



Owner project capabilities for infrastructure development: A review and development of the “strong owner” concept

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Abstract

Research on the management of major projects is one of the main themes of Peter Morris’ work. We address this theme in the context of transportation infrastructure projects and focus in particular on the contribution of the “strong owner” to project performance. After defining the strong owner concept, we will suggest that the theoretical literature on dynamic capabilities can be the source of deeper insight into the strong owner and will thereby develop the concept of *owner project capabilities*. The paper will then present a framework generated from a review of the existing literature complemented by pilot empirical research which provides the basis for a research agenda on the role of the owner of the infrastructure assets in achieving high performance on transportation infrastructure projects. In discussion, the paper suggests that the framework developed is applicable to a wider variety of major projects and programmes.

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1. Introduction

The social and economic role of infrastructure in modern societies is well understood (Stevens et al., 2006), yet its acquisition has typically been fraught. An important theme of Peter Morris’ work over the last 30 years (e.g. Morris, 2013; Morris and Hough, 1987) is the management of the infrastructure projects through which such assets are acquired by both the public and private sectors. The aim of this paper is to build on the original work of Morris and Hough (1987), and particularly their finding on the importance of a “strong owner” for high performance on major infrastructure projects, by developing a framework for understanding *owner project capability*. This will be done through an abductive literature review complemented by pilot research with four national transport infrastructure owners.

The development of such a framework is particularly timely because a recent research has identified the so-called “infrastructure gap” (World Economic Forum, 2012) which is the gap between the current investment in infrastructure, and the investment required to support properly economic growth; a gap which is widened by the severe dilapidation of many existing public sector infrastructure assets (Kessides, 2004). At the same time, there is growing political clamour for using infrastructure investment to stimulate growth, particularly in the ailing economies of Europe, but also in countries such as China, and such investment, if properly done, can be self-financing under current macroeconomic conditions (IMF, 2014). Our starting point is the seminal work of Morris and Hough (1987) on major projects and the role thereon of “strong owners”. Next, we introduce our theoretical perspective on *owner project capabilities* for major infrastructure projects developed from recent work in strategy on “dynamic capabilities” (Helfat et al., 2007) and discuss our research method. The core of the paper is devoted to the development of the proposed

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framework, focusing on transportation infrastructure as an important sub-class of economic infrastructure. In the discussion, we will suggest that the main lines of argument also apply to social and business infrastructure and to information infrastructure. We aim thereby to contribute to theory and practice in the management of projects in two ways. First, we provide an extended review of the literature on the management of major infrastructure projects since the publication of Morris and Hough (1987) complemented by empirical research with transport infrastructure agencies. Second, we provide an analytic framework that views research from the perspective of the economic infrastructure owner in order to provide the basis for further research and practice on *owner project capabilities*.

2. Major project challenges for the infrastructure owner

For much of the period since 1945, research on major project management was dominated by the challenges of the Cold War armaments programmes and closely related programmes such as the space mission (Morris, 1994). The research conducted under the auspices of the Major Projects Association during the 1980s and published as Morris and Hough (1987) broke new ground in extending the empirical research base to non-military major projects, and in particular to *economic infrastructure*, defined as that which “keeps the country running” (NAO, 2013: 5) including energy, transportation and telecommunications (IMF, 2014). This research provided the empirical basis of some of the abiding themes of Morris’ research around the importance of front end definition and the “management of projects” as well as the defining feature of the project life-cycle. It thereby provided the basis for a continuing interest in managing major projects.

In summarising the findings of their case studies, Morris and Hough (1987: Chapter 11) identify the importance of a “strong owner” as a dimension of project success. The theme is revisited in Morris (2013: Fig. 10.1) where the importance of the various owner roles is explored. However, the strong owner is discussed in the context of legal and contractual matters – in effect the owner is reduced to a client as mere contract-giver – and not related to the discussions on stakeholder management, institutional context, and project strategy. This leaves a sense of lack of agency in Morris and Hough’s (1987: Fig. 12.1; see also 1994 Fig. 46) summative research model (Dalton, 2007); that is, it is not clear who should be doing what to ensure “project success”. Although these broader topics are discussed in some length in Morris’ (2013) latest book, they are not explicitly connected with the owner role. These considerations therefore beg the research question of what is meant by a “strong owner” on major projects? This paper will attempt to answer this question by focusing on transportation infrastructure projects. We here define “success” in terms of the achievement of the expected benefits of the investment project for the owner rather than the broader set of criteria encompassing other stakeholder interests (Cooke-Davies, 2002; DeWit, 1988).

3. The capabilities literature and managing major projects

Research on innovation in complex product systems has identified the project-based firm and its *project capabilities* as central to competitive advantage in high technology industries (Brady and Davies, 2004; Davies and Brady, 2000; Ethiraj et al., 2005; Lampel, 2001; Nightingale et al., 2011). However, this literature is essentially supplier-focused. That is, it is focused on the activities of the project-based firms that supply new infrastructure assets such as information systems, high speed trains, and training simulators rather than the owners of those assets (Flowers, 2007) which typically act as both investors in, and operators of, such assets. This supplier focus underlies the recent development of perspectives such as the “business of projects” (Davies and Hobday, 2005), the “P-form” (Söderlund and Tell, 2009, 2011) and “project business” (Arto and Wikström, 2005; Arto et al., 2011). It also provides an important input for our own exercise.

Davies and Hobday (2005; Table 3.1) provide a useful summary of project capabilities for supply-side firms which they categorise as “pre-bid, bid and offer” capabilities and “project and post-project” capabilities. Similarly, Ethiraj et al. (2005) identify the importance of “client-specific capabilities” and “project management capabilities” in the performance of software services firms. We can usefully summarise these as *commercial* and *project coordination* capabilities; the latter form much of the core content of the project management discipline. However, the project management literature does not usually identify whether these are the responsibility of the supplier alone, or should be shared with the owner and by default, it is often presumed that they are a supplier responsibility. Suppliers’ commercial capabilities are about both their relationship with their clients, and their relationships with their own suppliers. We can infer that owners will need to “match” suppliers’ commercial capabilities with their own.

In addition to being supplier focused, this literature on project and commercial capabilities does not distinguish between dynamic and operational capabilities (Helfat et al., 2007), although the identification of the importance of “base-moving projects” (Brady and Davies, 2004; Davies and Hobday, 2005) for innovation in project-based firms could well be developed to address this distinction. *Operational capabilities* are the ability of the organisation to deploy its resource base (human, material, etc.) to provide effectively and efficiently goods and services to its customers. *Dynamic capabilities*, in contrast, are the ability “of an organization to purposefully create, extend, or modify the resource base” (Helfat et al., 2007: 4). As Winter (2003) points out, what is a dynamic capability for a purchasing firm may only be an operational capability for a supplying firm. Thus, project capabilities for a project-based firm may – almost by definition – be operational, but for a purchasing owner organisation they are almost always dynamic because they extend the resource-base of that organisation, but are not its “core business” (Kay, 1993). We therefore propose to focus our research on *owner project capabilities* — that is the dynamic capabilities required by the owner organisation for the acquisition of infrastructure assets in order to extend or improve its operational capabilities in

distinction to the operational capabilities deployed by the project-based firms which supply those assets.

4. Method and research question

Our method is analogous to abduction from empirical observations (Van de Ven, 2007) with the aim of providing a “conceptual framework” (Shapira, 2011) to stimulate future research on the owner role in project organising. This is not a “systematic review” (cf. Tranfield et al., 2003) because the field is so broad and the terminology-in-use so varied that such a review would be intractable, and also such reviews tend to miss contributions from books due to the reliance on the Web of Science for key-word searches. For instance, because Achterkamp and Vos (2008) rely on two Web of Science journals for their review of stakeholder management, they exclude the kind of project management handbooks upon which Peter Morris built much of his reputation from their scope and thereby miss important contributions to the literature. Rather, our review is based on extensive reading and knowledge of the research field of major projects and the conceptual framework we present offers the basis for systematic reviews by others.

We chose as the starting point for our analysis the “three domains” perspective on the research field of “project organising” (Winch, 2014). This is based on a wide-ranging review of the research in project organising (i.e. the project management research that is not derived from operational research concepts and methods) and identifies three principal organisational domains in project organising. Each identifies a distinctive type of project organisation with differing underlying business models. The domains approach starts from the premise that project organising is fundamentally about the creation of new value (Winch, 2010) in the form of assets that can be exploited for beneficial use.

The three domains are (1) the supplier domain of the project-based firms which supply the human and material resources required by the project to deliver the asset; (2) the domain of the temporary project or programme organisation that delivers the asset; and (3) the owner domain of the investor organisation that charters the project and will be operating the completed asset to deliver goods and services to its customers. In this paper we focus on the owner domain and the dynamic capabilities required by the owner in project organising.

The project organising domains model identifies three conceptually distinct areas in which the owner potentially requires capability. The first area is the set of capabilities that the owner itself needs in order to successfully implement its investment projects which we define as *strategic capabilities*. The second is the set of *commercial capabilities* needed to manage the interface between the owner organisation and the project-based firms which supply it with the resources required for the investment project. The third is the set of *governance capabilities* needed to manage the interface between the owner organisation and the temporary project organisation that is set up to deliver the investment.

Following an initial review, an early version of the framework as a “meaningful system” (Van de Ven, 2007: 104) for

understanding *owner project capabilities* was developed. This framework was then presented and discussed in a workshop with Trafikverket (Swedish Transport Administration) to establish both the value of such a framework from a practitioner perspective and the face validity of the framework developed. Further literature review, and 34 interviews with senior representatives from four infrastructure clients (Danish Road Directorate; Rijkswaterstaat (Netherlands); Norwegian Public Roads Administration; and Swedish Transport Administration) produced the final framework presented in Table 1. In developing this framework we focused on the following research question:

Which dynamic capabilities are required by the owners and operators of transport infrastructure to develop their infrastructure assets? We dub these *owner project capabilities*.

5. The owner domain: strategic capabilities

In this section we discuss those activities which are the full responsibility of the owner organisation alone; in essence, these are the capabilities that the owner requires to relate the investment project to the broader strategy of the organisation (corporate, business etc.). This connection is the focus of research on *project strategy* (Arto et al., 2008; Loch and Kavadias, 2011; Morris and Jamieson, 2005; Turner, 2009) where projects are conceptualised as the organisational means of implementing corporate strategy (Morgan et al., 2008). So, in this section we unpack the concept of project strategy and relate it to the concept of the strong owner. We include in this domain many areas which are not normally considered within the project management literature, but which are important for the full development of project strategy as a dynamic capability. The focus is on which projects receive investment and why. Infrastructure assets provide many different services and the organisations that own and operate them typically have many contending opportunities for investment to extend their resource base, so how do they choose which ones go forward and thereby become projects and programmes?

Selecting the most beneficial project Remarkably little attention has been paid in the mainstream project management literature to the processes of investment appraisal and hence the allocation of the capital without which projects cannot exist. Long seen as a technical issue for the textbooks, e.g. Flyvbjerg et al. (2000) have changed that perception and convincingly identified the issue of “strategic misrepresentation” in investment appraisal, or more bluntly, “lying” about costs and benefits to get the investment for the project. In subsequent debates the notion of strategic misrepresentation has been conflated in some quarters with that

Table 1
Owner project capabilities.

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

of “optimism bias”, or the natural tendency to look on the bright side (Weinstein, 1980). The two are, however, very different concepts. The former is an organisational phenomenon in bad faith where incentives distort investment appraisal; the latter is a psychological phenomenon in good faith where cognitive limitations produce biased assessments (Winch, 2010). Thus the former is more deception and the latter delusion (Flyvbjerg et al., 2009).

Defining the project mission This is fundamentally about why the project is being done (Brown et al., 2013), which can only rarely, we suggest, be reduced to the metrics of investment appraisal (Winch, 2010). For instance, the cost–benefit analysis of the proposed High Speed 2 railway line in the UK has a relatively low, but positive, ratio of benefits to costs; but it is also symbolic of a political drive to bring the north and south of the country closer together so that the former can share more equally in the latter’s economic success and to show a continuing political commitment to investment in transport infrastructure (HS2, 2013). Unless the owner can clearly articulate the project mission, then the sort of lobbying that generates strategic misrepresentation can easily take hold and scope can easily creep as all sorts of stakeholders try to free ride on the project. As Sir Alistair Morton, Co-chairman of Eurotunnel, put it in the case of the Channel Fixed Link, The project was “assembled round a hole like a Polo mint ... [there was] no client driving it forward with a vision of what the operator needed to have” (Morton, 1995).

Raising the capital is clearly a fundamental owner capability; owners which cannot raise the capital cannot make the investment and hence there is no project. Furthermore, if the investment cannot be sustained the project will default. For the public sector, the ability to raise the capital to fund investment in upgrading infrastructure to meet 21st century standards has become increasingly difficult. Squeezed between high levels of debt, resistance of voters to pay higher taxes, and growing welfare claims (Streeck, 2011) governments have been turning to public–private partnerships in an attempt to provide additional sources of capital for major projects (Hodge et al., 2010). There is, however, limited research on how these new forms of project finance, where the loan is secured on the asset being created by the project, shape the overall management of the project from an owner perspective.

Managing the project portfolio is central to project strategy (Killen et al., 2012). Project portfolios are projects sponsored by the same owner which share scarce resources, but do not have any technical dependencies (Winch, 2010). The principal resource here is, obviously, capital, and so portfolio management is closely linked with capital budgeting (Bower, 1970), but investment appraisal is not the only issue. Penrose’s (1995) classic analysis of the growth of the firm argued that the principal constraint on growth – and hence strategy – is the managerial resource available internally to the firm. Penrose also argued that it is difficult to acquire such resource externally because of the need to induct new recruits to the culture and practices of the firm. As one important way in which organisations grow is through investment projects to acquire greater productive capacity it can be suggested that one of the

principal constraints on the ability of the owner organisation to implement its strategy for growth is its ability to manage the investment projects in its portfolio.

Managing stakeholders plays a central role in managing projects, and can only really be handled effectively from the owner side. Recent literature reviews (Achterkamp and Vos, 2008; Littau et al., 2010) provide useful thematic overviews. However, a limitation of this approach is that by focusing on stakeholders and their interests, it tends to emphasise agency in both stakeholder actions and owner responses. A rather different approach is to focus on the institutional embeddedness of the temporary project organisation in the manner of Selznick (2011) for economic infrastructure and Currie (2012) for information infrastructure. This means that attention is given to both the structural constraints on the project and agents’ attempts – successful or not – to remove those constraints.

The experience of the infrastructure agencies is that the strategic capabilities outlined above, whilst unequivocally deemed to have a great effect on the workings of each of the individual infrastructure agencies, were also mostly considered to be outside their remit. It was also clear that key early decision making processes and procedures that have a huge impact on the subsequent performance of projects, such as cost–benefit analysis, tend to be highly politicised and that the degree of influence that any of the agencies have in this domain is severely limited. Our study shows that the part of the owner organisation charged with the definition and delivery of infrastructure assets, and by extension the performance of the projects, is generally left outside of this domain and has very little power to influence any decisions being made. What is apparent is that the success of any project is very much dependent on the decisions made in these early stages. It is equally apparent that the hierarchical relationship between Government and the Agency heavily influences the deployment of capabilities in this kind of owner organisation. Only managing the project portfolio of the generic investment opportunities lies squarely within the remit of the four agencies, but this in turn is affected by national investment plans and the availability of funds throughout the project life-cycle.

Stakeholder management plays a central role in managing large infrastructure projects, but the four agencies go about it in markedly different ways. At one end of the spectrum, the strategy deployed is that stakeholder management can only really be handled effectively from the owner side, whilst at the other end the strategy is to pass on as much of the work of obtaining regulatory approval to the supply side as possible. For the latter strategy there is a difference between where the regulations are unambiguous and prescriptive, the codes are published, and simply require interpretation; and when the codes are not prescriptive or where there are significant uncertainties and obtaining consent is a negotiation process. The chosen strategy reflects different priorities in resourcing and preferred types of contracts, but also reflects the institutional context within which the projects are initiated. A key concern among the four agencies is to find a balance in the amount of resources allocated to these tasks, and the possibility of overcoming institutional rigidities.

In summary, a noticeable feature of the literature on project strategy is that it is only intermittently engaged with current research in strategic management (cf. Faulkner and Campbell, 2003) generally and theoretical developments in strategy-as-practice more specifically (Johnson et al., 2007). It also tends to take a rather linear approach to strategy implementation. We therefore suggest that future research should address the practice of “project shaping” (Merrow, 2011; Miller and Lessard, 2000; Smith and Winter, 2010). Project shaping captures the organisational processes around creating a project mission and securing the resources to achieve that mission. Whilst technical evaluation skills underpin project shaping, the social and political skills to mobilise resources, engage stakeholders and articulate vision are the more important — in a word shaping is about leadership (Morris, 2013). Such analyses would preferably take an institutional approach to the analysis of practice. In particular, it would be useful to examine the ways in which tools such as cost benefit analysis become performative (Cabantous and Gond, 2011); that is the extent to which they are used not to select the most beneficial project, but to “fit” the chosen project to the selection criteria.

6. The owner and its suppliers: commercial capabilities

Few projects rely entirely on resources available within the owner organisation, and this is very unusual for infrastructure projects outside the maintenance function. The commercial interface between the investing owner which supplies the financial resources and the project-based firms it hires to supply the human and material resources is crucial to project success (Lowe, 2013; Winch, 2010). Owner commercial capabilities are therefore the key to successful asset delivery, and have often been lacking, particularly in government owner organisations (NAO, 2009).

Packaging capabilities have received remarkably little research attention, yet they are the first step in developing an owner contracting strategy through which the work breakdown structure (WBS) is packaged into market-friendly clusters of work. It is, perhaps, a sign of this that the standard reference remains Thompson who proposes in this seminal work that “organizations seek to place reciprocally interdependent positions tangent to one another, in a common group which is (a) local and (b) conditionally autonomous” (1967: 58). In contracting strategy terms, this translates into clustering together tasks in the WBS which require relatively intensive levels of coordination into packages for external contract. The interfaces *between* the packages thereby define what the owner itself needs to manage, whilst interfaces *within* the packages are the responsibility of the supplier for that element of scope and formally “blind” to the owner. Packaging is therefore fundamental to commercial capabilities because contracts can only be issued for what suppliers can supply, and hence underpins contracting capabilities.

Contracting capabilities Identifying, selecting, and motivating potential suppliers draw on deep commercial capabilities of understanding the structure of the supply market,

ensuring “competitive tension” through the procurement process, doing the final deal, and designing appropriate incentives that motivate desirable behaviour. New, complex forms of procurement have significantly raised the order of difficulty in attaining such capabilities (Caldwell and Howard, 2010; NAO, 2009). The literature on contracting capabilities is relatively well developed (Winch, 2010). However, it has tended to focus on only one aspect — the nature of the transaction. Other factors that need to be taken into account in contracting strategy include the capabilities of the supply chain, the timing in relation to the economic cycle, and a wide variety of issues in the institutional environment such as public sector procurement regulations.

Relational capabilities Contracts represent the formal or structural aspects of relationships between commercial parties; however, contracts cannot function to govern commercial relationships in the absence of “softer” inter-organisational relationships (Gil et al., 2011; Poppo and Zenger, 2002). Recent research on procuring complex performance (Caldwell and Howard, 2010) has identified the importance of owners’ ‘relational capabilities’ on complex projects. These capabilities enable owners to interact effectively with their supply chain and to select and implement the appropriate mix of formal (contractual) and trust-based relations. However, despite the increased popularity of concepts such as frameworks and alliancing, owner organisations are frequently limited in this area by national competition and public procurement laws (Winch, 2010), which in turn affect the extent to which they can develop their relational capabilities for the purpose of one-off large projects.

The Experience of Infrastructure Agencies is that the composition of commercial capabilities is in no small way dictated by the position held, and power wielded, by the agency (or in broader terms the owner organisation) in the market. Likewise, the necessary commercial capabilities are shaped by the market’s ability to deliver, or in other words, the general capability level of the suppliers in specific areas of the market. Furthermore, apart from the state of the market, political decisions and associated strategic choices in terms of contract types have also affected the agencies’ capability sets.

It follows, not surprisingly, that the four agencies differ in how they have configured their commercial capabilities. For example, moving towards more extensive use of design and build and service-led projects in one case has led to the owner organisation to no longer need internal design capability. However, it has also led to the identification of other capabilities to be developed such as being able to evaluate the tenders and to manage asset integration. For the agency that has gone the furthest down the route of using different forms of contracts, including various forms of private finance, the issue of integrating work packages becomes a major challenge. Indeed, for this agency the political decision to use private finance to fund projects has had a marked effect on how projects are procured and the requisite commercial capabilities. The agency in question has over the past decade steadily changed its preferred contract types for publicly financed projects from design–bid–build forms of contracting to management contracting, and design and build solutions. In short, it has slowly distanced itself from its projects. As a consequence, the

agency has moved away from having detailed design competence to focus more on process and system control, which in turn has clearly affected the procurement and contract administration strategies. An example of this is the development of engineering standards and nomenclatures created to facilitate the translation of functional specifications. This strategy of standardising specifications is also seen by the other agencies as a way to improve design quality and reliability.

In summary, we suggest that the research on owner commercial capabilities needs to move beyond its established focus on the transaction to a broader set of issues around relationships, and a greater sense of strategic intent around how the resources required to achieve the owner's investment intent are to be acquired. Whilst there is a developing literature on the "intelligent client" (Aritua et al., 2009, 2011), this retains the existing transactional focus on the client as a deal-maker rather than the owner as an investor. Similarly, transaction cost economics provides a useful underpinning to the conventional analysis, but it remains restricted to an analysis of the transaction. Opportunities exist to introduce concepts from the supply-chain management literature around the capabilities of suppliers and the structure of the supply market (e.g. Kaufman et al., 2000). This work could be complemented by the emerging lines of research on "project marketing", or how suppliers shape the markets in which they engage (Cova and Salle, 2011; Kujala et al., 2010).

7. The owner and its projects: governance capabilities

The concern with commercial capabilities is essentially outward facing from the owner towards the project-based firms which supply the resources that allow the project to be developed and delivered. However, the owner also has a distinct set of responsibilities towards the temporary programme organisation which it finances to deliver the asset (Winch, 2014). There is a set of *governance capabilities* which support the interface between the permanent owner organisation and the temporary project organisation. It should be noted that our definition of "governance" is narrower than that espoused by Müller (2011) which extends it to what we have defined here as the commercial interface as well.

Assurance capabilities are focused internally into the owner and are essentially about assuring senior management – and, in this context, politicians – about the progress of the project (NAO, 2010). Stage-gate processes (Cooper, 1993) which address the "who, when, what" questions of who should make decisions on the progress of project when in the life-cycle on the basis of what information (Winch, 2010) underpin most assurance processes. Williams et al. (2010) and Young et al. (2012) provide case studies of assurance on government projects, demonstrating the rather mixed implementation of assurance arrangements. These weaknesses in implementation have encouraged a greater centralisation of assurance processes within government under the auspices of finance ministries. An early example of this is the "quality at entry" process in Norway (Samset, 2008); a more recent development is the establishment of the Major Projects Authority in the UK (NAO, 2014).

Stage gate processes are most useful during the front end phases of project shaping whilst the costs of cancellation are small. As the project evolves past technology selection and scope definition, sunk cost effects and escalation dynamics (Winch, 2013) give the project considerable momentum. This does not mean that the owner's role in assurance is reduced. As the project moves through detailed design and into execution an active owner role remains vital. One approach is the three "lines of defence" for assurance — 1) effective project controls within the owner project team; 2) internal assurance independent of the project team provided by the programme management office; and 3) internal audit (Hone et al., 2011).

One problem with formalised procedures such as stage gates is that closing the gate on the project can be much the same as closing the stable door once the horse has bolted; similar problems apply to essentially lagging indicators such as the "lines of defence" of formal assurance. A complementary approach is to pay attention to early warning signs of difficulties emerging on the project, especially "gut feelings" (Williams et al., 2012). Grenny et al. (2007) have argued that there is a "crisis of silence" on projects because difficult conversations are not had by those responsible for the project. The importance of the owner's project manager regularly walking the project – particularly when it is on site – has also been identified (Winch, 2010).

Project coordination capabilities are highlighted by the importance of controls as the first line of defence. Project controls involve the collection of schedule and budget data on execution progress and comparing those data against plan. These data then provide the basis for reporting on project progress during the previous control period and forecasting progress during the subsequent period and beyond. The basis for control is the schedule and budget established in project execution planning (PEP), a process that starts (or should start) during project shaping. Of course, these processes are at the heart of the various project management bodies of knowledge, but those documents are silent on who should be carrying out which project coordination activities. A study of the UK construction engineering sector (Merrow et al., 2009) showed that performance of projects in execution significantly improves when the owner team implements its own PEP process and manages its own project controls, independently of the contractors, so that the owner team can independently validate estimates provided by the contractor. More generally strong, fully staffed owner teams are vital to successful project execution (Hui et al., 2008; Merrow, 2011).

Asset Integration addresses the final phases of the project where the asset being created by the project is integrated into the existing operations of the operator for beneficial use. This is the "back end" complement to the front end definition of the project. "Benefits realisation" is a well established topic in the literature on IS/IT project capability (Ashurst et al., 2008), but there is limited attention in infrastructure project management research. Indeed, we have been unable to find a single paper on the topic. Yet, as infrastructure systems become more complex involving multiple technologies, the challenge of managing into beneficial use will surely grow, as Heathrow's Terminal 5 found to its cost (Brady and Davies, 2010). Those that actually

have to use the system once it is in operation – the deliverers of front line services such as baggage handlers; train drivers; production workers – need training. Crucially, these users typically form part of the owner’s operational organisation and are essential to moving the completed asset into beneficial use.

One aspect of asset integration is systems integration. Traditionally owners took responsibility as system elements were acquired from suppliers, and then integrated by the owner into a working system. However, this is becoming increasingly challenging for many owners, particularly for large, one-off “systems of systems” projects such rail systems, satellite systems, and airports (Davies and Mackenzie, 2014; Davies et al., 2009). Thus, the business of systems integration (Prencipe et al., 2003) has emerged as one form of outsourcing.

The Experience of the Infrastructure Agencies is that they struggle to sustain a strategic portfolio of investment that would allow them to maintain a full set of governance capabilities which financially are an overhead that is not always sustainable. Notwithstanding, an area of principal concern in all four agencies is that of ‘oversight’ — that is the ability of the owner organisation to monitor project processes within its capability scope. Of importance here is the decision whether the organisation should rely solely on mandated reporting from suppliers or have its own representative team on site to verify that progress reports actually reflect progress. The strategies of the four agencies clearly differed here and are perhaps best illustrated with two quotes from our interviews:

They are there all the time these boys and girls that are furthest down the chain as construction managers, spending more or less the whole day on site. They should be there all the time. We should know exactly what is going on. Project managers are not there all the time in the same way, but they attend weekly meetings. That is how it is divided up. There should not be a working day on which we are not present. (Project manager, Swedish Transport Administration).

And

We check that the right documents have been supplied in time ... (but) we only do a check on the project if our risk analysis says that it is necessary, and it is the only way to accept a risk in order to make the risk amount acceptable or to reduce the risk. (Director, Rijkswaterstaat).

In summary, we suggest that governance is the least researched area of project organising. We rely principally on government reports for research on assurance capabilities — Norway’s Concept research programme is an important exception here. So, we still know little about how governance arrangements actually work in practice, and which approaches to assurance are most appropriate in which contexts. Perhaps most importantly, we have little evidence-based guidance on when oversight becomes overbearing. Similarly, there is a gap in the research on asset integration capabilities. The IT/IS project literature on benefits realisation would be a good place to start, but we need more case studies of the issues around commissioning, start-up, and user training. We also need to

understand more about which systems integration capabilities the owner needs to retain engagement in the process and ensure asset integration and which can be outsourced (cf. Davies and Mackenzie, 2014).

More generally, a theme which runs through the issues around governance capabilities is the use of information systems. Much day-to-day assurance relies on enterprise information systems such as SAP. In the mainstream area of project coordination new opportunities are opening up to support the management of projects as we move from “Project Management 1.0” to “Project Management 2.0” (Whyte and Levitt, 2011) ranging from 4D scheduling and shared information environments through to fully interactive building information modelling (BIM). What is also becoming clear is that owners are the principal beneficiaries (Eastman et al., 2008), and hence should be the principal champions, of BIM due to both the potential for greater effectiveness in the temporary project organisation and the benefits of an as-built model for asset management through the operational life-cycle. So far as managing into beneficial use is concerned, the provision of the BIM model becomes part of this process. Similarly, the growing importance of IT in infrastructure assets increases the challenges of systems integration — many of the problems at T5 were software issues (Brady and Davies, 2010).

8. Maturity in owner capabilities: acquiring capability

Our framework presented in Table 1 begs the obvious question of how owners can acquire the desired mix and level of capabilities. Investment in large scale infrastructure assets is inherently lumpy (Oum and Zhang, 1990), and therefore poses a number of challenges. Broadly there are two answers to this question: either endogenously through organisational learning and development, or exogenously through contracting for them.

It is difficult generally to learn from projects (Brady and Davies, 2004); it is even more difficult for owners to learn from them when they are not their core business. Similarly, learning from the operation of existing facilities to identify the requirements for new facilities presents challenges. Merrow (2011) argues that one of the principal criteria for effective front end loading is “team integration”, and the most important element in team integration is the presence of representatives from operations in the project team during project appraisal and technology selection. Hence, owners need *absorptive capacity* (Cohen and Levinthal, 1990). In short, this means having the capability to identify and acquire externally generated knowledge that is critical to operational capability, whilst also learning from their earlier investment projects and being able to analyse, process, interpret, understand and act on the information obtained.

To further complicate matters the capabilities required are acquired in different ways and the process is partially path dependent. For example, relational capabilities can be seen as the outcome of organisational learning through repeated interactions with suppliers. Project coordination capabilities, on the other hand, are predominantly the result of specific human resource investments in the appropriate competencies.

This means that some capabilities can be developed rather quickly whilst others can only feasibly be developed over time. It follows that where the investment programme is particularly lumpy, there might be a strong temptation to use third party consultants. However, this can lead to the long-term loss of owner capability (Flowers, 2007) and Merrow (2011) stresses the importance of the owner-employed people in effectively managing projects.

The Experience of the Infrastructure Agencies is that all four implemented similar types of strategies to deal with the issue of learning between projects. Strategies include technological solutions, such as searchable databases created in order to learn from the past experiences and “community of practice” type solutions that are mainly focused on learning from present experiences. For the latter, geographical proximity is clearly an issue, and it can be deduced that geographical distance and the size and scope of the project portfolio dictates the efforts put into inter-project learning. A key issue, identified across all four agencies, is how learning is affected by the reliance on consultants. This is not only an issue in terms of knowledge accumulation and a transient workforce, but also one of training provided to the project team (i.e. who gets to go to the training courses). What the agencies have in common is that they have all sought to deal with the issue by seeking to identify key strategic roles on the project that should always be held by their own personnel, and through the creation and implementation of standard routines and processes. However, the agencies differ in their preferred strategies, with some actively seeking to increase the ratio of employees to consultants on the project team, and others doing the direct opposite. Standardisation of routines and processes is given more attention in those agencies that are more heavily reliant on consultants.

9. Towards a research agenda on owner project capabilities

Our review has identified a number of potential avenues of future research around owner capabilities. These include the practice of project shaping, with particular attention to decision-making around investment appraisal; understanding the packaging problem in the context of overall contracting strategy, and research on the practices around the emerging project information systems that have been dubbed Project Management 2.0 with particular attention to controls.

However, a number of lines of potential enquiry have not been developed in this paper due to lack of space. A first, and important one is power (cf. Pinto, 1998), particularly around processes of project shaping. The concept of a strong owner inherently implies significant power with respect to others, yet “the possession of great power necessarily implies great responsibility” (Lamb, 1817: 1227), so we need to understand the capabilities of the responsible strong owner, and how that responsible owner best wields its power because in many transport infrastructure markets it is a monopsonist.

A second line is that of risk and uncertainty. We have not explicitly addressed the challenge of managing projects as uncertain adventures because it is pervasive in the practice of strategic, commercial and governance capabilities. However,

the theory and practice of project risk management has lagged behind developments in behavioural psychology (Winch and Maytorena, 2011), and its analytic techniques are near useless for addressing the inherently uncertain nature of the future (Taleb, 2008). Much more research needs to be done before we have robust tools to support decision-making on projects, particularly at the front end.

A third line regards the internal processes of capability development. For some owners it might be useful to establish specialist units such as project management offices to enhance capability development. Responsibilities could, for instance, include the allocation of managerial resources to individual projects, ensuring the integrity of project control systems, and developing specialised tools and standards for the owner organisation (Unger et al., 2012). They can, thereby act as the second “line of defence”. Project management maturity models such as P3M3 can be used to assess overall capability and hence provide the basis for developing a strategy for capability development. Projects academies are also important here, often run in collaboration with universities.

Does the framework presented in Table 1 have broader relevance beyond transportation infrastructure projects? We believe that it does. Recent research using project benchmarking data in energy infrastructure projects (Merrow, 2011), and in social and business infrastructure (i.e. non-residential construction) more generally (Hui et al., 2008) has also identified the importance of the owner role – operationalised as “owner dominance” in the latter – in project performance. These data refer to private sector owners. Data on the public sector, for the UK at least, come from the National Audit Office’s Value for Money Reports. Content analyses of these reports on construction (Dalton, 2007), defence (Kebede, 2011), and information systems (Cha, forthcoming) show that only a trivial proportion of project delivery problems are caused by either supplier incompetence or externally generated risk events — overwhelmingly the failures can be attributed to the public sector owner. These data also support the contention of Baker et al. (1983) and RAE (2004) that project management performance in the public and private sectors does not differ significantly. What differs is the level of public scrutiny of performance in the public sector, not performance across the portfolio of projects as a function of whether the owner is in the public or private sector. We are therefore convinced that the framework summarised in Table 1 has relevance to projects for the acquisition of a wide variety of physical infrastructure by owners in the public sector or private sector.

This begs the question whether the framework is also applicable to information infrastructure, defined as “a set of shared IT resources that provide a foundation to enable present and future business applications” (Duncan, 1995: 39)? One of the cases reported by Morris and Hough (1987) was an information infrastructure project, and the presence of a strong owner was deemed essential to the success of the project. However, information infrastructure projects do differ from physical infrastructure on a number of dimensions including a relatively rapid pace of technological change, and the “virtual” nature of the infrastructure asset leading to greater difficulties in defining project mission and scope (RAE, 2004). Perhaps most importantly, new

information infrastructure assets can often have more pervasive implications for the organisation of the owner's operations in terms of both structure and business processes. This implies relatively greater emphasis upon the “back end” of projects as the asset moves into beneficial use (Cha, forthcoming) and some will involve very significant organisational change. For this reason, we would suggest that being a strong owner as defined here is, if anything, even more important for investors in information infrastructure projects than in physical infrastructure projects.

10. Concluding thoughts

This paper has outlined a first sketch of what owner project capabilities might look like as a bundle for infrastructure owners. Owners of infrastructure, in essence, do two things: they are investors in infrastructure and they are usually the operators of that infrastructure to provide infrastructure services to their customers. We started from the premise that these two activities require a very different set of dynamic capabilities from the project-based firms which actually design and construct infrastructure. We have therefore identified areas of research that are not normally in scope to the field of project organising such as investment appraisal, and also looked at more mainstream capabilities such as project coordination capabilities through a new lens.

One of the principal challenges to accepted notions within the field from our argument is that it can no longer – if it ever could – be considered coextensive with the field of temporary organisation (Winch, 2014). For many years the field has focused on temporary organisation (Bakker, 2010), but capabilities are, almost by definition, features of permanent organisations. The second challenge to the field is that we need to think much more clearly about which actor in the project coalition is deploying which capabilities, and cease to treat project management as a best practice toolkit which is always applicable. Rather we need to research, for instance, what level of detail the owner-side estimators need to go to in budgeting, what balance should be left to the supplier, and how the two activities should interface. And we need to do so in a fashion that allows us to take institutional factors into consideration.

Connecting more broadly with management theory, we can suggest that the owner capabilities identified here are a good example of dynamic capabilities (Helfat et al., 2007) in that they allow infrastructure owners to extend their resource base in order to deliver more and better infrastructure services to their customers. The dynamic capabilities approach emphasises the resources available to the organisation and its ability to change which, in essence, boil down to the managerial resources available to the organisation for “administrative coordination and authoritative communication” (Penrose, 1995: xi).

This paper has begun to unpack the notion of the “strong owner” first introduced by Morris and Hough (1987) in the context of infrastructure projects. We have shown how important it is to move beyond conceptualising transaction-orientated “clients” towards conceptualising “owners” as investors in and operators of infrastructure assets with the mission to provide

infrastructure services to users. Drawing on the work in strategic management on dynamic capabilities and earlier work on supply-side project capabilities, we have developed a conceptual framework for *owner project capabilities* by reviewing the relevant literature and drawing on the experience of four different transport infrastructure owners. This conceptual framework is only a starting point. Ultimately, there is no one ideal or universally applicable “strong owner” capability set; context is all here. However, we hope we have given a clear indication of the issues with a view to stimulating others to investigate ways in which owner capability sets are configured in different contexts. How these capabilities should be configured is the basis for our proposed research agenda.

Conflicts of interest

There is no conflict of interest.

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