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"Strong Owner" capabilities for successful delivery of railway construction and renewal projects for Danish railway infrastructure owner

Daniel Woodier, Industrial PhD, Technical University of Denmark

Christian Thuesen, Associate Professor, Technical University of Denmark

Abstract

While the importance of the role of the Owner is recognised in project studies, and there is a growing interest in evaluating the maturity of Owner organisations, there is not yet a consensus on the role of the Owner and the capabilities that this entails. This paper considers the project capabilities that an Owner organisation should possess in order to strengthen the role of the Owner in project delivery and proposes how an assessment of these capabilities could be made in practice. Preliminary findings from the study give some validation of the Winch and Leiringer Strong Owner framework (2016), but with high variability in the assessment of the maturity of the organisation, even within a relatively small sample. Reported herein, the iterative development of a generic Owner capability maturity model (OCMM) and discussion of how the maturity assessment process could promote self-assessment and reflection within the organisation.

Keywords: Owner project capabilities, railway infrastructure development, organisational maturity model

Introduction

Today the infrastructure sector is under increasing pressure in the importance of delivering on the sustainability agenda in a cost-effective and resilient way, while the complexity and uncertainty of the task is escalating rapidly. The railway industry, in particular, is faced with the challenges of renewal and electrification of existing infrastructure and the implementation of the new signalling system in the context of an increasingly complex cyber-physical system, while causing the minimum possible disruption to the daily operation of the network. Therefore, our ability to effectively plan, design, and deliver these important societal systems must keep up with increasing demands of modernisation, sustainability, and climate change adaptation.

Infrastructure owners play a critical role at each stage of projects from defining the need, and conception of the project to reintegration into the global infrastructure system. This paper intends to explore the defining capabilities that an owner organisation should have in order to succeed in project delivery. The role of the Owner organisation is one of the less researched areas in project organising, but it has been subject to increasing research in recent years (ICE, 2020; Winch, 2014; Winch and Leiringer, 2016). Based on interviews with European owner organisations, Winch and Leiringer (2016) proposed a framework of **"Strong Owner" project capabilities** that an owner organisation should possess in order to strengthen the role of the Owner in project delivery.

This paper starts with an introduction of the challenge and the overall research question, before describing the theoretical basis, methodology, how the Owner Capability Maturity Model (OCMM) questionnaire was developed, some initial results, and finally discussion of the results, conclusion and suggestions for further research and development.

Research objective

The overall research questions for this paper are therefore:

- what capabilities should an Owner organisation possess in order to strengthen the role of the Owner in infrastructure project delivery? And,
- how can an assessment of capabilities be made in practice?

This research intends to test the "Strong Owner" framework of capabilities in the empirical context of the Danish national railway infrastructure owner, Banedanmark, and to develop an Owner Capability Maturity Model (OCMM) which could potentially be applied in different contexts to other owner organisations. There is a potentially high academic and industrial interest in developing our understanding of what capabilities make a "Strong Owner" organisation and in developing a generic assessment so that it is possible for other owner organisations in different industries to make a self-assessment and identify individual strengths and areas for improvement.

The overall objective of this paper is to present findings of a maturity assessment made against the capabilities identified in the "Strong Owner" framework. Thereby we aim to contribute to the theory and practice of infrastructure project organising, firstly by extending the framework of capabilities as proposed by Winch and Leiringer (2016), and secondly by developing a Maturity Model, which can be used to assess the maturity of an organisation against the "Strong Owner" capabilities. Using Banedanmark as a case study, we expect to develop the "Strong Owner" project capabilities framework to allow other owner organisations to assess their maturity and identify their own development needs.

By following the process of the maturity assessment, the intended result is that owner organisations develop the dynamic capabilities needed to assess the environment, the organisation, and its development needs, to mobilise the necessary resources and create change in the organisation.

Theoretical framing: Owner capabilities project delivery

Theoretically, this paper is founded in the resource-based view of the organisation (Barney, 1991) whereby organisational capabilities, if developed correctly, can be a significant source of competitive advantage. Further definition and discussion of capabilities are given by Amit and Schoemaker (1993) and Teece, Pisano, and Shuen (1997). For this paper, it is important to note that capabilities are defined as a property of the organisation and can not be provided by an external supplier. As Makadok (2001, p.388) writes: "a capability is firm-specific since it is embedded in the organization and its processes, while an ordinary resource is not".

Winch (2014) describes a conceptual framework that defines three domains of project organising: project-based firms; projects and programmes; and owners and operators, and describes two areas for future research, the second of which being "project organising as temporary configurations of permanent organisations in coalitions to deliver particular outputs" (2014, p.721). This highlights the importance of defining the capabilities of the owner organisation as opposed to other project-based firms. On this basis, Winch and Leiringer (2016) proposed a framework of "Strong Owner" capabilities (outlined in table 1) that an owner organisation should possess to thrive in project delivery.

The concept of a "capable owner" is also one of the "five pillars" of the Project 13 (2022) delivery model, which contains many similar themes to the Winch and Leiringer (2016) framework. Project 13 further propose that senior management of infrastructure owner organisations make assessments of

the maturity of the organisation to "**raise the awareness of the organisation's capabilities through discussion and gap analysis**" (Project 13, 2022).

The assessment of the Owner capabilities made in this paper is based on the "Strong Owner" capability framework (Winch and Leiringer, 2016). Addressing the two-layered research question, this paper describes firstly the details of how the Owner Capability Maturity questionnaire was developed and secondly, the process by which the organisation makes a self-assessment and thereby how the organisation could develop the dynamic capabilities summarised as "sensing, seizing and transforming" (Teece 2018, p.364).

Table 1 Summary of the strong owner capabilities as presented in Winch and Leiringer (2016)

Strategic capabilities	Commercial capabilities	Governance capabilities
• Project selection • Project mission definition • Capital raising • Stakeholder managing • Project portfolio managing	• Packaging • Contracting • Relational	• Assurance • Project coordination • Asset integration

Method

The Owner Capability Maturity Model has been developed within the case of the national railway infrastructure in Denmark, Banedanmark, combining and extending the theoretical framework of strong owners (Winch and Leiringer 2016) with a single case study (Flyvbjerg, 2006). The maturity model is further inspired by Chaabi and Anevlavis (2022) who prototyped an initial maturity model for strong owners on the same basis. Due to a request for simplification, the 11 capabilities in the original framework were reduced to 9 by combining Project Selection, Project Mission Definition and Capital Raising under a single heading of Project Shaping. This was done in line with Winch and Leiringer (2016, p.275) who "suggest that future research should address the practice of "project shaping".

The empirical context is the owner of the national railway infrastructure in Denmark, Banedanmark. Banedanmark is currently exploring project planning and governance from the perspective of the infrastructure owner, the objective being to study the capabilities that an owner organisation needs to master to navigate the projects of the future.

Banedanmark is at the centre of a historically high period of activity following the national railway Electrification Programme, implementation of the European Rail Traffic Management System (ERTMS), also known as the Signalling Programme, and the track renewal and speed upgrades, which are carried out prior to the above overarching programmes. Banedanmark's strategy is to "develop and build an attractive, green, safe and efficient railway, by delivering on the three core priorities: Punctuality, Projects, and Orderliness" with a view to the delivery of electric trains to Aarhus and Aalborg in 2026 and Fehmarn Belt in 2029.

Projects at Banedanmark are highly complex because the construction projects must be coordinated with the daily operation of the network and with ongoing Signalling and Electrification mega-projects. Consequently, the construction, renewal and maintenance projects are often hybrid cyber-physical projects involving many design disciplines, specialist contractors and suppliers and IT development for the power and signalling systems.

Owner Capability Maturity Matrix (OCMM)

The maturity model was developed to be responded to by key employees of Banedanmark at different levels of the organisation. The questionnaire intentionally targeted different levels in the organisation, with a focus towards the Construction division that plans and executes track renewal projects. Questionnaires were sent to nine members of middle and senior management with seven responses received and interviews held to clarify the responses. The feedback from the interviews has not been included in this analysis as the interview was mainly held to clarify the context, purpose and meaning of the questionnaire.

The Owner Capability Maturity Model (OCMM) is a questionnaire addressing the strategic situation of Banedanmark. In the questionnaire the respondents evaluate the organisation from 1-5 against each of the Owner Capability categories as proposed by Winch and Leiringer (2016), see Table 1 above, whereby the rating of 1 is worst, 5 being best, and 0 if the capability is considered not to be relevant at all. Since the Winch and Leiringer capabilities are summarised in one or two words, some descriptive text has been added to help explain the capabilities (provided in full in Appendix 1). The descriptive text is inspired by the Winch and Leiringer (2016) paper and the prototype maturity model developed by Chaabi and Anevlavis (2022).

A description of each maturity level is provided in the questionnaire to indicate how to rank the organisation:

- Level 0: Not relevant for this organisation
- Level 1: Initial – internal processes poorly controlled and reactive to change in the external environment
- Level 2: Managed/Repeatable – internal processes controlled but still reactive to changes in the external environment
- Level 3: Defined – internal processes controlled and proactive towards changes in the external environment
- Level 4: Quantified – internal processes controlled and measured and proactive towards changes in the external environment
- Level 5: Optimizing – continuous improvement of internal processes and resilience towards changes in the external environment

The number of levels and descriptions are based on the Capability Maturity Model (CMM and CMMI) developed at Carnegie Mellon's Software Engineering Institute (SEI) (Chrissis et al., 2003). Further discussion of the development of capability maturity models is given in (Maier et al, 2011).

There are two further questions for each capability, firstly to state which level the respondent would like the organisation to attain in the future, since it may not be necessary to be level 5 for all categories. These responses are referred to later in this paper as the assessments of the “current” and “future” levels.

Initial Development of the OCMM

The format of the questionnaire was modified after two rounds of initial feedback from test respondents. When giving feedback to the questionnaire, many respondents stated that they found it difficult to give a (1-5) maturity rating to the organisation; some of these reasons are elaborated below. Although the capability descriptions are primarily provided to clarify the meaning of the capability, the wording of the description can have an important effect on the understanding of the capability and therefore influence the level rating given.

One respondent stated that each subject still contains many “dimensions”, where the organisation may be at different levels for different “dimensions”, even within the same capability. Further, another respondent stated that since the organisation is so large, different departments within the organisation were at different levels of maturity, therefore, it is difficult to give one level rating to the whole organisation. Similarly another respondent found it difficult to make a distinction between the maturity levels, since the description of each level could be interpreted in various ways.

Feedback was also given that the level to be achieved in the future was not clear, since this could be based on a long or short timeframe and whether the response should be based on an ‘ideal’ scenario where unlimited resources are available, or a ‘realistic’ scenario, which was more likely to be achieved.

Initial results – Assessment of Current Level

A summary of the initial results is presented in Table 1, with average values for the assessment of the “current” and “future” level and the range of values given for the assessment of the “current” level. The minimum and maximum values for the assessment of the “current” level for each capability from all recipients show a surprisingly high range for many capability categories. This suggests that there are potential sources of disagreement within each sub-category. However, it is unclear whether this is due to a difference of opinion or a difference in interpretation of the question, for example, due to the wording of the description.

Initial results – Assessment of Future Level

The responses received were consistent in giving a rating of Level 4 or 5 to the question “Which level do you think this organisation should achieve in the future?” for the proposed capabilities. There is some variability, but the average for all survey responses for all capabilities is between 4 and 5. This suggests that the capabilities, as summarised by Winch and Leiringer (2016), are important for the organisation to develop, thereby supporting the framework and the choice of capabilities. Viewed at the level of the capability description, there is slightly greater variability. For example, one survey response gives the sub-category “Assurance – control dashboards” a rating of “Level 0 – Not relevant”. The overall category “Assurance” has an average level of more than 4, which suggests that the category descriptions could be improved in future.

	CATEGORY	SUB-CATEGORY	RANGE - CURRENT			FUTURE
			MIN. CURRENT	MAX. CURRENT	AVERAGE CURRENT	AVERAGE FUTURE
STRATEGIC CAPABILITIES	PROJECT SHAPING	INVESTMENT APPRAISAL	2	4	3,00	4,50
		BUSINESS CASE	1	4	2,60	4,50
		BENEFITS	1	4	2,40	4,50
	PORTFOLIO MANAGEMENT	PROJECT SELECTION	1	5	2,83	5,00
		RESOURCE COORDINATION	1	4	2,50	4,50
	STAKEHOLDER MANAGEMENT	INVOLVEMENT	1	4	2,83	4,00
		RELATIONSHIPS	0	4	2,67	4,20
COMMERCIAL CAPABILITIES	PACKAGING	METHODS	1	3	2,08	4,80
		REQUIREMENTS	2	5	3,00	4,60
	PROCUREMENT	CONTRACTING STRATEGY	2	5	3,29	4,67
		SUPPLIER SELECTION	2	5	3,14	4,67
		SUPPLIER MARKET	1	3	2,57	4,50
	RELATIONAL	TRUST AND TRANSPARENCY	1	3	2,43	4,30
		LEARNING AND INNOVATION	1	5	2,43	4,75
GOVERNANCE CAPABILITIES	ASSURANCE	SYSTEMATIC APPROACH	2	5	3,29	4,92
		CONTROL DASHBOARDS	0	4	2,57	4,08
	PROJECT COORDINATION	ENGINEERING MANAGEMENT	1	3	2,43	4,58
		ROLES AND RESPONSIBILITIES	2	4	2,93	4,25
		DIGITAL TOOLS	2	4	2,67	4,63
	ASSET MANAGEMENT	DATA BASIS	1	4	2,33	4,60
		DATA QUALITY AND DOCUMENTATION	1	5	2,67	4,75
		ASSET HANDOVER	2	4	3,00	4,75

Table 1 – initial results for Assessment of Current Level and Future Level

Discussion

As mentioned in the introduction, there is potentially a high academic and industrial interest in developing our understanding of what capabilities make a "Strong Owner" organisation and in developing a generic assessment to identify strengths and areas of improvement. The process of performing the Owner Capability questionnaire is the first step in gathering responses from relevant stakeholders in the organisation.

The Owner Capability Maturity assessment, as described in this paper, gave some positive confirmation of the capabilities as proposed in the "Strong Owner" framework. However, the range of responses to the "current level" indicate that there could be a broad range of perspectives on the current performance of the organisation.

With the results received from the questionnaires, a gap analysis has been made showing the difference between the average "current level" and average desired "future level" for each capability category numerically. It is then possible to identify the largest development gaps by capability and the description sub-category. The largest gap could be used as the priority for improvement in the organisation, although there should be some consideration or weighting to reflect the relative importance between categories. However, this approach would only be valid if there were a high level of consistency in the responses, reflecting a general consensus in the assessment. The responses received from this relatively limited survey sample have shown a very high degree of variability, indicating disagreement in the assessment.

The next step of future development will be to arrange a workshop including approximately the same nine recipients of the questionnaire, including the senior division directors and heads of section, whereby the respondents to the questionnaire discuss the results and the different perspectives that gave rise to the variability in the ratings. This workshop would intend to unearth different perspectives on the external environment and the internal workings of the organisation ("sensing") and opinions on how the necessary changes could be enacted ("seizing and transforming"). The results of the workshop will then be analysed for the validation of the theoretical perspective of the Winch and Leiringer "Strong Owner" capabilities (2016), and potentially how the dynamic capabilities (Teece, 2018) associated with this self-assessment could be formalised in a future organisational procedure.

Finally, in developing the OCMM it has become apparent that the most useful aspect of performing the maturity assessment is to unearth the differences in perspective and to enhance the organisation's capacity for reflection and self-assessment, which is where the true value of the maturity assessment process can be realised.

Limitations and assumptions

As described in the review of theory, it is important to emphasize that the capability under consideration is "firm-specific" (Makadok, 2001, p.388), therefore an internal capability not provided by an external supplier. Considering the three domains of project organising: project-based firms; projects and programmes; and owners and operators (Winch, 2014), it is assumed that the capabilities that are not described by the Strong Owner framework can be supplied efficiently and effectively by the "market", i.e. external project-based firms. Therefore, it may be an assumption of the Strong Owner framework that there are also strong project-based firms filling the other roles and providing the other necessary capabilities for project delivery.

Winch (2014) raises the point that although projects are usually described as temporary endeavours, the project-based firms and owners and operators are typically relatively permanent entities. Therefore Owners may choose to develop capabilities in other areas, such as technical disciplines or supply chain management, where there is a potential economy of scale through repetition on repeat projects. This entails the development of additional capabilities not covered by the "Strong Owner" framework.

Finally, it should be noted that the focus of the Owner capabilities described here is towards project organising and delivery, where the Owner is acting in the role of Client. Depending on the type of Owner and industry, there may be a range of other activities for which the Owner is responsible, such as the operation of the infrastructure, which the Strong Owner capability framework may not cover. Therefore, when considering organisational design, the Strong Owner framework should be considered as the minimum of fundamental capabilities that are necessary with regard to project delivery.

Conclusion

This paper set out to confirm which capabilities are necessary for an Owner organisation to possess to strengthen the role of the Owner in infrastructure project delivery and to develop an approach for making this assessment.

While the development of the OCMM questionnaire has given a preliminary validation of the capabilities identified in the Strong Owner framework, the results have also shown a high degree of variability, especially with regard to the current status of the organisation, even within a relatively small survey sample. Consequently, a second stage is planned for further elaboration of the responses received and the perspectives behind the assessments.

In developing this maturity model, it appears that the true value in following the process is to generate and instil the dynamic capabilities of self-assessment and reflection in the organisation based on the foundation of the Strong Owner capability framework.

While the details of the capability descriptions may change slightly, this assessment process could potentially be applied in many Owner organisation contexts to enhance organisational learning and improvement.

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APPENDIX 1: Full capabilities sub-category descriptions

	CATEGORY	SUB-CATEGORY	HOW TO USE THIS SHEET: Each of the rows below contain a different Organisational Capability, which is defined in this context as a "the collective skills, abilities, and expertise of an organization ... which represent the ways that people and resources are brought together to accomplish work" (Smallwood and Ulrich, 2004). 1. For each row, mark the current level of the organisation with an 'X' in the relevant column (E - J). 2. Choose a level in column K, for the desired level that the organisation should achieve in the future. 3. Write in column L the main party responsible for owning or leading this capability in the organisation (Note can be a single person or organisational unit). 4. Comments can be filled in column L
STRATEGIC CAPABILITIES	PROJECT SHAPING	INVESTMENT APPRAISAL	"The organisation applies a systematic process of investment appraisal in the selection of projects against the organisation's strategic priorities and based on the requirements of asset management.
		BUSINESS CASE	The organisation creates a compelling evidence base to support the funding of the projects including costs and intended benefits. The organisation can shape the scope of the projects to match the available funding.
		BENEFITS	The organisation can clearly articulate the objective of the projects in terms of the anticipated benefits, and verifies that the benefits are realised after project completion."
	PORTFOLIO MANAGEMENT	PROJECT SELECTION	"The organisation has a controlled ability to make a long-term prognosis for selecting the right projects at the right time considering the available internal and external resources.
		RESOURCE COORDINATION	The organisation can efficiently coordinate resources between multiple concurrent projects. The organisation is able to control the level of complexity and risk arising from the management of multiple concurrent projects".
	STAKEHOLDER MANAGEMENT	INVOLVEMENT	"The organisation makes sure of early involvement of the stakeholders in the project taking into consideration their point of view. The organisation has managed an approach for communicating reliable information to the different project stakeholders.
		RELATIONSHIPS	Close and managed relationship is built between the client and the different stakeholders. Politicians support and back up the owner organisation's decisions. Note this category is more broadly oriented towards the relevant approval authorities (such as environmental) and general public. The category 'Relational' below relates to the project stakeholders who are directly participating such as consultant, contractor and supplier.

COMMERCIAL CAPABILITIES	PACKAGING	METHODS	"The organisation has a well-defined set of methods to group work into tenders of appropriate size and complexity and to execute projects as suited to the available supplier market. There are procedures in place for how packages should interact, and how to control the interfaces, so that delay in one package does not cause delay in other packages."
		REQUIREMENTS	The organisation is able to articulate project requirements at a level of detail to describe the intended project benefits, reduce risk and at a level of clarity to be understood by the executing parties".
	PROCUREMENT	CONTRACTING STRATEGY	"The organisation has a well-defined contracting strategy including market analysis to identify the suppliers who can supply. The organisation is able to identify, evaluate, select, and inspire potential suppliers. The organisation is able to manage a transparent tendering processes, ensuring desirable and fair deals, and design sufficient rewards that are attractive for the suppliers both in terms of financial and behavioural aspects.
		SUPPLIER SELECTION	The organisation has a contracting approach which is structured appropriately considering the size and complexity of each project, where the selection of the suppliers is based on well-defined criteria and the risk is allocated to the party best suited to manage it. The organisation works with suppliers who have excellent experience and appropriate resources such as human resources, machinery, and competencies for executing multiple projects for a particular time."
		SUPPLIER MARKET	The organisation collaborates with many international organisations to increase its network, knowledge, skills, capabilities, machinery, and benefits from a broad global supplier market.
	RELATIONAL	TRUST AND TRANSPARENCY	"The organisation has a high level of trust between the project participants ensuring transparency in project execution. Most issues are resolved between organisations, avoiding external conflict resolution.
		LEARNING AND INNOVATION	The organisation promotes the continuous sharing of learning and innovation"
GOVERNANCE CAPABILITIES	ASSURANCE	SYSTEMATIC APPROACH	"The organisation defines a systematic model for controlling and monitoring the project's progress and communicates the progress of the project with stakeholders effectively. The organisation defines the project's milestones to control and monitor the project's progress."
		CONTROL DASHBOARDS	Dashboards are created to visualize the project progress transparently.
	PROJECT COORDINATION	ENGINEERING MANAGEMENT	"The organisation has developed a specialized competency in engineering management, its resources having the ability to coordinate between the different disciplines in the industry.

		ROLES AND RESPONSIBILITIES	Clear roles and responsibilities are defined for optimal coordination.
		DIGITAL TOOLS	Digital tools are used effectively to monitor project performance and communication between project parties."
	ASSET MANAGEMENT	DATA BASIS	The organisation possesses updated and accurate data about the asset information and the organisation has developed tools to work with the data optimally
		DATA QUALITY AND DOCUMENTATION	Project data is well-defined and documented, and the organisation is responsible for updating the data in the following years. Furthermore, the organisation trusts the data to make decisions based on that.
		ASSET HANDOVER	There are well-defined formal procedures to hand over a finished asset to other parts of the organisation or external organisations."