastructure projects also suggested that if a controlling strategy dominates in the early phases then flexibility will probably be needed during the detailed design and construction phases, entailing associated costs for these later changes (Szentes and Eriksson, 2015).

Although either a control or a flexibility mind-set might dominate a project, a mixture of both approaches is needed to enable project members to deal satisfactorily with various issues (Olsson, 2006; Koppenjan et al., 2011; Szentes and Eriksson, 2015). A similar conclusion in the healthcare context was made by Faraj and Xiao (2006), who found that fast-coordinating actors responded to unexpected events by alternating between routine coordination practices (i.e., planned strategies) and reactive coordination practices (i.e., flexible strategies). To balance flexibility and control may be crucial in the early phases of projects, since it is difficult to estimate how flexibility can be implemented in the future in an uncertain context (Cui and Olsson, 2009).

In the existing research on projects, flexibility most often refers to decisions that ultimately affect the product or final outcome (Carthey et al., 2011). Also in cases when scholars explicitly discuss process flexibility (Olsson, 2006) or organisational flexibility (Miller and Olleros, 2000), the focus is frequently on how to organise so as to be able to adjust the facility being planned or constructed to changing circumstances.

In this thesis, however, a more general view of project organising is taken. Here, it is the development and flexibility over time in the project organisation and its practices that are of concern. Such flexibility may be related to a variety of circumstances and purposes, and not only related to an urge to remain flexible in relation to the final product. One way of conceptualising project processes and connecting them to a general body of research that deals specifically with coordination and related management processes is to view these processes as enactments of organisational routines. The following section introduces research on the role of routines, as used for both coordination and shaping the capabilities of organisations.

2.2   Organisational routines and capabilities

The temporary organisation of a large project will inevitably establish many routines, involving multiple actors in its day-to-day operations. The most influential definition of an organisational routine is "*a repetitive, recognizable pattern of interdependent actions, involving multiple actors*" (Feldman and Pentland, 2003). To consider routines as processes enables a researcher to ask a wide variety of questions; Pentland and Feldman (2005) reflect upon using organisational routines as the unit of analysis in research, underlining in particular the '*importance of understanding the internal structure and dynamics of organisational routines*'.

The coordinating role of routines stems from their collective, interactive dimension, which also differentiates organisational routines from individual habits (Becker, 2004). Routines enable actors to predict what others will do and what is expected of themselves (Feldman and Rafaeli, 2002; Becker, 2004; Felin et al., 2012). They are considered vital for the coordination of actors who have dispersed knowledge (Becker, 2004), especially in large projects (Davies and Brady, 2016). According to Gkeredakis (2014), coordination is enabled when '*actions of dispersed individuals are made witnessable*

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and anticipatable within a local division of labour, such as a project team'. However, routines are also seen as fundamental in shaping the capabilities of organisations more generally. Nelson and Winter (1982; 2009) emphasise the role of operating routines that guide the day-to-day activities of an organisation as repositories of organisational knowledge. In this view, routines constitute the memory of an organisation.

2.2.1 Changing routines

Although routines may be seen as static and unchanging, at some point they were new, possibly even novel, practices in the particular organisation. Gersick and Hackman (1990) describe three main mechanisms for how routines are introduced in groups: importation, creation at the start, and evolution over time. Importation refers to when routines are brought in from a source external to the group, for example from permanent organisations or former projects. Creating routines means that participants purposefully shape their own routines, which may not be a simple matter. For example, Pentland and Feldman (2008) warn that a common mistake is to focus on developing artefacts such as checklists and computer programs, and subsequently to expect these to lead automatically to certain responses by organisational members. The actual pattern of activities may turn out very differently from the pattern intended by those in charge of developing routines. Finally, routines may evolve over time, as needs for specific patterns of activities are experienced and new routines naturally take form.

Despite the fact that routines are often perceived as stagnant practices, and thereby in opposition to learning and innovation, changes do occur within established routines. There are a number of causes that contribute to changes or updates in routines: novelty, failure, deadlines, interventions, autonomy, changes in groups or tasks (Gersick and Hackman, 1990), considering subsequent activities and external interdependencies (Gkeredakis, 2014), as well as the context and notions of individuals (Feldman and Pentland, 2003). According to Gkeredakis (2014), changes in coordination are most commonly made in order to adapt to unusual or problematic developments. Jarzabkowski et al. (2012) describe a cyclic process of continuously updating routines as a model in which coordination amends its own flaws. They outline how identified gaps (or absences) in coordination (which may be induced by any of the reasons

previously described) are filled by new coordinating elements which, as they are combined and repeated over time, eventually form new routines. Accordingly, Brady and Davies (2004) conclude that combining existing and proven routines in novel ways is a fruitful strategy to introduce innovative routines. Similarly, other recent research has also highlighted such recombination of resources to achieve innovative results (Giezen et al., 2015).

2.2.2 Meta-routines and dynamic capabilities

Changes in operating routines may also result from planned and systematic processes. Research on knowledge management has increasingly emphasised that meta-routines, or dynamic capabilities (Nelson and Winter, 1982, 2009; Zollo and Winter, 2002; Becker et al., 2005; Parmigiani and Howard-Grenville, 2011), are important for the capacity of organisations to learn and innovate. This also applies to projects and project-based organisations (Davies and Brady, 2016). Such second-order routines govern activities to revise and update operating routines in response to a changing environment. Pentland et al. (2012) found that internal (endogenous) changes to routines may be explained by a process of variation, selection, and retention. The same 'dynamic properties of routines' can also explain formation, inertia, and learning curves in relation to routines.

Meta-routines may be especially useful in flexible organising strategies for complex project organisations as a means to evaluate and adapt operational-level organisation and processes to continuously changing needs. As a project progresses, new tasks arise that may require further coordination. Meta-routines may be established to identify and respond to such changing demands.

2.3 Heuristics

Recently, research has increasingly focused on the micro-foundations of organisational structures and routines, especially the ways in which managerial cognition influences such organising processes (Eggers and Kaplan, 2013). Analyses of the types of routines and organisations that tend to arise in specific contexts have increasingly emphasised the role of heuristics (Loock and Hinnen, 2015; Pentland and Hærem, 2015). Heuristics are simple rules of thumb or mental shortcuts that help to simplify and make sense of

complex contexts. They enable fast decision making that demands little cognitive effort. A vast array of heuristics that influence individual decision making in various situations has been identified in the research (Tversky and Kahneman, 1974; Bazerman, 1998; Kahneman, 2011). Heuristics may also operate on the organisational level, where they have been conceptualised as '*articulated and often informal rules-of-thumb shared by multiple participants within the firm*' (Loock and Hinnen, 2015).

Traditionally, much psychological research has focused on the ways in which heuristics can cause deviations from rational decisions (Kahneman, 2011). Often, it is assumed that greater analysis and cognitive effort lead to more accurate solutions. However, recent research has adopted a more positive view on heuristics-based thinking, emphasising that it may produce acceptable solutions in a shorter time and use fewer resources. Furthermore, in some situations heuristics are ecologically rational, which means that a specific heuristic applied in a specific context leads to better decisions than more elaborate strategies (Mousavi and Kheirandish, 2014).

Organisational heuristics, as opposed to individual heuristics, are often idiosyncratic and differ between firms. Individual-level heuristics can be expected to influence decisions of teams on a more subconscious level, but organisations may also consciously develop simple rules of thumb to control and coordinate decision making (Bingham and Eisenhardt, 2011). Such heuristics are easy to communicate and learn, and therefore enable coordination (Loock and Hinnen, 2015).

Earlier studies of heuristics in project contexts include investigations by Kadefors (2005) on the influence of fairness heuristics on negotiation strategies in construction projects, Winch and Maytorena (2009) on project managers' sense-making in risk identification, Flyvbjerg (2014) on the impact of optimism bias in estimations of cost and expected benefits, and Karrbom-Gustavsson (2016) on 'subjective prioritization strategies' used by individuals to decide what project tasks to perform in everyday practices. However, not all these studies explicitly use the term heuristics.

In calls for further research, it has been suggested that it is important to focus on the role of heuristics in various types of organisations and various types of decisions (Loock and Hinnen, 2015), as well as on identifying which kinds of heuristics are unique to the

formation and persistence of organisational routines (Pentland and Hærem, 2015). To understand how organisations and routines develop in large projects, it should be important to study the influence of heuristics on such organising processes. Furthermore, in line with findings of studies such as Bingham and Eisenhardt (2011), it should be investigated if and how large projects develop simple rules that act as coordination mechanisms.

2.4 Research on project routines

Routine research describes routines as central to many organisational phenomena, including stability, change, flexibility, learning, knowledge transfer, coordination, and innovation (Becker, 2004; Pentland and Feldman, 2005). This centrality implies that studies on the development and successive adaption of routines may increase our understanding of the conditions that affect the organisation and performance of large infrastructure projects. However, despite the fact that coordination capabilities are central to the success of large projects, and even though much coordination is accomplished by routines, little research to date has explicitly investigated routines in a project context (Davies and Brady, 2016). Most research on the development of and changes to routines has focused on permanent organisations. Some insights from the limited research that does cover routines and projects are described below.

Empirical research (Zika-Viktorsson et al., 2006) has shown that individuals commonly experience 'project overload' when they are engaged in multiple projects. This overload may result in inefficiencies, high levels of stress, and decreased individual competence development. Routines were seen as important for helping individuals to gain a sense of control and structure in project work, and insufficient project routines were identified as an important factor leading to project overload.

Winch (2010) emphasises that routines have several beneficial features in construction project organisations: they are repositories for know-how and proven rules of engagement, they provide heuristics that increase efficiency, they are sources for change as well as stability, they provide perceptions of due process, and they imply the division of labour. Accordingly, project routines can be imported from other organisations but need to be adjusted to the current project's tasks and team members in order to be useful.

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In the construction industry, there are institutional-level standards and roles that influence project organising and enable the efficient coordination of partners in individual projects (Kadefors, 1995). Much research focuses on the difficulties of introducing change in construction, and these difficulties also apply to routines (Bresnen et al., 2005).

Regarding meta-routines that are used for continuous evaluation, Julian (2008) found that in practice, reflection is often deferred until the end of a project. To some extent, such routines are included in flexible management strategies. In underground construction, for example, observational methods are used to monitor and adapt project implementation to actual ground conditions (Powderham, 1998). In conjunction with such methods, it has been found that a system of meta-routines to continuously review current conditions and update the responsible organisation to any changing needs that are identified is also important (Le Masurier et al., 2006).

2.5 Reflections and research questions

There are many recommendations in the literature on how to organise and manage large and complex projects that involve multiple actors. Much of this research evaluates project performance after its completion. Further, there is strong emphasis on either the very front-end of initiating a megaproject or the construction phase, while there is comparatively little research on the design phases in infrastructure projects in general (Gil and Theter, 2011; Zerjav, 2015). Although there are exceptions (Van Marrewijk, 2007; Bektas et al., 2015), early design phases are seldom investigated in any detail, despite the fact that these phases include substantial planning activities that heavily influence the final outcome.

In general, phases in large projects have diverse set-ups and practices, since they conduct different tasks. However, challenges related to coordinating multiple actors occur in all phases. Furthermore, partly due to the sometimes lengthy processes associated with obtaining government approval, individual players are replaced between phases. As a project enters the early design phase, following the smaller-scale organisation of the pre-studies, the number of suppliers involved in the project organisation increases considerably. This increase implies that measures for organisational control and

flexibility need to be reconsidered. As stated earlier, the purpose of this research project is to increase the understanding of how organisational structures and routines for coordinating project participants are designed and develop over time. Based on the literature review, this purpose is translated into three research questions:

RQ1: What is the influence of permanent organisations, project members, and industry practices on establishing organisational structures and coordination in the early design phase of a large infrastructure project?

The findings corresponding to this research question illustrate the conscious development of organisation and routines in the early design phase, describing choices and likely sources of inspiration for the emergence of routines and organisational structures.

RQ2: How do organisational structures and routines change during the early design phase of a large infrastructure project?

The second research question generates a discussion of the ways in which a project adapts its organisational structures and routines to changing circumstances, as well as an increased understanding of project needs and contexts. The discussion covers the type and extent of refinements made to existing routines and the project organisational structure, as well as how the need for such changes is identified.

RQ3: How does the unique and temporary character of a large project shape the development of organisational structures and routines?

This research question addresses the findings of research questions 1 and 2 in tandem. In particular, it is discussed how the temporary and transitory context influences processes of adaptation and change, including the potential for meta-routines, and also what type of shared heuristics that may emerge to enable coordination.

3   Research approach and design

When the focus is on understanding the dynamics in different types of settings, a case study is preferred (Eisenhardt, 1989). The aim is to gain in-depth understanding of coordination and project practices as they emerge and change over time (Blomquist et al., 2010). Therefore, a practice-inspired approach was adopted (Feldmand and Orlikowski, 2011), which means studying practices on the micro-level in order to understand how practitioners act in and make sense of situations (Blomquist et al., 2010; O'Leary and Williams, 2013). This approach is also supported by van Marrewijk et al. (2008), who suggest that megaprojects should be investigated with an internally-focused, contextually-grounded view of actual practice, instead of using an outsider's view that looks for pre-specified phenomena. Direct observation enables researchers to gain insights into and understanding of practice. Qualitative and ethnographical methods, which are based on direct observations, are suitable for the study of organisations (Schwartzman, 1993). Below, the process of designing the study is described more in detail.

3.1   The pre-study and selection of case

The process leading up to this PhD thesis started with a pre-study whose purpose was to define and evaluate the research focus and to plan further research activities. The pre-study consisted of semi-structured interviews with two representatives from engineering consultancy firms and three from the governmental infrastructure client (i.e., the STA) between September 2011 and January 2012 (Table 3). Interviews lasted between 1.5 and 2 hours and took place in the offices of the interviewees.

Table 3. Details of pre-study interviews. The last column indicates which papers drew upon the interviews.

Interviewee details	Date	Papers
STA Technical Design Leader in the RailTunnel project; interviewee had experience with other large projects	1 September 2011	I, II
Senior consultant, Rock Engineering	2 September 2011	
Senior STA employee, engaged in policy development	12 September 2011	
Senior consultant, Infrastructure	7 October 2011	
STA Assistant Project Director in the RailTunnel project; interviewee also had experience with other major projects	18 January 2012	I, II

The focus of the interviews was on interviewee experiences with large projects and what they found particularly interesting or challenging. Issues related to collaboration between client and engineering consultants in the early design phase arose repeatedly in these interviews, as well as the challenges involved in coordinating experts from diverse technical fields. It was during this analysis of the transcripts that it was decided that a study based on direct observation rather than retrospective interviews was preferable, in order to obtain detailed insights into project coordination.

To achieve the level of detail that this study aspired to reach, it was further decided to focus on a single case study of a project that could be easily accessed. To choose a project, theoretical sampling (i.e., selection of a case because it will provide interesting findings and not because it is an average representation of reality) was used. This sampling strategy is suitable when the aim is to concentrate on specific issues and to clarify the deeper causes of problems (Flyvbjerg, 2006; Eisenhardt and Graeber, 2007). Two of the interviewees were part of a large project, and since the project had already been suggested as a case study object, these interviewees were also asked about the project organisation structures, general project activities, and about their roles in the project.

3.2 The main case study

The case study was informally started when I attended an information event for potential tenderers in November 2011 and conducted the two pre-study interviews with the project members mentioned in the previous section. In March 2012, I was granted access to the project, which meant I was allowed to attend project meetings and to gain access to project web portals. At this point the main case study was formally initiated, and remained ongoing up until the summer of 2015. Below is a brief description of the case study project; immediately following, the means of data collection and analysis are presented.

3.2.1 The case study project

The RailTunnel project comprises a 6 km railway tunnel and three stations in an urban area. Costs are estimated to about €2 billion, of which about €100 million was budgeted for the early design phase. This phase was initiated in 2011 and finished in early 2015.

The RailTunnel project fulfilled two practical criteria for conducting a practice-based study: easy access due to geographical proximity and a schedule that fit the timeline of the research project. Most importantly, it was chosen because it was one of the largest ongoing Swedish projects and involved many actors. The major project was technically challenging and had adopted a large, novel, and complex organisation. It therefore had the potential to reveal many issues and complexities relating to coordination during the early design phase.

The start of the case study coincided with the arrival of consultants in the RailTunnel project. At this point, the consultants were being contracted or in the process of defining their assignments. Similarly, the client project organisation was also being formed, as employees were successively appointed to, or in a few cases transferred from, the project. The project is described more in detail in chapter 4 and in the five appended papers.

3.2.2 Observations

Data collected from the single case study consisted mainly of observations; altogether about 450 hours were spent observing project participants. Since client-consultant coordination and how these processes were decided was the focus of this research, an important source of data has been meetings. Observing and understanding management meetings over time is recommended when studying project processes and for understanding the actuality of projects (Söderlund, 2013). Meetings create both order and disorder in social systems and are important for learning about the setting (Schwarzman, 1993). Furthermore, stories that emerge spontaneously in everyday life, during meetings for instance, reveal what is important to those involved (Schwarzman, 1993).

In a typical setup for the observations of the meetings that I attended, I sat at the same table as participants, favouring a position on a corner or in the back to avoid interfering

with meeting interactions. Initially, notes were written by hand on paper, which were digitalised to Word documents after meetings. After May 2012 notes were instead made on an iPad as a way to make the data collection more efficient.

My participation at meetings did not seem to have any major impact on members' behaviour. My intent was to disturb project members as little as possible. I found it preferable to attend and observe events rather than to ask for descriptions of them in interviews, in order to limit the number and length of interviews and to be discrete when observing. I would consider myself a 'neutral observer' (Walsham, 2005), meaning that project members in general did not perceive me as belonging to any particular individuals or groups in the project. Disagreements and personal opinions were freely voiced in my presence, including those that were left out of meeting minutes. There might have been some initial self-censoring by members, but with time I believe that potential barriers caused by my presence were further lowered.

In some meetings with interdisciplinary groups that involved consultants new members repeatedly participated, and although there were frequent round table presentations I believe that many of those present forgot who I was and that I was only there to observe and learn more about coordination in the project.

During the first year, one main task was to familiarise myself with the project and the project organisation and processes. To obtain an overall view of how client-consultant interaction was designed, I initially attended a variety of meeting types. There were, however, many types of groups and meetings in the project, and not all could be observed, especially not repeatedly over longer periods of time. Since an aim was to follow developments in organising over time, a limited number of meeting series on different levels in the project were selected for deeper and continuous observation. A summary of the meeting series in the project that I attended is found in Table 4. The Top Management group was most frequently followed in order to see which organising decisions were made, and on which grounds, throughout the early design phase. Furthermore, I attended project-wide seminars and presentations that included topics related to organising. These comprised delivery presentations by consultants, regular client project workshops that discussed topics such as the working environment, as well

as occasional workshops and evaluation meetings. Also, 'project days' that functioned as combined kick-off and information seminars were observed; such seminars included the client, consultants, and sometimes municipality representatives.

Table 4. Meeting series and other gatherings observed in the case study project, including the time interval of attendance, the number of occasions, and the number of hours attended. The last column indicates which papers drew upon the findings from the various kinds of meetings.

Meeting series	Attendance	No.	Hours	Papers
Top Management	April 2012 – May 2015	42	108	I,II,(III),IV,V
Design Group	March 2012 – May 2013	11	32	I,II,(III),V
Cooperation Group	April 2012 – January 2013	10	52	I,II.III,V
Coordination assignment(s)	April 2012 – May 2013	12	28	I,II,V
Rock engineering assignment	March 2012 – December 2014	22	38	I,II,V
Station Line meetings*	August 2012 – May 2014	19	52	I,II,V
Client project workshop	April 2014 – May 2015	4	28	II,IV
Project day/Kickoff	September 2012 – February 2015	5	38	(I),II,V
Workshop/Information for multiple consultant assignments	March 2012 – August 2014	13	68	II,V
Various workshops	March 2012, April 2014	2	11	II,V
Total	**March 2012 – May 2015**	**140**	**455**	

*The Station Line meetings included meetings internal to the consultants as well as meetings with the client.

When taking field notes, the aspiration was to capture dialogue on organising, routines, decision making processes, and other management-related decisions. I strove to write, as far as possible, shorter versions of statements while preserving the language used by project participants. This was generally achieved, but the level of detail differed depending on the relevance of the topic to the overall purpose of the study. To triangulate findings from observations, informal discussions, and semi-structured interviews, a short questionnaire survey to selected consultants and extensive project document studies were conducted.

3.2.3 Semi-structured interviews and informal conversations

Many opinions were shared in meetings and I had numerous coffee break discussions with project participants that helped me understand their perception of managerial choices. I did, however, receive more information from client members than consultants

and wanted to balance the input. As a complement to the observations, semi-structured interviews (Table 5) were conducted to allow interviewees the opportunity to elaborate on their answers (Bryman and Bell, 2011). In the first round, seven consultant representatives were interviewed. These interviewees were central to the project. They were selected because they were the participants who had been observed more frequently (i.e., and could thus more easily elaborate on the observed topics and practices), and they were also considered more likely to be open-minded in sharing opinions. There was an emphasis on coordination assignment members since they also had a novel role. Additionally, I later conducted two shorter interviews with client representatives, and focused mainly on a bonus system. I also conducted one retrospective interview with the Project Director after the early design phase had finished.

Table 5. RailTunnel interview details. The last column indicates which papers drew upon the interviews.

Interviewee details	Date	Papers
Senior consultant, Coordination	21 May 2013	I, II
Coordination Assignment Manager	5 June 2013	I, II
Former consultant, Coordination & Representative (Ombud) Station Assignment (2)	17 June 2013	I, II
Organisational consultants (2)	2 September 2013	II, III
Rock Engineering Assignment Manager	24 October 2013	I, II
Design Manager	9 May 2014	I, III
Project Director	27 May 2014	I, III
Project Director	12 February 2016	II, IV

Interviews were recorded and transcribed. The five consultant interviews lasted between 1-2 hours, the two client interviews about bonuses lasted about 30-40 minutes, and the retrospective interview with the Project Director lasted for 1.5 hours. To balance my familiarity with the project, my main supervisor was involved in developing the interview guides and participated in conducting the consultant interviews.

3.2.4 Email survey

For a specific topic where I wanted to get first-hand information from all consultant assignment managers and in order to save time, I sent out an email survey instead of

conducting interviews. The limited response to bonus possibilities could not be explained by observations alone and was an interesting phenomenon, especially since consultants had been part in specifying the bonus routine. The survey consisted of seven questions regarding financial incentives and their effect in the project. It was answered by 15 consultants who were or had been assignment managers. The email survey provided data for Paper III and is more closely described there.

3.2.5 Document studies

To further complement observations captured in field notes, project documents were studied. From the start of the case study, access was given to a large amount of the project documentation. This documentation included reports from earlier project phases, information posted on web portals for all project participants, preparatory documents for meetings, and meeting minutes. Formal meeting minutes were usually 3-5 page long Word documents and appendices were frequently PowerPoints that often included a prepared subject for group discussions. Sometimes there were Excel sheets with reports or quantitative information, drawings, or models. Another kind of appendix exclusive to client groups was a 'decision and activity log'.

3.2.6 Analysis

The research approach has been an evolving process. Events that occurred in the main case study project have influenced my research interest and research questions. Over time, new findings have continuously given rise to new ideas or questions. The ambition has been to keep an open mind during the entire research project and to be attentive to phenomena related to coordination of large, inter-organisational, complex projects. Furthermore, I have iterated between empirical findings and theory, which is characteristic of explorative research (Eisenhart, 1989).

The field notes were the basis for tracking decisions and changes in management procedures. The first run-through of field notes was made after each meeting, in order to correct spelling errors, spell out abbreviations, and at times complement with information from memory. In this process, I highlighted discussions that I perceived to be relevant to the research focus in order to be able to easily find them later.

A more extensive analysis of field notes and other data took place when I had gathered enough data to start to develop a paper on a specific topic. Then I used search tools in Explorer and Word to find documents and sections covering the topic of interest. These searches were often based on my close familiarity with the project taxonomy. I defined keywords and searched for these, and also used synonyms I knew had been used in the project. If documents that I had expected to find in the result list did not show up, I usually located and skimmed through these as well. Apart from field notes, mainly meetings minutes and appendices were studied to trace decisions and to some extent the discussions that led to these decisions.

Findings that had the potential to be useful for the paper under development were copied and pasted into separate documents, in Word or Excel, using the keywords or codes as headings. New codes were sometimes created when reading through the documents, and codes were continuously re-evaluated as the data were analysed.

For Paper IV, which was the last initiated paper, the Critical Incident Technique was used in the analysis (Flanagan, 1954). First, as many incidents as possible connected to the aim of the paper were catalogued, and a list of potentially important incidents were described in greater detail. After further review, these incidents were shortlisted and converted into a narrative about the process for deciding the organisation of the subsequent project phase.

3.3   Reflections on research methodology

The strengths of the study are that it is in depth, submerged in the context, and longitudinal. The longitudinal study made it possible to acquire a sufficient number of observations to capture developments in the project and to identify which practices were routine. A drawback was that it was very time-consuming, restraining possibilities for other equally in-depth case studies (Walsham, 2005). Another weakness, which applies to all single case studies, is the difficulty in generalising findings. In this instance, the findings were primarily compared to earlier research on routines and heuristics instead of other case studies, in order to achieve theoretical generalisation (Ritchie et al., 2013).

I will briefly reflect on myself as the researcher and the research setting, as is recommended in ethnographic inquiries (McDowell, 1992). I am a Swedish female with

a MSc. degree in Industrial Management and Engineering, with a concentration in supply chain management. I have no training in civil engineering and had never been involved in the infrastructure industry prior to my PhD studies. This allowed me to enter the field with an open mind and to be free of pre-conceptions of 'how things should be done'. This also meant that I did not fully follow detailed technical discussions, but I believe that I grasped the aspects that were relevant to this research project, namely when, who, and why actors needed to coordinate. Like me, several project members also had degrees from Chalmers, which helped to build rapport in most groups. I also conducted interviews with members of other projects. These helped me to better understand the management of large projects although the content of those interviews is not explicitly referred to in the appended papers.

In Top Management meetings, where I was frequently present, I was almost expected to show up. When I entered the project there were confidential discussions about ongoing tendering activities that could not be shared until after the announcement of who had won the contracts, and I had to sign a confidentiality agreement covering that period. However, I was never asked to leave a meeting. The research project focused on routines, which is generally not a topic of interest to external stakeholders. I would nonetheless never share sensitive details from discussions that were not found in the project's meeting minutes if anyone would have asked me about issues that were outside the scope of this PhD thesis.

Going native is always an issue when spending much time on ethnographic activities, as becoming socialised with people in the field might lead a researcher to have difficulties observing them with a fresh outlook (Walsham, 2005). Some months into the study, I learned and used project taxonomy like a project participant. Such familiarity might have made me consider the project's everyday practice to be common practices in the construction industry and made me miss out on interesting findings. To avoid going native and missing out on potential academic contributions, I discussed or co-authored all my papers and the cover paper with my supervisors, who did not have close relationships with the project participants.

The main case study of the RailTunnel project has been the basis of all the papers, and the methods and data used for each paper are described in their respective methods section. Of course many developments took place in this complex project other than those reported here, but I was not there to observe them or hear enough about them to make further inquiries. An overview of the main study and papers appended to this thesis is found in Figure 1, which shows the production timeline of the papers.
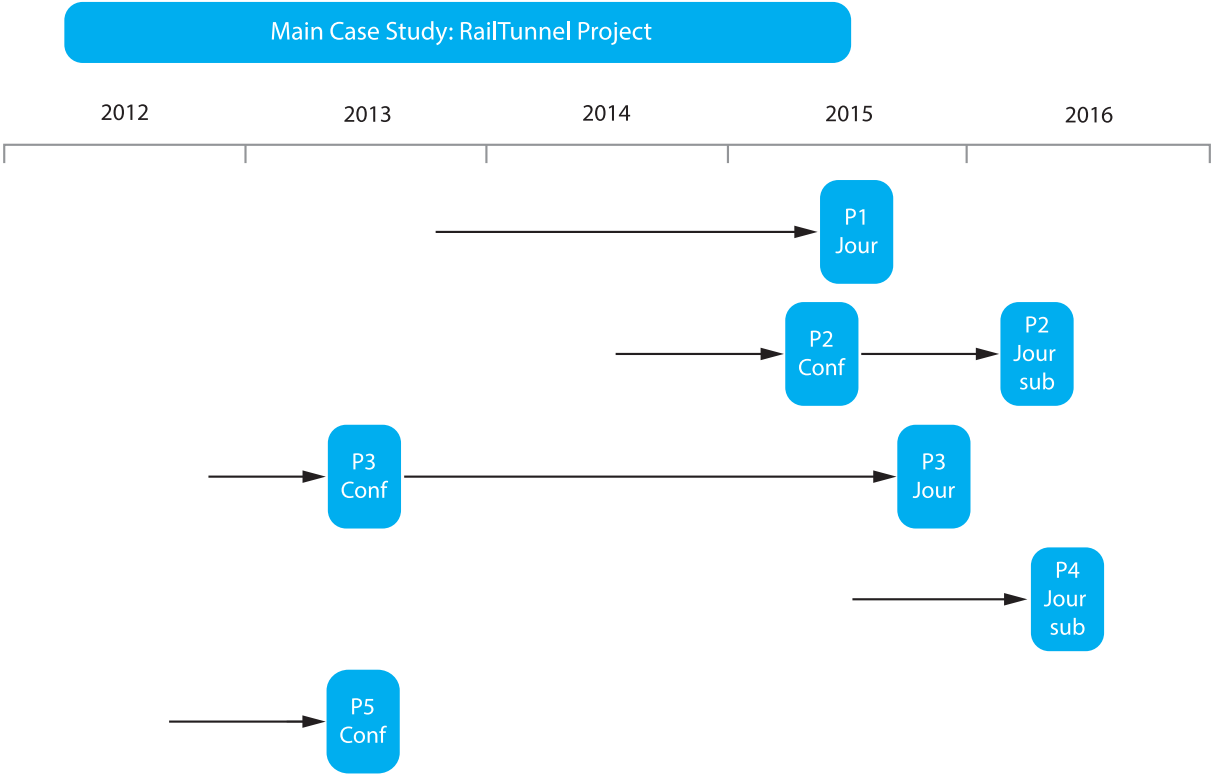

Figure 1. Timeline for the research process. Arrows indicate points in time and also the relation between conference and journal publications, as well as journal submissions.

4 Project organising in the RailTunnel project

This section offers a brief overview of the project as well as further details relating to the organising structures and processes discussed in the papers. When using the term 'project', both client and consultant groups and members are included. The project was part of a larger programme of transportation infrastructure investments and was funded by a consortium of state, regional, and municipal authorities, as well as road tolls that were introduced, in part, to finance the investments. The aim of this project is to increase the regional railway capacity through development in an urban area. The overall structure of the client top management group is found in Figure 2.
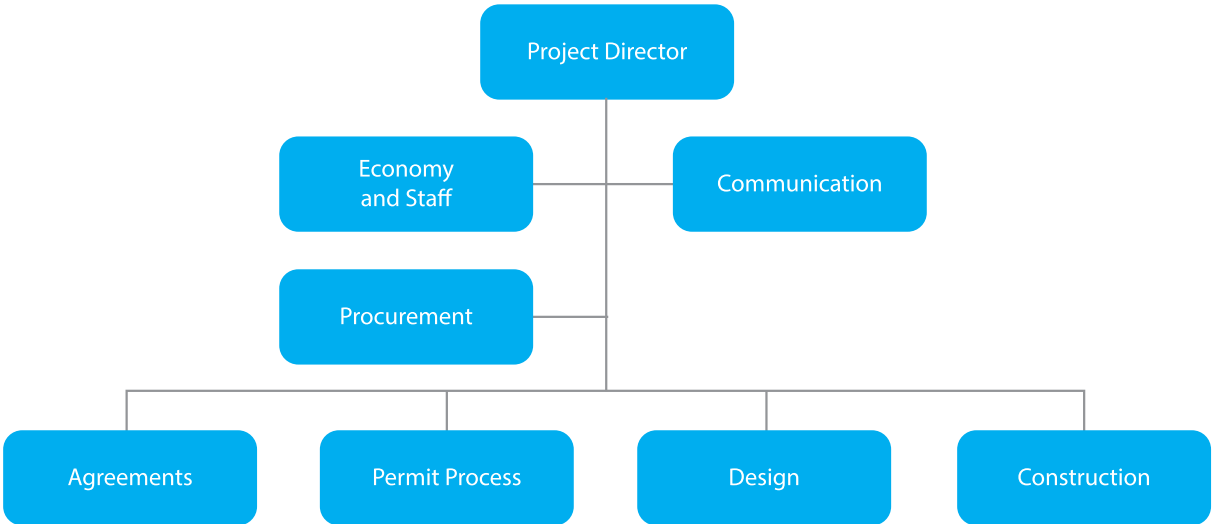
Figure 2. The project top management group.

4.1 The organisational structure in the early design phase

The early design phase lasted between 2011 and 2015. During 2011 a small group of client staff was employed and made preparations, set the organisational structure, and tendered for consultants. The Project Director was transferred to a parallel large project at the start of 2012 and was thus replaced, and early on a few client members shifted to the other project as well. As the new Project Director was appointed, all internal technical experts had been allocated to the project and the contracting of consultants was running and the successor retained the organisational concept, which was considered novel and unusual. In the design group, initially there was one group of 13 smaller technical assignments (of which one was performed in-house) to deliver field investigation data and technical requirements for the future infrastructure to another

group of five larger design and coordination assignments. All these assignments were mainly staffed by domestic consultants and architects. Figure 3 illustrates the design group in the client project organisation at the start of 2012.
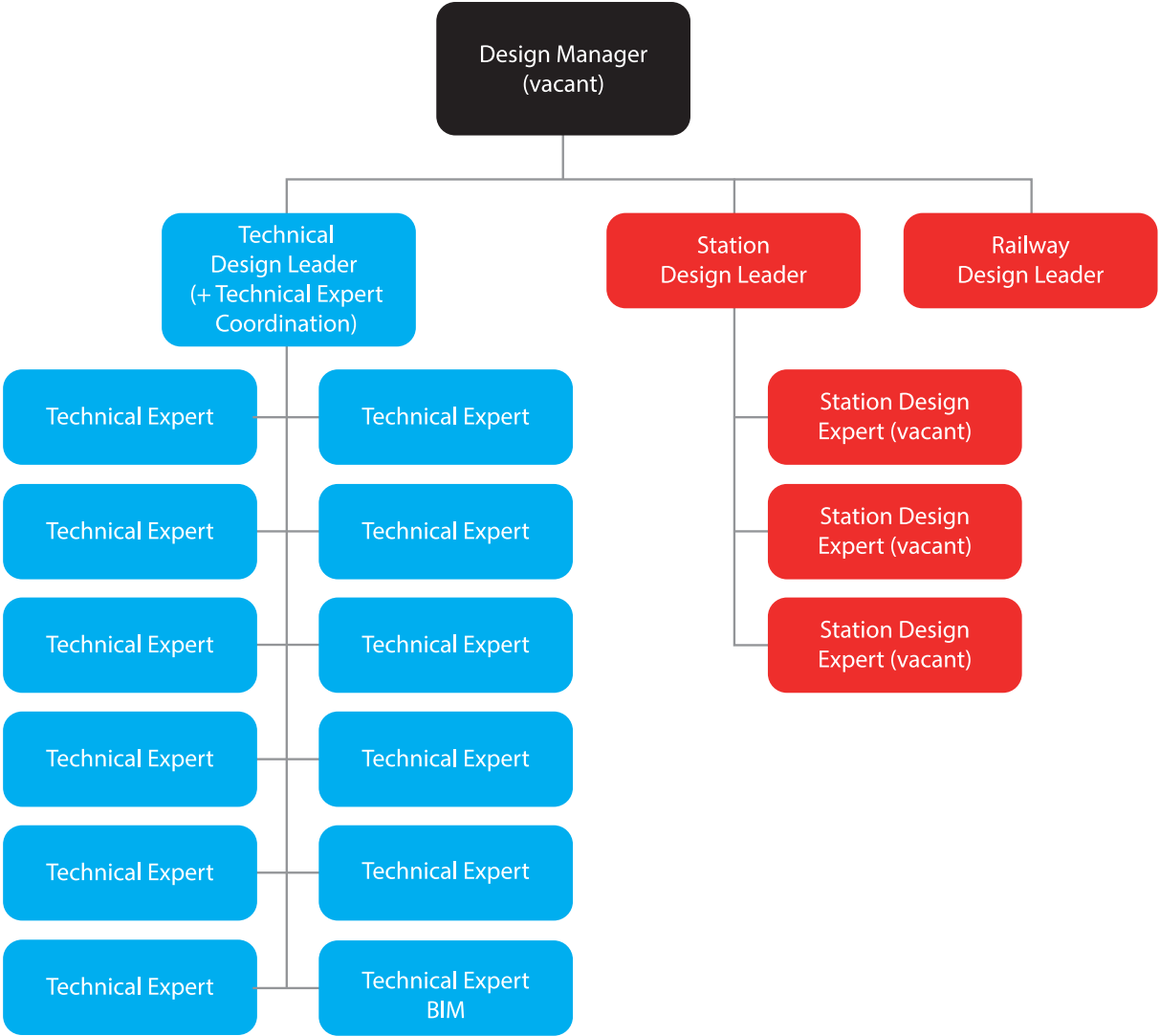
Figure 3. The client design group at the start of 2012.

During the spring the observations started and as the first design development activities did not commence until then, this is referred to as the start of the early design phase. The first change happened when the Design Manager was appointed. The Building Information Modelling (BIM) assignment and its technical expert (blue) were moved closer in order to report directly to the Design Manager, due to their importance for coordinating all design activities. The next restructuring (Figure 4) occurred when consultant assignments were merged after the same consortia won several of the tenders. The Railway assignment merged with a Stations assignment, and the two coordinating

assignments merged with the BIM assignment into a new larger Coordination Assignment. A consultant wanted the client's project team to match the newly restructured assignment organisation. This caused a rearrangement of Design Leaders, and the former Stations Coordinating Leader became an assistant Design Manager who was in charge of the new Coordination Assignment. The increased workload of the Railway Design Leader led to the creation of an assistant position that was in charge of the station, another Station Design Leader had an assistant due to planned parental leave.

Figure 4. The final client design group structure in the fall of 2012.

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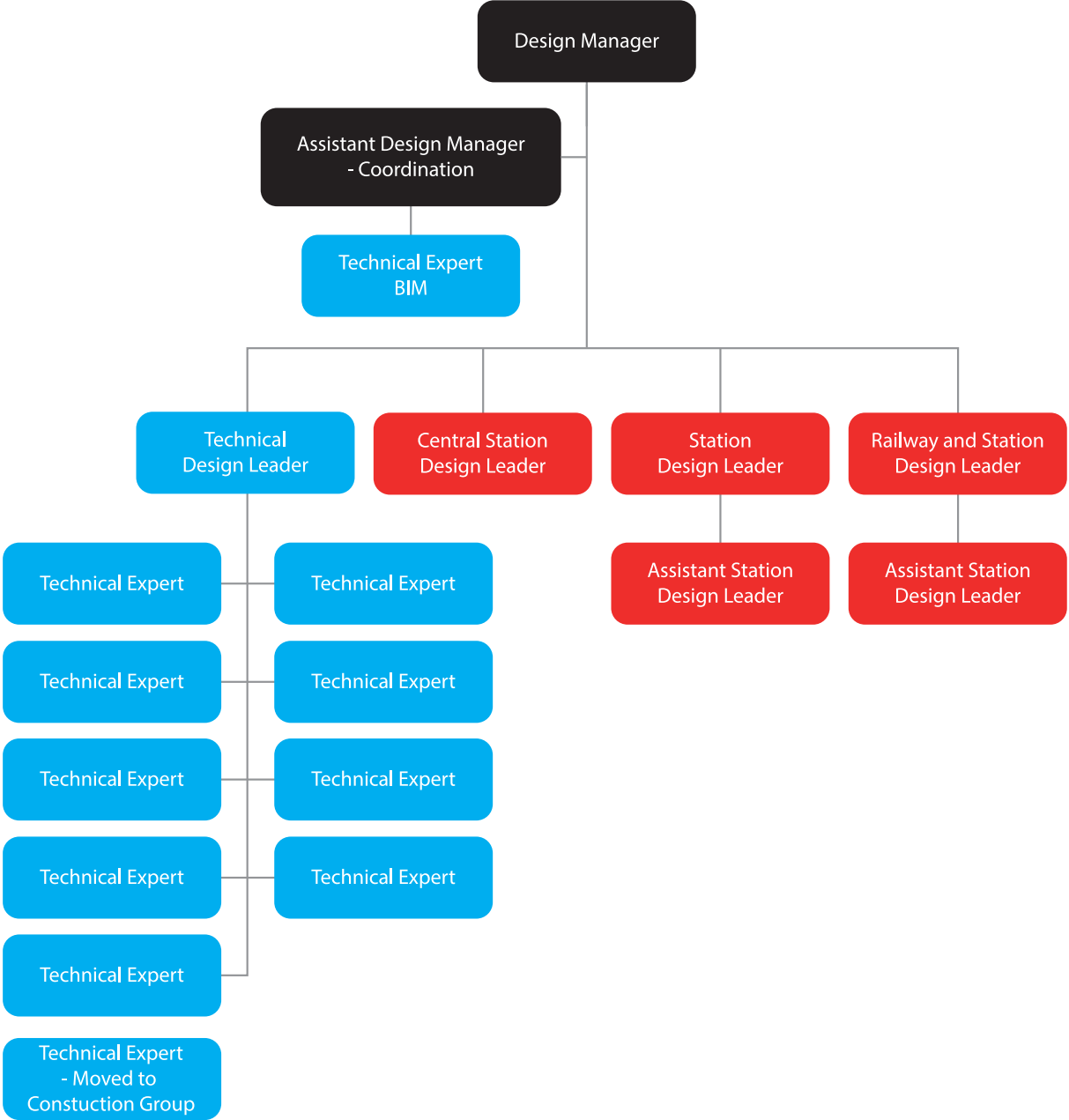Most of the incoming members had previously been involved in another large project that the new Project Director had been running and some individuals originated from the permanent client organisation. Almost all top and middle management client members stayed until the start of the subsequent detailed design phase.

Findings in the papers mostly cover changes in the design group, but there were a few changes in other client groups as well. One example was the unplanned change to introduce a legally-oriented environmental consultant assignment. This change was implemented due to the potential appeals by external stakeholders that most certainly would come. The group was under the care of the Agreements Manager, who had pointed out this project risk and suggested such a group in an attempt to save time in subsequent phases. To have a separate assignment for this purpose was unusual, and because of this its place in the organisation was recurrently debated in the client project organisation. During early design, however, this group remained where it had been initiated.

As the phase finished, a total of 80 part- and full-time client members had belonged to the project organisation. In the (final) 16 assignments, a total of 900 consultants had participated in project work, 800 million SEK of the 1 billion SEK budget had been spent, about 900 requirements had been formulated for the current and following phases, and the desired deliverables had been submitted.

4.2 Planning for the next project phase

During the last year of the early design phase, the client project management team once again designed a project organisation. The Project Director involved many client project members to discuss the basis of the upcoming client organisation that would handle detailed design and construction. This organisation would be operational for about three plus eight years and handle a number of sub-projects that were procured with traditional, Early Contractor Involvement, or Design-Build contracts. The compartmentalised organisation in the early design phase had required more coordination than expected. In discussions leading up to drafts of the new organisation, this experience was a strong argument to minimise the number of groups. The permanent client organisation was not

involved in the development process, but did have a final say in approving the structure. In the next section, extended abstracts for each of the appended papers are presented.

5 Summary of appended papers

All papers are based on the RailTunnel case study, and to different extents they contribute to answering each of the three research questions. Paper I presents an overview of the most important organisational routines and the sources of their development and change, with an emphasis on the client project organisation. Paper II describes the emergence and successive adaptation of organisational structures and routines, and discusses the role of heuristics in these decision processes. Paper III focuses primarily on the inter-organisational Cooperation Group and its meetings for developing a specific set of routines to handle a new bonus system. Paper IV discusses the process of forming the organisation for the subsequent phase, and focuses on critical incidents. Paper V examines how experiences of organising from other contexts were introduced during the first year of the study.

5.1   Paper I

Eriksson, T. (2015) Developing routines in large inter-organisational projects: A case study of an infrastructure megaproject, *Construction Economics and Building,* 15(3), 1-16.

General management research has increasingly recognised the significance of routines in organisational performance. Owing largely to their size and uniqueness, megaprojects may establish and develop their own bespoke routines. The paper investigates how this is done during the early design phase of a megaproject. The discussion in the paper is organised around three assumptions:

1. Project routines in megaprojects result from a combination of routines imported from participating organisations, including industry practice and project-level initiatives.

2. Since many routines in megaprojects are new and unfamiliar to both organisations and individuals, learning processes occur, as reflected in the change and adaptation of routines over time.

3. The temporary nature of megaprojects limits investments in the development of routines and increases tolerance for dysfunctional routines.

The paper presents a list of routines in the project. Findings revealed that the client exerted the greatest impact on choice of routines and confirmed that the temporary nature of tasks limited efforts to fine-tune routines. Changes in routines were primarily reactive, responding to changing circumstances and increased understanding of project needs. Findings suggest that meta-routines to consciously review routines should be used to a greater extent and designed to capture supplier experiences as well as those of the client's.

5.2 Paper II

Eriksson, T. and Kadefors, A. Heuristics and mantras: decisions in designing large project organisations. *In the review process of a scientific journal.*

Previous version: Peer-reviewed conference paper, presented at the conference of the International Research Network on Organizing by Projects (IRNOP) 2015.

This paper examines organising processes that take place in the early design phase of a large infrastructure project with a focus on the factors influencing how the organisation and important routines are designed and adapted over time. In particular, the role of heuristics or simple rules of thumb for decision making on both individual and organisational levels is discussed. A subset of heuristics relevant to organising and coordinating large and complex projects is identified and used as an analytical framework.

One important observation is that the potential influence of heuristics is high in large projects that have substantial freedom to design and select their own project organisations and routines. For example, the recent and therefore available experiences of project managers may be influential, as well as general tendencies to focus on the partitioning of tasks and increasing specialist knowledge at the expense of coordination needs. A finding is that the satisficing heuristic, meaning that the first acceptable solution is selected, seems to be particularly significant for organising in temporary transitory contexts. Further, project-level shared heuristics may be expressed as short catchphrases, or mantras. As for managerial implications, it is concluded that project managers should be provided with a repertoire of relevant heuristics and routines to ensure a thorough set of options in decision-making regarding organising in their projects. Also, implementing meta-routines for organisational assessment and development should be beneficial.

5.3 Paper III

Eriksson, T. and Kadefors, A. (2015) Designing and implementing incentives for engineering consultants: encouraging cooperation and innovation in a large infrastructure project. *Engineering Project Organization Journal,* 5(4), 146-159.

This paper is not explicitly related to literature of routines or coordination but may be seen as an example of a process of developing a new kind of routine which illustrates the findings in Paper I and II. In construction there is a tendency to expect high quality output of consultant work also when only a basic service is formally required and paid for. However, from being a relatively common feature in contractor contracts, financial incentives are increasingly being introduced also for consultants. Incentives are usually supposed to improve collaboration and motivation among partners through extrinsic motivation, but may also have effects on project processes, as well as symbolic roles in signalling trust and innovation. This paper describes and analyses the development and implementation of bonuses for consultants in the RailTunnel project.

The project had bonuses for cooperation and innovation, where the latter was in effect a cost saving bonus. Routines to award both bonuses were jointly developed by client and selected consultant representatives. Consultants were supposed to nominate themselves for exceptional performance, but few nominations were received. Despite that the bonus routine did not produce the intended response, it was not amended. For low-stake incentives to add value, symbolic roles and the communication processes generated by the incentive scheme need to be strategically and purposefully managed. A conclusion is that research is needed to guide clients in considering a wider range of measures for enabling innovation and collaboration in design teams.

5.4 Paper IV

Eriksson, T, Söderlund, J. and Kadefors A. Evolving and involving – a process perspective on developing the client function in a large infrastructure project

To be further developed and submitted to a scientific journal.

Project tasks change with formal phases of a project, and such transitions also change the requirements for the coordination of actors. Project management needs to adapt and possibly also restructure the organisation. In this paper, the process of identifying needs and designing the organisation for the upcoming project phase is investigated through a case study and by identifying critical incidents.

Our findings indicate that also when basic principles are set at an early stage, the organisation evolves over a longer period of time, as bits and pieces gradually fall into place. A substantial part of the project organisation was involved in the long-term and incremental process of restructuring the organisation. Short guiding principles such as 'part of a whole' and 'one project' were relied on to guide workshop discussions and brainstorming. The process also served to raise support for the matrix organisation that the Project Director had visualised. Suggestions made early in the process were usually the ones that were accepted and radical changes were rarely introduced. Ideas of the future supported by information gleaned from previous projects helped form the organisation. The findings illustrate the significance of taking a process perspective of what actually goes on in large and complex projects.

5.5 Paper V

Eriksson, T. (2013) Learning in the early design phase of an infrastructure development project, *Proceedings of Nordic Conference on Construction Economics and Organization, Trondheim June 12-14.*

Peer reviewed conference paper presented at the 7th Nordic Conference on Construction Economics and Organization. Winner of Best Young Researcher award. The appended version is updated to match thesis terminology and correct minor language errors.

There are few opportunities for project participants to gain first-hand knowledge of long-lasting large infrastructure projects, altogether there ought to be important benefits in learning from other projects. Input from other projects may be both tacit and explicit and of both technical and organisational character. Previous research has described how knowledge and experiences can be transferred in personalised or codified forms. Project research tends to emphasise the importance and potential of social processes to diffuse knowledge in projects, underlining positive outcomes of bringing together individuals from various specialist fields. Ideally, there should be rich but non-redundant information exchange between projects. This paper investigates from what sources a large infrastructure project retrieved knowledge, in what format information was transferred, and if the knowledge was technically or organisationally oriented.

The main knowledge sources were found to be a small number of similar projects and earlier phases of the same project, and to some extent the public client (through mandatory systems and initiatives). Technical and organisational knowledge was retrieved and acted upon in both codified and personalised form, although knowledge relating to organisational aspects tended to more often be transmitted and further integrated into the project organisation in personalised flows. The results suggest that project organisations might experience redundant knowledge transfer, but this could also give rise to more opportunities for knowledge integration among project actors.

6 Discussion

Large infrastructure projects have extensive budgets, many stakeholders, and numerous uncertainties. They involve many actors, are temporary and unique, but are also long term. These characteristics affect the scope and type of organising processes that take place during a project, where the complexity of decision making frequently reflects the complexity of the project (Giezen, 2012). The size and uniqueness of such projects mean that guidance from permanent client organisations is often limited. Furthermore, it is difficult to systematically transfer knowledge about large projects between projects, especially since project team members usually belong to multiple permanent organisations.

Decisions made in the early phases of projects have a considerable effect on project execution and operations. Similarly, introducing technical changes at the front end results in relatively small costs compared to making such changes later (Alfalla-Luque et al., 2015). It is thus important to have sufficient resources in a project's early phases and also that the organisation facilitates sound decision-making practices. Although these ideas have been acknowledged, there has been limited research on organisational setup and processes in design phases of infrastructure projects in general (Zerjay, 2015) and in early design phases in particular (Hertogh et al., 2008). This research project has followed the process by which the early design phase of a large infrastructure project was organised. The dissertation emphasises the client perspective but also relies on insights from the supplier side. The discussion is structured according to the three research questions.

6.1 RQ1: *What is the influence of permanent organisations, project members, and industry practices on establishing organisational structures and coordination in the early design phase of a large infrastructure project?*

There are many potential sources of inspiration when designing a project's organisation and routines: industry standards, requirements from the permanent organisations, examples from other projects, individual preferences, and implicit rules of thumb (Kadefors, 1995; Eggers and Kaplan, 2013; Loock and Hinnen, 2015). In the case study

project, all these factors were influential when developing organisational structures and routines to varying extents (Papers I, II, III, and IV).

On the client side, those formal decision makers who have the final say about large projects' organisation comprise the permanent client organisation and the top project management team. In the case study project, the design of routines tended to be more controlled by the permanent organisation, while project members had freedom to develop the project's organisation (Papers II and IV). Previous research has shown that when project members are allowed flexibility, they tend to utilise it (Olsson, 2006), and this project was no exception.

Paper I describes and discusses the most important project routines. In accordance with Gersick and Hackman (1990), the routines are classified as imported, created, or evolving over time. The research question refers to sources of imported and created routines, while the evolution of routines is discussed in relation to research question 2. The imported routines primarily consisted of reporting and administrative routines developed by the permanent client organisation, STA. These were generally quite detailed and were related to time, cost, and content, often imposing templates and Information and Communication Technology solutions to which all projects in the client's portfolio had to conform. This way of introducing artefacts to implement routines has been found by previous research to produce unexpected results and to be less successful than anticipated (Feldman and Pentland, 2008), which was also the case in the studied project. The permanent client organisation also influenced project routines through more abstract policies. In particular, the "Pure Client Role" policy for outsourcing development work provided the project with ideological guidelines without explicit performative instructions for everyday operations. Here, the intent was to allow the suppliers more responsibility and autonomy and to strive for more organisationally flexible approaches.

In terms of importing routines from other sources, previous studies have shown that individuals involved in large infrastructure projects seldom have extensive and organised reflective interaction with representatives from other projects, especially with regards to organisational aspects (Hertogh et al., 2008). Paper V describes activities

related to technical and organisational knowledge transfer at the start of the case study project's early design phase, and Papers II and IV contribute further details about their development over time. Some organised experience exchange with other projects transpired, but the primary focus of these exchanges was on technical aspects (Paper V). The Project Director consulted informally with peer project managers and other projects' members; they also presented at workshops and at RailTunnel project kickoffs.

In terms of created routines, many routines were designed at the start of the early design phase by central client project members (Papers I and II). These routines included meticulously planned meeting schedules and instructions for meeting practices. The consultants primarily were part of developing the cooperation scheme and created a bonus system for cooperation and innovation (Paper III). Client project members, primarily the initial Project Director and his team, also determined the innovative and complex structure of the early design organisation (Paper II). At the end of the early design phase, a new project organisation structure for the subsequent phase was created (Paper IV). Project-level discretion was high in terms of decisions about organising, and the Project Director in particular was influential. The process was quite reflective, but the organisation that was ultimately chosen was very influenced by his initial idea of a matrix organisation.

Research on routines has increasingly emphasised the role of heuristics, often referred to as mental shortcuts or simple rules of thumb, in shaping routines and organising practices (Pentland and Hærem, 2015). When the client project management team enjoys a high level of discretion, it implies that such cognitive heuristics may be important. Paper II discusses the potential influence of heuristics such as availability, recognition, familiarity, partition focus, and satisficing (Mousavi and Gigerenzer, 2014; Loock and Hinnen, 2015) on organising decisions.

The main benefit sought with the compartmentalised and specialised organisation was the possibility of attracting the best technical and organisational competence on the market. Another perceived advantage was that the organisation would equip project management with a flexible organisation and enough control to cope with technical difficulties, in line with recent research (Olsson, 2006; Koppenjan et al., 2011). The

project strove to organise in a way that avoided premature closure of design solutions. Although these benefits were at least partly realised, the organisation also wound up needing higher coordination than expected. This suggests that partition focus heuristics impact decision-making processes. Furthermore, project members' own experiences exerted more influence on organisational decisions than input from external actors, indicating that the availability heuristic was also influential. The few spontaneous reflections by client members on organising and coordinating drawing on their previous experiences primarily referred to the same previous project in which several project members had participated (Papers IV and V). However, although some areas of responsibility were distributed differently than is customary, most roles and practices were familiar to project members (Papers I and II), which points to the importance of institutional industry level standards and conventions for project coordination (Kadefors, 1995).

6.2   RQ2: *How do organisational structures and routines change during the early design phase of a large infrastructure project?*

In a large infrastructure project, uncertainty is high and circumstances change over time, as do available resources. A substantial share of organisational structures and routines are custom-made, and therefore they are certainly un-tested in many cases. Furthermore, few of the participating individuals will have been involved in organising other large projects, and if so, seldom in organising more than one. This all implies that many organisational structures and routines formed at the outset of a project phase may turn out to be at least partially inadequate when implemented and therefore in need of fine-tuning. Other organising elements may function well for a period of time but may still require updates to adapt to changing contexts. Changes to routines may be caused by various reasons: deadlines or future needs, failure, novelty, and changes in the context, to mention a few (Gersick and Hackman, 1990; Feldman and Pentland, 2003; Gkeredakis, 2014). All the appended papers describe changes to project routines and organisation in the case study project. In the studied project, several factors triggered changes and even when the overall task, actors and resources remained the same in the project, small and incremental changes were made to coordination (Paper I).

Changes to the project's organisational structure were few, partly due to the contract-based environment where the consultancy assignments were largely fixed. The appointment of a new Project Director caused no changes to the organisational structure, as it was considered too costly to start anew when the organisation was already being implemented. In effect, the most extensive changes took place after consultants were procured, as some assignments could be merged when the same firms had obtained several contracts (Paper II). This change also led to corresponding changes in the client organisation. The client project organisation underwent some planned expansions during the first year, where predefined positions were filled as another project was completed and as a result released client personnel (Paper II). This indicates that planned (and controlled) changes were made due to a combination of expanding project needs and a strategy to benefit the permanent client organisation. Another illustration of organisational flexibility was an unplanned change due to proactively implementing a group to counter anticipated appeals; as in the case of the mergers, it was an attempt to save time and reduce needed administration. By the end of the phase, the project organisation was drastically redesigned, as the consultancy assignments finished their tasks and the move from design to implementation began (Paper IV).

On the subject of routines, some were developed at the beginning of design activities while others were created later or evolved as needs arose (Paper I). These routines were fine-tuned to varying degrees as they were needed or tested. Changes to routines are often incremental (Becker, 2004; Feldman and Pentland, 2003), and research on design activities in projects suggests a tendency to stick to initial solutions and to prefer incremental rather than fundamental changes (Samset and Volden, 2016). In the studied project, the Project Director intentionally avoided to introduce substantial changes in the organisation or routines. As discussed in Papers I and II, tendencies towards small and incremental changes in both routines and organisational roles were visible in the case study project. For example, the frequency of meetings, fixed agendas, the number of participants, and roles were changed. Larger or formal changes were rarer. In several cases, routines were not adapted despite the fact that they were not considered fully functional. In the case of the bonus system, for example, there were fewer nominations than expected, and the actual processes for nomination and award seldom corresponded

to the predefined formal routine. Still, few efforts were made to refine the bonus routine (Paper III). In the case of the design review process, the routine was designed and adjusted concurrent with design activities. When actual design reviews were conducted, the reviews varied widely depending on which individuals were involved, and the formal guidelines had little effect on the feedback provided. Top Management described this as an annoyance, but the routine itself was not amended. Thus, relatively few adjustments took place even when routines were considered preliminary when they were introduced (Paper II). As a spontaneous strategy to cope with insufficient routines, project members 'filled in' for non-optimal routines in an ad hoc manner to fulfil coordination needs (Paper II). When project management started to plan for subsequent phases, development and refinement of the current organisation and routines became even less prioritised and were diminished (Paper IV). In general, the project showed strong reliance on continuous governing, meaning 'spontaneous micro-processes of organizing emerging ex post', rather than maintaining pre-set routines (Sanderson, 2012).

In line with previous research (Julian, 2008), more structured evaluation was deferred until the end of project sub-phases. With the exception of client Top Management and steering committee meetings, the only forum where organisational aspects were occasionally reviewed with the intent to amend them was a client workshop series also involving sub-project managers. The performance of management aspects such as those discussed above was often discussed informally as participants saw a problem (see e.g. Papers I, IV, and V). The dynamics of designing the next organisation were recognised by the Project Director, who stated from the start that they would design *a*, not *the*, new organisation and that it would be developed further in the future (Paper IV). However, despite this recognition that the future organisation would most definitely be updated in later phases, no one discussed meta-routines to govern such adaptation (Paper IV).

Adapting routines and activities to changing circumstances requires a flexibility-based strategy (Olsson, 2006; Koppenjan et al., 2011; Szentes and Eriksson, 2015). Finding a balance between control and flexibility may be crucial in a project's early phases when future possibilities for flexibility are uncertain (Cui and Olsson, 2009). In the case study project, several explicit initiatives were undertaken so that the project could avoid

premature closure of design solutions. This was one of the reasons why the design task was divided into two groups of technical and design assignments; the four-step staged design process (described in Paper II) was introduced for similar reasons. This thesis, however, focuses on flexibility in organisational structures and routines in general, and not specifically in relation to adaptations in the project outcome. It is therefore interesting to note that no similar initiatives or meta-routines were developed to support a balanced and formalised approach to the adaptation of organisational structures and routines (see Paper IV). The need for organisational flexibility was acknowledged and also responded to but was not discussed to the same extent as was how to enable flexibility in output.

6.3   RQ3: *How does the unique and temporary character of a large project shape the development of organisational structures and routines?*

This thesis identifies some potential organisational challenges in the early design phase of an infrastructure project. In such projects, project management has high discretion to create project level organisational structures and routines (Paper I). As discussed in Paper II and in relation to RQ1 above, this implies that individual cognition and heuristics, or simple rules of thumb, can potentially strongly affect decision making in various respects. The impact of availability, recognition, partition focus, coordination neglect, and biases related to specialisation and team scaling were discussed. Further, in relation to RQ2, the thesis states that changes to routines and organisational structures over time were often incremental and reactive, and that meta-routines to evaluate or refine project organisation routines were not implemented. In this section, these findings are put in the context of the temporary and complex circumstances of megaprojects.

A project is inherently temporary and designed to be discontinued (Söderlund, 2011b). Large projects like the one studied contain several phases that involve transitions of tasks and responsibilities, and these phases are further divided into sub-phases and corresponding deadlines. This transitory context is also instrumental to the propensity to adjust organisational structures and routines over time. As discussed in Papers I and II, the case study findings indicate that the satisficing heuristic (Simon, 1956; 1957; Mousavi and Gigerenzer, 2014), which means selection of the first acceptable solution,

is especially influential in a temporary, transitory environment. When operating under a tight schedule, urgent technical issues often require project members' time and efforts, thereby reducing the time and cognitive capacity they are able or willing to apply to organisational development. The temporary context encourages satisficing in two ways: First, a satisfactory decision is reached quickly since it will affect only a single project or shorter phase, sometimes with an explicit intention to refine the organisation or routine further on. Second, because tolerance for non-optimal practices is higher when their end date is known and near, organising elements that are unsatisfactory or even flawed may be very resistant to change. Another implication is that the difficulties that large projects have to operationalise and fully implement novel policies and initiatives from the permanent client organisation is easily underestimated.

The limited incoming flows of knowledge about organisational matters can also be related to the mega-project context (Papers I, IV, and V). Apart from the influence of the satisficing heuristic, project members may perceive the project as unique, rendering experiences from other projects irrelevant. They may therefore consider their own competence just as good as or better than that of other project managers, due to their own familiarity with the local context.

It should be emphasised that finding a solution that is merely satisfactory and sticking to it economises on scarce project management resources in the transitory context. Changes in organisational structures and routines take time to process for those project participants who are affected. However, in this kind of low-validity environment (Kahneman and Klein, 2009) where individuals cannot acquire multiple experiences, and the relationships between decisions and outcomes are hard to establish, it should still be important to ensure that heuristics such as satisficing, availability, and familiarity do not gain too strong an influence. Meta-routines that govern adaptation of routines and organisational structures can fulfil this function. Since a satisficing tendency also limits the incentives for investing in meta-routines that provide recurrent assessment and feedback on organising issues, such meta-routines would need to be initiated at the level of the permanent organisation.

As discussed in Papers II and IV, organisational heuristics may also be consciously created at the project level to function as coordination mechanisms. Such simple decision rules are often effective because they are easy to communicate, learn, and apply (Loock and Hinnen, 2015). However, the transient nature of projects limits the breeding ground for shared organisational heuristics. Nevertheless, despite such limiting circumstances, the temporary and high-paced inter-organisational setting of large projects may still benefit from fast and frugal rules of thumb to coordinate actors. One salient example of shared organisational heuristics during the project took the form of spontaneously implemented short catchphrases: "Go Fish!" to refer to a specific web portal, "good enough" to avoid overdesign of design solutions and to align levels of detail in output, "finite number of meeting series" to counteract impulses for additional meetings to solve all uncertainties, and "one project" as well as "part of a whole" to guide organisational development (Papers II and IV). This very simple and open type of organisational heuristics may be labelled *mantras*. They can be seen as a way to remind project members of the overall principles to guide behaviour in the project. In the case project, for example, mantras served to help be a 'pure client', which meant assigning suppliers high accountability and avoiding becoming too controlling by micromanaging through detailed routines.

7 Conclusions

Large inter-organisational projects are generally technically complex, involve numerous actors, and are subject to high uncertainty. Much research investigates strategies that enable coordination and adaptation in such projects. However, despite the substantial coordination needs and the central role that routines play in such coordination, little research has explicitly acknowledged and studied the role of routines in such projects. This gap in the research is surprising, since management functions in large projects tend to have a high level of discretion in order to develop unique organisational structures and routines. In this thesis, general theories on organisational routines and heuristics are related to the specific context of a large infrastructure project.

The thesis contributes to the general discussion on organisational routines by e.g. Becker (2004), Feldman and Pentland (2003), Pentland and Feldman (2005), Parmigiani and Howard–Grenville (2011), and Pentland and Hærem (2015) through its focus on the genesis and development of routines in a temporary organisation. The results are based on an in-depth, longitudinal case study and thus provide access into the inner life of the project (Cicmil et al., 2006) and unique insights into the complexity of organising a large infrastructure project.

The study highlights that when project management is granted high discretion in terms of project structure and routines, the experiences and opinions of individuals have a substantial impact on organisational decisions. Thus, decisions may potentially be influenced by individual cognition and heuristics described in general research on decision-making and judgment.

The long-term, unique, and uncertain character of large projects makes it possible as well as a common practice to adjust routines over time. However, the study suggests that most adjustments are incremental and minor, and that project managers tend to settle on routines that are 'good enough'. Further, knowledge flows regarding organising experiences from other projects are limited. A main conclusion is that a temporary and transient context favours a satisficing logic, which in many respects is efficient but may also have drawbacks. This satisficing logic is also related to an absence of meta-routines to evaluate issues proactively and to capture organisational knowledge for further

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dissemination. Finally, shared heuristics in a large and complex project may take the form of mantras, since these are easy to use and communicate in coordinating activities.

7.1 Implications for future research

This thesis has highlighted the importance of organisational structures and routines in projects. In future studies, this approach should be combined with other areas of interest about large projects. For instance, further work on control and flexibility in temporary organisations should relate more explicitly to general research on routines. Future research should also explore relationships between attention to development of routines and the performance of large projects (Paper I). In addition, the effects of recurrent external input on project organising and routines should be studied, as well as the impact of meta-routines more generally (Paper II).

It would also be interesting to investigate further how cognitive heuristics impact organising in temporary contexts and on how organisational heuristics may travel between projects (Paper II). For example, one approach could be to study whether successful mantras can become more universally useful and become part of a general body of project management knowledge.

Finally, this thesis is based on a single case study. Additional studies should be conducted to see how the coordination process varies during different phases in development projects, and what choices project management makes under different circumstances and in other sectors. The Swedish and European context may also have been influential on the results, making other regional and international project interesting to investigate.

7.2 Implications for practice

Engineering consultants' creativity in terms of technology is taken for granted, but clients appear less appreciative of their potential contributions to organisation and coordination issues (Paper V). With the increasing emphasis on outsourcing public works, project managers could benefit from systematically bringing in project suppliers that possess a variety of experiences (Paper II). Permanent client organisations could also contribute to such a repertoire.

Considering the level of discretion project management has to form project coordination (Paper I and II), a repertoire of organising elements should be available, easy and inspiring for project managers to use. Owners involved in multiple large projects should seek to install meta-routines to ensure that the projects themselves include input from external sources, and they should also plan for systematic evaluation and adaptation of organisations and routines (Paper II). Proactive meta-processes for developing and evaluating project routines and capturing supplier experiences can balance the influence of individual cognition and heuristics, provide feedback to project members, and help project management identify critical routines to introduce in a specific project. The role of mantras, if consciously managed, can help create common ground among project participants. Meta-routines can act to pick up experiences and ideas found in mantras and translate them into organising elements—for example routines, organisational models, and operational heuristics—to be adapted and implemented in parallel and future projects (Paper II).

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