



Organisational design and development in a large rail tunnel project — Influence of heuristics and mantras

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Abstract

In design phases of large and complex infrastructure projects, a main challenge is to coordinate numerous technical specialists. Heuristics, or cognitive rules of thumb, is one factor that may influence the development of organisational structures and routines, especially if project management discretion is high. A longitudinal case study, comprising non-participant observation over three years, was carried out of the early design phase of a major railway tunnel project. Availability and familiarity heuristics were found important, as well as coordination neglect — a general tendency to focus more on partitioning tasks than on coordination needs. Satisficing, meaning that the first acceptable organising solution is selected and retained, was found to be strong in temporary, transitory contexts. Shared heuristics were manifest as short catchphrases, or mantras. Clients should develop meta-routines and meta-functions to support adaptation within, and learning between, projects.

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1. Introduction

Organising and managing large infrastructure projects is a truly challenging task. Such projects are frequently located in urban settings and have high environmental impact in terms of ecology, cultural heritage, mobility and city life in general. They are governed by rigorous planning regulations and require government approval in multiple dimensions and stages. Technical challenges and uncertainties are often significant, especially in the case of underground construction, and project organisations involve a large number of firms, in many cases related to each other by contracts. The complexity and uncertainty means that coordination needs are very high, and traditional management strategies based on extensive pre-planning and control are often found inadequate. Accordingly, much research on the management of such projects has focussed on how to balance between flexibility and control (Dvir and Lechler, 2004; Hertogh and

Westerveld, 2010; Koppenjan et al., 2011; Olsson, 2006; Pollack, 2007; Szentes and Eriksson, 2016). The emphasis has mainly been on effects and outcomes of various management strategies. However, to influence which strategies are employed in practice it should be equally important to understand their origins: How are principles for managing large infrastructure projects selected and which factors influence these choices?

In this paper we aim to provide a deeper understanding of how organisational structures and coordination mechanisms emerge and develop over time in large and complex infrastructure projects. The empirical basis is a longitudinal, qualitative case study of the early design phase of a Swedish railway tunnel project. At the start of this phase, project organisations grow significantly and numerous specialists become involved, on the client side as well as within the private consultancy companies performing design tasks. Important decisions are made that impact considerably on project outcomes and value to society (Gil and Tether, 2011; Zerjav, 2015). The case project was also subject to a process of outsourcing to external consultants tasks previously performed in-house by the client. The study describes decisions made upfront at the start of the early design phase, but also how organisational structures and routines

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were modified over time in response to increased awareness or a changing environment.

Because large infrastructure projects tend to be unique in their contexts, there are no comprehensive standard models for how to organise and manage them. Project management functions often have considerable freedom in setting both the organisation and many of the management routines (Szentos and Eriksson, 2016). This implies that organising in these projects is highly dependent on how the project managers understand their environment and select the responses they perceive as appropriate. Such cognitive capabilities can be seen as microfoundations of organisational routines (Eggers and Kaplan, 2013). Thus, several authors (Pentland and Hørem, 2015; Look and Hinnen, 2015) have recently suggested that literature on heuristics should be useful to understand organising processes. Heuristics are shortcuts or simple rules of thumb that guide decision-making. They may operate on a subconscious level but can also be deliberate and articulated (Bingham and Eisenhardt, 2011; Chow, 2014; Look and Hinnen, 2015). In the context of large projects, previous studies of heuristics have primarily focused on the influence of optimism bias, that is, the tendency to underestimate risks for negative events, in investment decisions (Flyvbjerg et al., 2003; Klakegg et al., 2016).

In this paper, we describe and analyse the role of cognitive heuristics in shaping project organising, but also how project managers themselves use shared simple rules as part of their own strategies to coordinate other project participants. We consider two dimensions of organising: organisational structures and routines for coordination. Organisational structures refer to how the project organisation is designed: which competences are involved, how work is partitioned and responsibility allocated, while organisational routines are “repetitive, recognizable patterns of interdependent actions, involving multiple actors” (Feldman and Pentland, 2003). The collective dimension makes routines central to coordination (Becker, 2004).

The paper is organised as follows: First, we briefly introduce aspects that shape conditions for coordination and adaptation in large projects. Next, we describe key concepts and findings in research on heuristics and identify the set of heuristics used as an analytical framework in the paper. Then, the case study methodology is outlined, followed by a section where case findings are described and analysed. Finally, conclusions are summarised and implications for practice and future research outlined.

2. Coordination and adaptation in large projects

Projects have in common that they are temporary organisations and designed to be dissolved (Söderlund, 2011). However, there are considerable differences between categories of projects (Lundin and Söderholm, 1995). Thus, many projects are small, standard and highly routinised (Davies and Frederiksen, 2010; Lundin and Söderholm, 1995). There are also truly unique projects where uncertainty is high and little previous experience exists (Söderlund et al., 2008), as well as vanguard projects, where new ways of working may be tried out and spread to subsequent projects (Brady and Davies, 2004; Davies and Brady,

2016). As stated above, infrastructure projects are often large and complex. However, although many aspects in the societal, technical and organisational context of an infrastructure project are unique, especially in a local environment of a city or region, similar projects are repeatedly being undertaken on the national and international levels. Also, large such projects share many characteristics with smaller ones. Thus, for infrastructure projects, as for construction projects in general, routines and organisational designs are to a considerable extent institutionalised on the industry level (Beamish and Biggart, 2012; Bechky, 2006; Kadefors, 1995).

Further, many large infrastructure projects are subject to high uncertainty, which means that they need to adapt to changing circumstances over time. This applies not only to technical solutions and scope, but also to organisational structures and routines (Davies and Brady, 2016; Le Masurier et al., 2006). Routines may develop over time in several ways. Feldman and Pentland (2003) showed that such patterns of action are often modified in small steps, through ongoing and often unrecognised processes of successive evaluation and adaptation in daily work. Changes in routines may also be of a more fundamental and dramatic character: Jarzabkowski et al. (2012) highlight how environmental changes or managerial intervention lead to disruptions of existing routines and, subsequently, to perceived absence of coordination. These gaps are filled by new routines, assembled from selections of known coordinating elements. Further, change may result from planned cycles of review and revision of existing practices. Research on knowledge management and innovation (Nelson and Winter, 1982; Parmigiani and Howard-Grenville, 2011; Zollo and Winter, 2002) has increasingly emphasised the role of such meta-routines, or dynamic capabilities, for revising and updating operating routines. For the purpose of this paper, it is important to understand how both project organisations and project routines are adapted to changing circumstances, to what extent such adaptation is based on planned and recurrent evaluation and feedback, and how heuristics influence adaptation.

3. Heuristics — an analytical framework

In the last decades, psychological research has identified a wide array of heuristics, sometimes called biases, which individuals intuitively apply when making decisions in uncertain and complex situations (e. g. Bazerman, 1998; Tversky and Kahneman, 1974). Biases affecting decision-making in social contexts, such as principles of stereotyping and attribution, have been studied in social psychology (e. g. Gilovich et al., 2002). The emphasis is often on how heuristics and biases cause deviations from rational thinking. It is generally assumed that there is a trade-off between accuracy and effort: more information-processing will produce a better decision, but a heuristic can yield a satisfactory response with much less cognitive effort (e.g. Kahneman, 2011; Simon, 1956, 1972).

However, the concept of heuristics is ambiguous. In a literature review, Chow (2014) found that although the view of heuristics as “simple rules of thumb” was prevalent, a common definition of the term was lacking and that the meaning varied between different fields. In effect, heuristics can signify both

intuitive, automatic processes and more mindful and consciously created patterns. Chow therefore proposes to differentiate between inferential and methodological heuristics. Inferential heuristics, then, “are often epistemically opaque: people often employ these heuristics without knowing that they do so, and without knowing the nature of these heuristics (...). Methodological heuristics, on the other hand, are generally epistemically transparent: these methods are more or less easily identified; we often consciously and deliberately employ them; their usefulness is usually known; and, because of this, an individual is able to compare and manipulate them (...).” (Chow, 2014; p 22)

In this paper, we examine both how inferential, cognitive heuristics on the level of the individual may influence organising in large projects, and what role methodological heuristics in the form of simple rules on the organisational level may play. We discuss these two categories separately, since they have different sources and different managerial implications.

It should be emphasised that the number of cognitive heuristics that may potentially influence decision making in a specific context is very high, and only a subset can be considered in one study. Also, in a qualitative case study the impact of a specific heuristic cannot be discerned and assessed as precisely as in a psychological experiment, but rather has to be inferred by successively examining empirical observations in relation to existing research on heuristics within several fields. This way, we identified a small set of cognitive, inferential heuristics as a basis for deeper analysis of our case study data. Some of these heuristics are specifically related to coordination, while others are among the most well-known and broadly applicable. Below, we outline the set of heuristics that we use as an analytical framework and suggest how their influence can be inferred in an empirical context.

3.1. Inferential, cognitive heuristics

3.1.1. Coordination heuristics

Inferential, cognitive heuristics related to organising and coordination have been studied in research with a psychological focus on organisational design processes. A basic observation is that when interdependent tasks are broken down and partitioned in subtasks, corresponding structures need to be put in place to coordinate these tasks (Galbraith, 1973; Thompson, 1967). Knowledge specialisation complicates such coordination by creating cognitive barriers of understanding between groups (Carlile, 2002). Also, the number of interpersonal links in a group grows exponentially with the increase in members. This means that adding more members to a team creates further coordination needs that, in turn, limit team performance (Hoegl, 2005). Staats et al. (2012) find that there is a general propensity when designing organisations to incorporate more specialist competence in teams at the expense of team efficiency, and label this behaviour the *team scaling fallacy*. In effect, it has been shown that it is difficult for decision makers to conceive and design measures that match actual needs for coordination. Based on research in social psychology as well as on numerous case studies of company successes and failures, Heath and Staudenmayer (2000) identified a combined heuristic of *partition focus* and *coordination neglect*,

meaning that people attend primarily to how to partition tasks but fail to fully acknowledge how much coordination needs increase when interdependent tasks are split and allocated to different individuals and groups. Thus, the impact of these heuristics in a project should be manifest if coordination mechanisms designed *ex ante* to integrate the knowledge present in the organisation are proved insufficient *ex post*, especially if there is a high partition of tasks.

3.1.2. Availability and familiarity

Regarding more general heuristics, the framework of Tversky and Kahneman (1974), comprising the categories of anchoring, availability and representativeness heuristics, is reflected in much of the literature (i. e. Bazerman, 1998; Kirkeboen, 2009). Of these, the *availability* heuristic combined with the related heuristic of *familiarity* refer to a tendency to prefer, select and assign greater weight to alternatives that are familiar and easy to recall (Bazerman, 1998; Herbert, 2010; Tversky and Kahneman, 1973). For example, recent and vivid experiences will come easier to mind than those further back in time. Moreover, people avoid uncertainty and favour alternatives that are perceived as familiar before previously unknown options, also in new and different situations. Such familiar and established solutions facilitate coordination by providing predictability and standardisation. In relation to our focus, influence of availability and familiarity heuristics should be possible to trace by examining organising decisions, and identify the impact of decision makers’ own, previous experiences, as well as that of established industry level practices and models, compared to input from other sources.

3.1.3. Satisficing

Another important general heuristic is *satisficing*, which is related to the concept of bounded rationality and refers to processes of decision making that result in a solution that is satisfactory rather than optimal (Simon, 1956, 1972). In more formal terms, satisficing is defined as “search through alternatives and choose the first one that exceeds your aspiration level” (Mousavi and Gigerenzer, 2014). Tendencies towards satisficing and further retention of organising elements have been observed in previous research. For example, Gersick and Hackman (1990) found that routines could be created based on very limited information but still be very persistent, and Brady and Maylor (2010) studied a project which did not revise its management practices despite obvious malfunction and strong external pressure. Indications of satisficing should be that few alternatives are explored when identifying and selecting solutions, and that initial solutions persist even in the face of repeated requests for new, changed or updated practices. Absence of meta-routines to review organising practices should also be indicative of satisficing.

3.2. Organisational heuristics

The concept of heuristics has recently been used also to understand decision making on the organisational level. Obviously, since individuals make these decisions, the inferential, cognitive heuristics described above may operate also on the

organisational level. However, organisations have also been observed to consciously develop shared methodological heuristics. In a study of strategic decision-making in growth companies, for example, Bingham and Eisenhardt (2011) found that these firms learned simple rules that they used to determine what initiatives should be taken, in what way, and in what order. Examples were “restrict internationalisation to Asia” and “enter new countries through acquisitions”. Such methodological heuristics developed in an organisational context can be seen as a category of fast and simple routines that require little cognitive effort to learn, apply and communicate. They are idiosyncratic across different firms and result from collective learning processes: successful organisations develop and refine their heuristics over time as a result of feedback (Bingham and Eisenhardt, 2011; Loock and Hinnen, 2015). Due to their shared nature, methodological heuristics should be easy to trace when a project is followed by observation over a longer period of time.

4. Method

For this study, we apply a projects-as-practice perspective (Blomquist et al., 2010; O’Leary and Williams, 2013), which implies a focus on the micro-level, attempting to understand how practitioners act and make sense of their situation. In the terminology of Sanderson (2012), we study governing processes, as opposed to more traditional contract oriented governance approaches. The research design was inductive and explorative, although the analytical framework, as described above, was selected from a broader but defined body of research on heuristics and cognitive biases.

The empirical basis is a case study of the early design phase in a major infrastructure project. Data primarily consist of more than 400 h of non-participant observations of project meetings and seminars, conducted by the first author between October 2011 and May 2015 (see Table 1). Meetings included client top management, design group and project development meetings,

consultant design work meetings and client-consultant joint meetings in coordination, partnering and individual assignment meetings. Meetings were usually 1–2 h, although there were also longer meetings and workshops. The organisational developments and organisation of the design process were observed continuously to identify how practices unfolded and how the organisation was modified in response to current issues.

In connection with observations, numerous informal conversations were held with various project members. Also, there was a pre-study involving shorter meetings with several client and consultant representatives. Further, a limited number of formal interviews were performed in order to clarify specific issues more in detail. These interviews, which also included open questions, were recorded and transcribed. Relating specifically to organising decisions, interviews were performed with four client members and seven consultants (see Table 2). Two client interviews in initial stages complemented the pre-study and contributed to our general understanding of the project’s organisation and the reasoning behind its design. The formal consultant interviews were carried out when they had worked for some time, and the purpose was to get a deeper understanding of the consultants’ views of the organisation and organising processes in relation to other projects they had been involved in. Additional client interviews took place towards the end of the phase. Further, a retrospective interview was conducted with the second Project Director after the phase was completed to allow him to reflect more freely on the organisation and the results of the phase. In general, interview findings were used to supplement and help interpret findings from observations and frequent informal discussions.

As described in Section 3 on the analytical framework, the study was inductive and explorative in the sense that the focus of analysis was adapted to how events unfolded in the project. Organising decisions and developments were tracked continuously, but there was no formal, software-based coding. Over time, focus narrowed to a smaller number of organisational structures and routines. In the final analysis the related development processes were verified by going back to field notes and formal minutes, as well as to the interviews.

In the next section, relevant developments in the Swedish infrastructure context are presented before describing and analysing how the project organisation and routines developed over time, and the role of heuristics in these organising processes.

Table 1

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.

Meeting series	Attendance	No.	Hours
Top Management	April 2012–May 2015	42	108
Design Group	March 2012–May 2013	11	32
Cooperation Group	April 2012–January 2013	10	52
Coordination assignment(s)	April 2012–May 2013	12	28
Rock engineering assignment	March 2012–December 2014	22	38
Station Line meetings *	August 2012–May 2014	19	52
Client project workshop	April 2014–May 2015	4	28
Project day/Kickoff	September 2012–February 2015	5	38
Workshop/Information for multiple consultant assignments	March 2012–August 2014	13	68
Various workshops	October 2011, March 2012, April 2014	3	14
Total	March 2012–May 2015	140	455

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

Table 2

Interview details.

Interviewee details	Date
Client Technical Design Leader	September 2011
Client Assistant Project Director (initial)	January 2012
Senior consultant, Coordination Assignment	May 2013
Coordination Assignment Manager	June 2013
Former consultant, Coordination and Representative, Station Assignment (2)	June 2013
Organisational consultants (2)	September 2013
Rock Engineering Assignment Manager	October 2013
Design Manager	May 2014
Project Director (second)	May 2014
Project Director (second)	February 2016

5. The RailTunnel project — description and analysis

The governmental Swedish Transport Administration (STA) is the largest client of infrastructure development in Sweden. STA was established in 2010, when the former Road and Rail Administrations were merged. Over more than a decade, there has been a process of outsourcing services and functions previously carried out in-house by the STA and its predecessors to external service providers. Thus, STA no longer performs any construction work and very little design work. Today, STA client project organisations mainly comprise top project management, project managers, technical experts to supervise and review supplier designs, and administrative personnel. At the time of the study, the central STA initiative “pure client role” envisaged further reductions in the level of design specification and verification carried out in-house. Parallel, a new model for organising and managing design contracts had been developed by the STA. The purpose was to encourage more reflection and creativity on the part of consultants, who should consider more alternatives before selecting the design solutions. The model implied that the activities of the consultancy assignments were divided into sub-stages, including two stages for planning work and investigating conceptual solutions before commencing actual design.

The RailTunnel project comprises an underground railway tunnel with three city stations in a major Swedish city. The budget is over 2 billion Euro and it is part of a substantial regional investment in infrastructure development. A pre-study was carried out in 2001–2007. In 2010, the proposal received funding and the STA re-established a project organisation for the next phase in the process: early design. In this phase, the corridor of the new railway was to be settled more in detail and early design documents produced and submitted for governmental approval. The budget allocated for the phase was around 100 million Euro. Work started in 2011 and lasted for approximately four years.

STA lacked sufficient resources to develop the project-specific spatial prerequisites and requirements/design parameters for this big project in-house. Larger parts of these tasks than what is usual therefore had to be performed by external consultants, an order which was also in line with the pure client role initiative. Altogether, these developments meant that STA employees should play a less active role in proposing design solutions and controlling consultants, which was a significant cultural change for both sides.

In setting up an organisation for a large project there are many restrictions. Market conditions, physical constraints of the facility to be constructed, policies of the permanent client organisation, availability of client personnel and the time required for conducting procurement are all important aspects to consider. Projects belonging to the Major projects division in the STA have considerable discretion in designing how to organise their projects. Except for some guidelines and an STA limit for the size of the client resources used, a Project Director may form the project organisation. In practice the Project Director will involve more client staff in this process, and also consult with the project steering committee and peer major projects. Still, the influence of personal preferences is high,

potentially leaving room for inferential heuristics to impact decision-making. In the following sections we focus, in turn, on the role of coordination heuristics, availability and familiarity, and satisficing.

5.1. Influence of coordination heuristics on organising

5.1.1. Initial organising decisions – task division

In the RailTunnel project, preparations for the early design phase started in 2011 with a client organisation based on members which had been involved in the preceding pre-study phase. As will be described below, the initial Project Director and assistant Project Director were both replaced at an early stage of the phase studied, but they were the ones who set the basic project structure. Normally, contracts for design work in this stage comprise most disciplines and are partitioned based on geography. In a parallel large road tunnel project, for example, there was one large contract only. However, an urban railway tunnel is more complex and when the client purchasers assessed market capacity they concluded that there would not be enough competition for one big contract in this case. This means that a key question was how to partition the work.

The initial project directors chose to separate the tasks of the early design phase into two major categories: a technical block responsible for developing prerequisites and requirements, and a design development block to produce designs, drawings and reports (see Fig. 1). The intention was that the technical assignments would precede and deliver input to the design assignments. The first block comprised 11 small technical assignments, divided based on discipline, while the four larger design assignments in the second block were divided geographically: one assignment for each of the three planned stations and one for the Railway Line. In addition, there were two Coordination assignments staffed by consultants and an in-house TEST assignment staffed by client employees.

The initial assistant Project Director had been involved in developing the stage-based design management model described above, and explained the separation into two blocks as reflecting the same underlying objectives: to encourage creativity and avoid premature closure of design solutions. Also, the separation would ensure that pre-requisites and requirements would be uniform across the entire project. However, the goal that he, and also many others in the project, emphasised the most was to secure the best competence for the project:

“There are several causes. One is the market situation: how big can the contracts be? And how can we engage other, more niched firms? So this is why we chose to separate in this way, because these [the technical assignments] are very technically specialised. If you work with hydrogeology, for example, you want to involve those companies that are specialised in that area. (...).”

Before launching this set-up, the client Project Directors consulted with numerous technical consultancy firms to assess

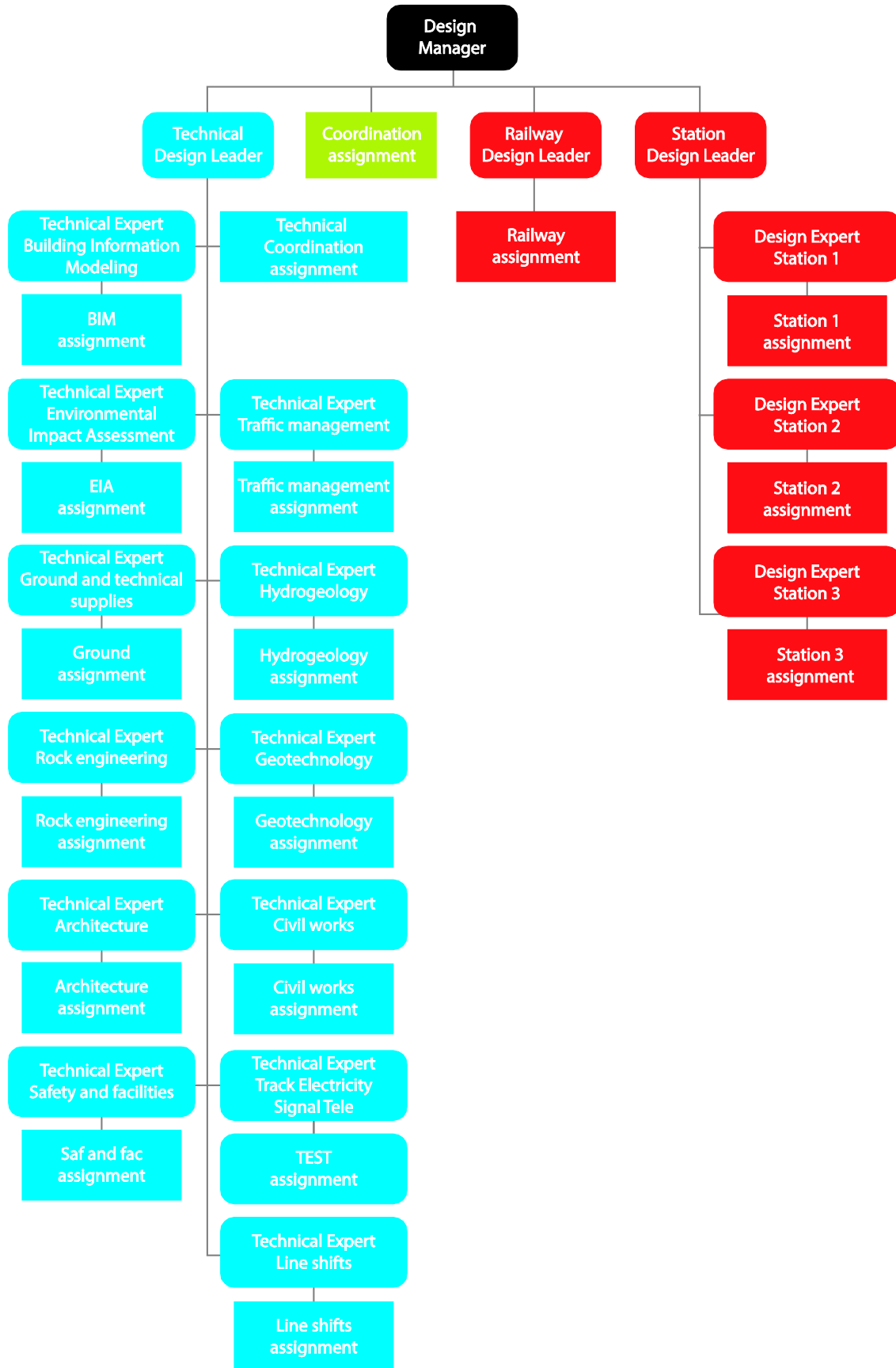


Fig. 1. The initial design organisation. The technical assignments are on the left and the design assignments on the right (rounded boxes are client members, squared boxes indicate consultant assignments). The technical discipline of Telecom-Electricity-Signal-Track (TEST) was not outsourced to consultants.

the interest in bidding for this type of assignments and to get more general input from consultants on project organising. They perceived that they got strong support, especially from the smaller, more specialised firms. Nonetheless, in our interviews with representatives of the larger consultancy firms these claimed that they had preferred fewer and larger contracts but got the impression that the client Project Directors had already made up their minds and were not interested in other ideas. The following quote from a consultancy representative further illustrates the high independence of the Project Director in setting the organisation:

“When we presented [our ideas] and we saw it [the suggested organisation], then the former Project Director asked me: Why should we have to do like all the others do?”

The initial Project Directors acknowledged that the organisation would require extensive coordination, and to compensate for this the two coordination assignments were introduced. Still, they seemed to have reasoned very much in line with the logic described by Heath and Staudenmayer (2000): their primary focus was on how to include the highest competence and partition tasks, while issues of coordination and how to practically integrate the knowledge gained less attention.

Before consultants had been procured, the initial Project Director and assistant Project Director were transferred to another, parallel, large project. A new Project Director was recruited from a third large project in the region which was approaching its completion. According to the second Project Director, the reason for replacing his predecessor was that the project was not moving forward, something that the second Project Director attributed to the strong focus on engaging the best competence to find the best solution. In general, the second Project Director was more attentive to the overall goals and strategies of the STA. He was sceptical to the complex project organisation with its many interfaces and high coordination needs, but decided that it would be too late and costly to change it. Moreover, many technical specialists in the client team believed strongly in the concept, since it allowed them to collaborate directly with high specialist competence in small consultancy firms.

5.1.2. Further project organising and coordination

The high partitioning of the consultancy assignments was mirrored in the client organisation (Fig. 1). One or two STA Technical Experts were put in charge of each technical assignment, and Design Experts were responsible for each of the Station design assignments. The Technical and Design Experts reported to three Design Leaders, and a Design Manager was responsible for the whole Design task. The client organisation (Fig. 2) further included the standard STA groups Economy and Staff, Procurement and Communication, in addition to groups responsible for Design, Construction, Agreements and Permit Process.

During the first half of 2012, the 17 consultancy assignments were being procured. Two consultant consortia then ended up being contracted for multiple contracts. Since fewer

assignments meant less administration and coordination, both client and consultants saw advantages in merging these contracts. Therefore, the Railway Line design assignment became responsible also for one of the Station assignments, and both the Coordination assignments and the BIM assignment were merged.

The mirroring of client functions to each assignment meant that client teams involving all client experts would simply be too large to be efficient (Hoegl, 2005). Thus, the high partitioning entailed negative team-scaling effects (Staats et al., 2012). Introducing the two, later merged, Coordination assignments was not entirely helpful, since this implied that the number of interfaces increased and gave rise to new uncertainty as to what the actual responsibility of a Coordination assignment was.

For the client experts, the need to limit the size of teams meant that they could not have as much direct contact with the top project management and other parts of the project as they were used to have. To enable coordination and disseminate information within the large client team, the Project Director employed a “cascade model”. The principle was that top management members would receive all information in the top management meetings. They should sort out what was relevant for their respective groups and further disseminate this in their group meetings. The group members, in turn, should select what information to communicate further down in the hierarchy. Yet, despite that the Project Director emphasised that they had to trust the information received in the cascade model and focus on their own tasks, this was hard for the client representatives to accept:

“Everyone wants to know everything, and someone said to me that ‘I don’t believe it unless I hear it from you’. And I said ‘I don’t understand this focus on me, as a Project Director, that is totally irrelevant. You must believe in your colleagues, you have to trust that they are competent to make these choices’”

Further, to avoid that too much time would be spent in meetings, the Technical Design Leader frequently urged both technical assignments and the other members in the Design Group to keep to “a finite number of meeting series”. Instead, people should use existing meetings, talk informally directly to each other, and also be more active in seeking the information they needed to perform their tasks. However, participants still experienced that the information did not flow as intended. As a result, the client top management started to communicate essential information more broadly, and eventually introduced lunch seminars involving all client members. Also, there were few opportunities initially for technical and design assignments to communicate directly. The coordination consultants then suggested a new type of cross-functional technical meetings, which the client accepted despite the general goal to avoid adding new meetings.

On the whole, and in accordance with the theory of coordination neglect (Heath and Staudenmayer, 2000), the full extent of the coordination needs surprised many project members. As one client Design Leader remarked: “I knew from the start that the project

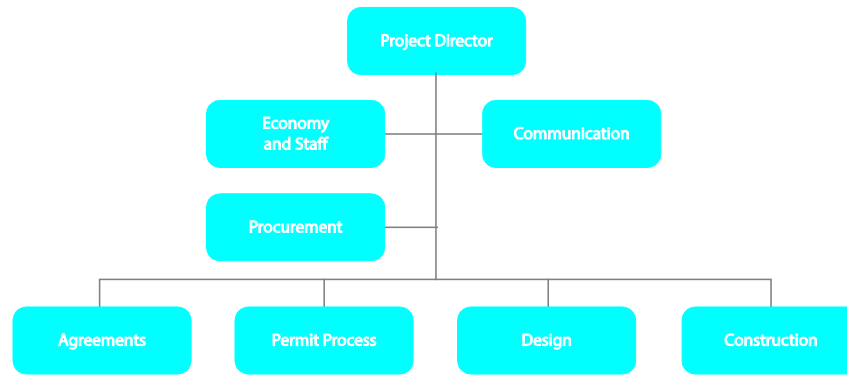


Fig. 2. The client top management group.

was going to be huge, but I didn't really grasp the full implications until now".

5.1.3. Increased cooperation and new style for design documents

Another idea that was originally developed by the former Project Director and assistant Project Director was the organisation for Increased Cooperation (IC). IC is a partnering model that has been used by the STA since 2003, primarily for construction contracts. It essentially comprises a governance structure with joint management groups, workshops for relationship development, a collaboration declaration expressing joint goals, and formal processes to follow up goals. The former Project Director and assistant Project Director were both highly committed to the idea of cooperation and had been part of a pioneering collaborative road tunnel project in the region some ten years ago. In the tendering documents for the RailTunnel consultant contracts, it was stated that the principles of IC would be employed and that a Cooperation Group consisting of client and consultant representatives would be established. This group should be responsible for IC activities and also for implementing a bonus system to reward cooperation and coordination. Here as well, the number of assignments meant that a Cooperation Group including representatives for all assignments would be too large. The original plan to solve this dilemma was that consultant assignments from both categories (technical and design) should take turns for half a year each to be part of the group. The assistant Project Director further had detailed plans for how to regularly follow up relationships by project-wide questionnaires and workshops, and a management consultancy firm was engaged to facilitate workshop activities.

After the initial Project Director and assistant Project Director were transferred, responsibility for IC activities was allocated to the soon thereafter appointed Design Manager, who had not previously worked with IC in a project context. He retained the basic set-up, including the facilitators, but the role of the IC initiative changed from being strategic to more operational. Further, procurement of the numerous consultancy assignments was a lengthy process that took place over more than six months. The Design Manager then decided to start up the activities in the Cooperation Group and involve consultants successively as they were contracted. Thus, only a few consultancy assignments participated in the initial activities of setting joint goals and

collaboration principles. When all consultants had been procured the group, as predicted, became too large, and the Design Manager decided that a re-organisation was required. The new Cooperation Group involved representatives for the three large design assignments, while the technical assignments were represented by one client member and the Coordination assignment. On the assignment level, the design assignments all had their own workshops while the small technical assignments had joint workshops. There were however no workshops including both technical consultants and design consultants, despite that this interface had been identified as potentially problematic and that the need for joint workshops including all consultants was voiced especially by individuals not in the Cooperation Group. Thus, IC activities was another area which suffered more from the high partition of tasks than initially previewed. It can also be mentioned that quite much time was spent upfront by the Cooperation Group to develop routines for nomination and award of bonuses related to Increased Cooperation (Eriksson and Kadefors, 2015). However, when it turned out that consultants were not active in nominating themselves, as they were supposed to, client managers began to nominate and award initiatives that they considered worthy of bonus.

The second Project Director as well introduced some new initiatives. In his previous project, some design solutions produced in the early design stage had needed to be completely revised in the next project stage due to changing requirements. The Project Director thought that this was a waste of resources and wished to avoid such costly overdesign. He therefore decided that the early design documents and design solutions should be more conceptual and less detailed, which was also in line with the pure client role-policy. The new model implied that the assignments should avoid digging deeper than necessary into detail and produce only the information needed to gain government approval. That the results should be "good enough" was a repeated message to consultants from the Project Director and Design Manager. In effect, the opportunity to implement a new style for early design documents was also a possibility to reduce coordination needs. While the complex organisation was hard to change, reducing the detail of the output was another way to speed up the process.

However, the new style of document also produced new needs for information processing. The division of responsibility between the technical consultancy assignments and the client

Technical Experts in developing requirements gave rise to many discussions. Similar uncertainties applied to the interface between the technical and design assignments. How to align the level of detail of design assignment deliveries according to the new document style was also a frequently raised question. In an internal meeting a consultant remarked that it was “hard to know what’s considered as a luxurious Porsche or a Skoda, and also which they actually prefer”. In the end, this issue was never resolved, and the level of detail in output varied between design assignments.

These two examples of the IC model and new style for design documents illustrate difficulties of predicting and planning to meet actual coordination and communication needs, not only those that result from partitioning of tasks but also needs that stem from introducing new ways of working.

5.2. Availability and familiarity

The cases of the IC model and new style of documents also show that the values, cognition and experiences of individuals, especially the Project Directors, were important. This was particularly evident in this project, since there were two Project Directors with quite different perceptions on how to organise and manage a project. Both the initial and the succeeding Project Director actively sought to mitigate problems encountered in their own previous projects and to further develop practices they had perceived as useful. Previous experiences impacted how Increased Cooperation was implemented and the new structure for design documents, as well as many smaller organising decisions. In the case of the second Project Director, he and many others in the client organisation all came from the same project, which meant that experiences from this project became particularly influential, especially in designing for the subsequent project phase. Formal input from other actors and projects was sought occasionally, but more related to technical than to managerial issues, and consultants were only rarely invited to contribute. Further, although the basic organisational setup in the project was unusual, many tasks and routines were familiar to the multifirm coalition of participants. Examples of such organising elements (Feldman and Pentland, 2003) were processes related to legal approval and many of the STA-level routines, the division of responsibility between different technical disciplines, many types of meetings and the principle of man-marking/mirroring of client and consultant organisations. Altogether, this suggests a strong impact of heuristics of availability and familiarity, meaning that well known and recent experiences tend to be a prominent factor in shaping decisions (Tversky and Kahneman, 1973; Herbert, 2010).

5.3. Satisficing as heuristic and deliberate strategy

Another aspect concerns to what extent organisational structures and routines changed over time. Few project members had extensive experience from this kind of very large project, and some practices were unique to – or applied for the first time in – the RailTunnel project. This should imply that many routines were less well tested and in need of further refinement and

development. In effect, several new routines were perceived by project managers as preliminary at the time when they were created and the intention was to update them as needed. In practice, however, many routines were never adapted or refined, or they were changed only at a late stage. This applied to, for example, routines for handling the information exchange between Agreements and Permit Process and the Design group, to development of common standards for design reviews, and to routines for handling bonuses. Accordingly, the important role of individuals performing ad-hoc coordination work was often emphasised in interviews with consultants.

Thus, despite that experiences often pointed at needs for new or significantly updated organisational structures and routines to enable coordination in the project organisation, most adaptations were small, incremental, informal and reactive, as described in general research on routines (Feldman and Pentland, 2003; Jarzabkowski et al., 2012). Initial and sometimes intentionally preliminary solutions were adhered to as far as possible. Much research on project governance, for example Le Masurier et al. (2006) and Davies and Brady (2016), argues for systems to proactively monitor and assess needs for modifying the strategy or the organisation. In the project studied, there were few formal occasions where project members evaluated and reflected on project organising. Organisational topics were discussed in a type of standard meetings for parts of the client project staff held a few times each year. Evaluations involving feedback from consultants were rarer still. Organising issues were brought up in Increased Cooperation workshops, but these were infrequent and included only a subset of consultants. The most ambitious occasion for formal organisational feedback was an ex-post evaluation workshop for the client Technical Experts and the consultant Technical Assignment Managers with the objective to improve future projects.

The limited changes in organisational structures and routines can be seen as reflecting a satisficing logic (Simon, 1956, 1972), meaning that searching stopped when an acceptable solution was found. In several respects, such satisficing was a strategy used intentionally by the second Project Director. In regard to the design output, satisficing was implied in the “good enough” strategy. However, he had a similar approach in designing the organisation:

“... according to my experience, this practice to adjust the organisation all the time ... you can make smaller adjustments, but not a lot of big changes. And you can’t perform calculations and say that ‘this is the perfect organisation’. Because it always depends on the individuals. You may adjust responsibilities to match individual differences, but not change the basic structure”.

He also contrasted satisficing with the optimising strategy used by the initial Project Director:

“The problem with the previous organisation was that it was too focused on finding the best solution (...) If you have that mindset: ‘I have to find the best option’, you will not move forward. I use to say that if we are going somewhere, some

people think that they can find the best way by calculations. And then there are other people such as myself who say that ‘well, we know that we are going to that place, so let’s move in that direction and then adjust along the way’.”

Thus, the Project Director would accept smaller and incremental changes, but was more sceptical about analysing organisational performance systematically with a purpose to optimise. Incidentally, the coordination consultants as well were reluctant to point out best practice; rather, they emphasised that there are many ways of organising a project. “What is important is that you believe in the model you choose”, was one view. Indeed, project coordination, as well as the implementation of IC, would most likely have been handled differently if the initial Project Directors, who believed in the initial organisation principles, had remained in charge.

5.4. Mantras as methodological heuristics

Heuristics, then of the methodological kind, may also be consciously created on the organisational level to function as coordination mechanisms. In the RailTunnel project, one salient type of such shared heuristics was short catchphrases, which were used repeatedly to remind people about the overall principles that should guide behaviour in the project. As already mentioned, the expression “good enough” communicated that project members should avoid pursuing design solutions too far. Other examples were the phrases “the cascade model” and “a finite number of meeting series”, both used as standard responses when project members called for more information and communication. Further, the humorous “Go Fish”, referring to a well-known game of cards for children, reminded project participants that the requested documentation could be found in one specific project database (which was a standard STA tool and perceived as difficult to navigate). The catchphrase “no cushions” was applied to avoid that each organisational level and sub-task added their own risk allowances, which would obscure the overall financial situation and hamper an efficient use of the budget allocated to the project. All these expressions caught on by other project members to some extent. According to the Project Director, they arose ad hoc, as “somebody in some meeting or discussion had the luck, or the capability, to summarise something very complex into something very simple”.

Interestingly, the Swedish Citytunnel project in Malmö employed similar catchphrases to govern the construction phase. There, the Project Director and his assistant over time developed a set of core principles which they used in their communication. Towards the end of the Citytunnel project, these principles were documented in a short book (Larsson and Ahlner, 2010). Examples of these principles were (authors’ translation) “systems are there to help, not to control” and “experiences are there to help, not to control”, “never delegate upwards”, “absence shall not delay project activities” and “presence shall not delay project activities”, and as an overall motto “dedication and hard work”. Representatives of the Citytunnel project were invited to share their experiences with the RailTunnel client project management team. Following this

workshop, people in the RailTunnel project occasionally mentioned the Citytunnel principles, but did not adopt them as their own.

This kind of very simple and open organisational heuristics may be called *mantras*. In dictionaries, the most common definition of mantra (outside the meditation context) is as “a word or phrase that is repeated often”. Secondary definitions are that a mantra “expresses someone’s basic beliefs” or is a “statement or slogan”. It is further stated that the original sanskrit meaning is a “sacred message or text, charm, spell, counsel.” Altogether, these definitions reflect the functions of these phrases in the studied project. The project mantras were designed to attract interest and capture something essential to the project. They were expressed in common language, thought-provoking, and preferably had a humorous twist. In both projects, the mantras were generated intuitively and spontaneously, and not as results of a deliberate strategy to develop such catchphrases.

Clearly, all mantras in the RailTunnel project were powerful in the sense that they were extremely easy to communicate and remember (Loock and Hinnen, 2015). The mantras were however less precise and more open to interpretation than the organisational heuristics described by Bingham and Eisenhardt (2011), which had more of an unequivocal rule character (e. g. “restrict expansion to Asia”). Although “a finite number of meeting series” and “Go Fish” were quite straightforward, especially “good enough” did not provide this kind of clear guidance, but still constituted some kind of response to frustrated project members. These then needed to take responsibility and make their own decisions, which was what the client top management team intended. When the project phase was summarised, it was concluded that the client organisation, despite the high fragmentation, had involved less than half of the resources allowed by STA (40 full time employees out of 90) and that the total cost for the phase came in significantly under the original budget. Despite that the project did not fully succeed in avoiding overdesign and achieving alignment in deliverables, the new model for design was accepted as a future STA standard. This indicates that also the “good enough” mantra to some extent was effective in producing the intended outcome.

6. Conclusions

While there is much research on the outcomes and efficiency of different strategies for organising and managing large projects, the factors that affect what strategy is chosen have been less in focus. This paper contributes to existing knowledge by examining the role of heuristics, or simple rules of thumb, in designing and developing routines and organisational structures in a large infrastructure project. The case study shows that in a complex, non-standard project where project managers have high discretion to design their own bespoke organisations and management strategies, cognitive heuristics may gain strong influence. These heuristics may be of a general kind, for example availability, familiarity and satisficing, or specifically related to decisions about organising and knowledge integration, such as coordination neglect, partition focus and the team scaling fallacy.

Our empirical observations suggest that the satisficing heuristic seems especially important when it comes to decisions about organising in a project context. In the project studied, satisficing occurred both as an unplanned response to overwhelming coordination needs and as an intentional strategy. The impact of satisficing on the design and development of organisational practices in a temporary organisation is twofold: First, since the practice will only be employed in a single project, and is perhaps explicitly acknowledged as preliminary and possible to update, a satisfactory organising solution is reached quickly. Second, the tolerance for non-optimal practices is higher when their ending date is known and not too far away. Adaptation entails costs, and novel work practices and roles demand substantial communication and joint sense-making. In a transitory context, sticking to a satisfactory solution should therefore be more attractive than in a permanent organisation. Moreover, organisational structures and routines have a transient and elusive character that differentiates them from the physical properties of the facility being constructed, many of which can be assessed – and criticised – long after the project is completed. In the domain of organisational design, by contrast, structures and routines change and are ultimately dissolved. During the project it is not only hard to tell what solution is the better, but employee turnover, external circumstances or crises may quickly change what could be seen as optimal (Merrow, 2011). Thus, when it comes to organising, a mega-project in many respects is a low-validity environment, meaning that individual decision-makers have limited opportunities to acquire multiple experiences, and also that relationships between decision and outcome are hard to establish (Kahneman and Klein, 2009). Altogether, while there are considerable risks and opportunities related to organising in large and complex projects, project-level incentives for installing and implementing routines to develop, review and update organisational structures and practices are weak. This implies that there is a need for mechanisms on a higher organisational level both to mitigate risks of over-reliance on heuristics in project organising, and to enable more systematic learning from a wider range of experiences generated in various projects.

Another finding in the study is that managers in large and complex projects use simple shared heuristics in the form of short catchphrases for purposes of coordination and control. We label these catchphrases “mantras”, and suggest that they could have an important role also to raise awareness and spur open idea generation and testing in a new area, thereby paving the way for developing new practices for wider implementation. Accordingly, DeBarro et al. (2015) describe the development of project practices in the domain of innovation as a transition from “mantra to method”. However, the tendency to stick to a satisfactory solution, in combination with a general difficulty to adequately predict coordination needs, also imply that it is easy to over-estimate the capacity of large infrastructure projects to develop new organisational practices all the way to full implementation. Such projects may seem long, but they are still temporary and divided into sub-phases, often defined by externally controlled delivery deadlines. To effectively drive development work, the division

of responsibility between permanent organisation and project needs to be carefully considered.

7. Implications for practice and research

Based on our empirical data and analysis, we suggest that client organisations which repeatedly undertake large and complex projects should establish a strategy for long term learning in the domain of project organising. This requires that a permanent function is established to be responsible for implementing and managing the strategy. This meta-function should engage in continuous development and testing of new practices by picking up new experiences and ideas and translating them into pre-designed organising elements, for example routines, organisational models and guidelines, which may be implemented and further adapted in individual projects. Another important role of this function would be to ensure that projects themselves install simple meta-routines to systematically evaluate if, and in what way, they need to adapt their organisational structures and routines. In particular, such meta-routines should include mechanisms to benefit from input from external sources, for example project suppliers, standing advisory boards for organising issues, or recurrent exchange of experiences with other projects.

As for implications for research, it should be emphasised that this study is based on a single infrastructure project in a Swedish context and has focused on a small set of heuristics. Future research should investigate the impact of other heuristics, and also variations between projects in other countries and sectors. Further, the relationship between permanent organisations and projects in driving development should be studied, as well as the impact of meta-routines and corresponding client functions.

It is also interesting to investigate if successful mantras can be de-personalised and become parts of a general body of project management. These expressions gain much of their power by their imaginative language and connection to certain individuals, and it is not obvious that these qualities are retained if used by others. Studies are needed to examine how such simple catchphrases travel between projects and how the knowledge embedded in them may be captured and exploited.

Conflict of interest

There is no conflict of interest.

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